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ELECTRONIC BUSINESS

E-BUSINESS START-UP MODELS

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Abstract: *This paper presents opportunities of implementation of Canvas Business Model in e-business planning. Canvas has become an important tool for entrepreneurs nowadays. The advantages of this model are numerous. Therefore, the aim of the paper is to introduce the possibilities and benefits of using such model. Canvas Business Model can be used for new business ideas and for analysis of existing ones. There are several adaptations of this model, such as Lean Canvas. Lean Canvas is business model used for start-ups and mostly on-line business. The second part of this paper gives the examples and first steps for implementation of both models in electronic business start-up. Considering mentioned examples, this research can be used as a guide for future entrepreneurs in business model creation and the main objective reflects in ensuring that process of business development is concisely and clearly demonstrated including the crucial application steps. This model focuses on the key segments of a business. Moreover, it enables its users to define strengths and pain points and to understand them.*

Keywords*: canvas, business, model, lean, start-up, entrepreneurship*

1. INTRODUCTION

Business model presents conceptual tool containing a set of objects, concepts and their relationships with the objective to express the business logic of a specific business. (Pateli and Giaglis 2003). This concept was firstly introduced in 1957 in article written by Bellman. However, the academic research on this topic started in 1990s, and since then it intrigued numerous academics, scientists, businesspeople and entrepreneurs. It has become particularly popular in, what is known as, dotcom boom and it is thought that poor business models actually led to downfall of lot of e-business companies of that time. Globalization, uncertainty and ICT environment have contributed to the growing popularity of this concept, especially in the e-business industry.
Electronic business represents the conduction of business processes on the Internet. Business processes include buying and selling products, servicing customers, processing payments, collaborating with business partners, sharing information, running automated employee services, etc. (Radenković, Despotović-Zrakić, Bogdanović, Barać, Labus, 2015)

In e-business, information and communications technology is used to enhance business. It includes any process that a business organization conducts over a computer-mediated network. E-business can be described as transformation of organizational processes in order to deliver additional value through implementation of technologies and computing paradigm of trending economy (Lee, 2009).
Primary processes that are enhanced in e-business:

- Production processes, which include procurement, ordering and replenishment of stocks; processing of payments; electronic links with suppliers; and production control processes.
- Customer-focused processes, which include promotional and marketing efforts, selling over the Internet, processing of customers' purchase orders and payments, and customer support, among others; and
- Internal management processes, which include employee services, training, internal information-sharing, video-conferencing, and recruiting. Electronic applications enhance information flow between production and sales forces to improve sales force productivity. Workgroup communications and electronic publishing of internal business information are likewise made more efficient

The aim of this paper is to demonstrate how business model can be used in developing new business. In order to increase the understanding of this process and to provide steps and tools for its implementation, the service provider start-up will be used as an example..

Starting business on the internet is a good way to realize entrepreneurial idea, especially if it is cost consuming and requires significant investments. There are multiple ways to start business online, including selling products, creating an affiliate site that has a functional store, drop shipping for a merchant or starting an information publishing business (Chhabra, 2013). All of these methods have their own set of

advantages and disadvantages, which is the crucial reason to determine business goals before deciding on a model.

2. E-BUSINESS MODELS FOR START-UPS

The first step in e business development (regardless is it an e-business) is to create detailed business plan. One of the purposes of a clear business plan is to have all steps, ideas, hints and goals identified and transparent. In practice, for most business, plan should reflect focus strategy, resources and their responsibilities matrix, the financial projections of cash flows and necessary investments sales forecasts and marketing strategy. (Dollinger, 2003)
The plan helps the founders to distinguish meaningful pieces related to projected expense, sales, timing of payments. Its focus is definition of business purpose, how the goals are going to be achieved and why the founders are the right people for this business. Also, details regarding the financial resources necessary for progress and timeline of the growth phases that will lead to profitability are important step.
Bullet points that should be included and elaborated in every business plan are:

- Executive summary – it should reflect the key highlights of the plan
- Products and services - core of business purpose
- Management team - should include relevant team review that explain why management personnel are the right people for their jobs
- Market research and clear definition of target niche. Also, it is important to identify possible competition.
- Quality Strategy
- Milestones and Metrics – key metrics that will be used to track the growth and progress of business in question
- Financial Plan – the most critical component. It should include : Sales Forecast, Personnel Plan, Profit & Loss Statement, Cash Flow Statement and Balance Sheet
- Risk Management
- Continuity Plan

Simultaneously, it is necessary to define business model which must be implemented in process of business planning. The main difference between business plan and business model can be explained by following definition. The business model is the mechanism through which the company generates its profit while the business plan is a document presenting the company's strategy and expected financial performance for the years to come. The business model is the center of the business plan. (Neilson, Pasternack, 2005)
Model describes how the company is positioned within its industry's value chain, how it organizes its relations with its suppliers, clients, and partners and how it manages money flows in order to generate profits. On the contrary, he business plan translates this positioning in a series of strategic actions and quantifies their financial impact. Nowadays business models can be divided in “basic models” and “new models”. Basic models assume that companies compete either on price or non-price components. New business models are based on innovative organization forms and/or new products or services, mostly in electronic business area (Daidj, 2014).Academic research on business models has started in late 1990s, and since then numerous definitions emerged. One of the first was written by Timmers in 1998. Timmers defines a business model as a three part concept “(a)an architecture for the product, service and information flows, including a description of the various business actors and their roles; and (b) a description of the potential benefits for the various business actors; and (c) a description of the sources of revenues.”

Every company has a business model, whether that model is explicitly articulated or not (Chesbrough, 2006; Teece, 2010).

In 2005 Morris et al. proposed new definition which says that “A business model is a concise representation of how an interrelated set of decision variables in the areas of venture strategy, architecture, and economics are addressed to create sustainable competitive advantage in defined markets”. (Morris, Minet, Richardson, Allen, 2006)

Similarly, at the same year, Shafer at al presented his definition: “We define a business model as a representation of a firm’s underlying core logic and strategic choices for creating and capturing value within a value network.” (Shafer, Smith, Linder, 2005).

In recent years, George and Bock defined business model as the design of organizational structures to accomplish a commercial opportunity. They also mention three dimensions to the organizational structures: resource structure, transactive structure, and value structure (George, Bock, 2011).

The business model concept defines how a firm creates and captures value for its stakeholders (Amit and Zott, 2001).
Despite countless definitions, researchers have not yet come up with a general one. The reason can be found in diverse implementations of business model. Regarding e-business models, authors agree on key characteristics of model, but focus is different. Nowadays, most often used models are: Canvas and Lean Canvas.

2.1. Canvas business model

The Business Model Canvas is strategic management and entrepreneurial tool. (Osterwalder, Pignegur, 2010) It is well-known business model, used in order to highlight the key segments of a business. The model describes the most relevant parts of business plan and helps its users to focus on values for its enterprise. The purpose of Canvas is to point out how an organization creates, delivers, and captures value. (Osterwalder, Pignegur, 2010) It is widely used among entrepreneurs both for business plan creation and analysis. Canvas was created in 2008 by creator Alexander Osterwalder. and he created it in 2008 Since thean, a lot of numerous versions of Canvas Business Model emerged (Coes, 2014). Boris Shiskov compares Business Model Canvas to the Value Map in his book “Business Modeling and System Design “. He recognizes Canvas as one of the most established methods in industry for business design, innovation and creation. (Shiskov, 2014) Today’s market is uncertain and driven by factors beyond one’s control: demographic changes, recession, environmental issues, increasing global competition. These factors are beyond control of most companies, but they and their business models are affected by them. Therefore, companies cannot change the environment, but they can change the way they operate and the models they use. (Clark, Osterwalder, Pignegur, 2012)

Canvas Business model is a tool consisted of nine segments known as building blocks.
Nine main elements and also referred as key drivers of Business Model Canvas are:

- Customer Segments
- Value Propositions
- Channels
- Customer Relationships
- Revenue Streams
- Key Activities
- Key Resources
- Key Partnerships
- Cost Structure

These elements can be clustered in few groups: Value which includes value proposition, Relationships (including Channels, Customer Relationships, Key Partnerships and Customer Segments), activities (Key activities and key resources) and financial aspects (cost structure, revenue streams). Each segment needs to be filled in with answers to key questions. It is important to have in mind the main goal while filling the blocks. However, it is necessary to avoid any overlapping in defined questions and answers.

- Customer Segments (CS) - This building block defines the different groups of people or organizations a business plans to serve. A customer groups have to be carefully and precisely defined since there can be overlapping in some segments.

- Value Propositions (VP) - The Value Propositions summarizes all reasons and advantages of buying a product or using a service for specific consumer segment. The Value Propositions may be quantitative (example: lowest prices, speed of service) or qualitative (design, customer experience). This statement should point out why that one particular product or service will be the best choice in each aspect, what problem it solves and what is the value it delivers.

- Channels (CH) - This building block is used to show how a company communicates to its customers. Also in this part of a model it is important to explain how company plans to reach its consumers in order to deliver their Value Proposition. Channels are directed toward distribution, sales and communication activities.

- Customer Relationships (CR) - This block is used to describe what kind of relationships a business builds with key customers. This element includes personal interactions (such as one on one meeting), customized relations (mass customization), automated relationships (reviews, comments, and generic replies). This element influences the value propositions and thus overall customer experience.

- Revenue Streams (RS) - The revenue streams show how a company earns income and generates profit from its business. In this part it is described how each customer segment contributes to revenue and profit. Revenue streams can be classified and calculated differently. Usually there are two basic types: revenues from singular transactions and repeated transactions (monthly, yearly or other subscription). The focus in this building block is on calculation of customers' willingness to pay for a product/service.

- Key Resources (KR) - The most important assets which are crucial and irreplaceable for the business are key resources. Those resources can include intellectual resources, financial, physical or human resources. It is hard to define all key resources, but it is of utmost importance for business maintenance.

- Key Activities (KA) - Key activities represent the most important processes and activities the company has to undertake in order to make it business work. The important thing in this block is to list and define all the activities regarding other building blocks such as necessary operations to create Value Propositions, reach Customers, maintain Relationships, promote the product or service, upgrade values, reduces costs and earn revenues. and earn revenues.

- Key Partnerships (KP) - This block represents the stakeholders that make business model work. That is usually network, created among employees, business partners, suppliers, organizations, government and clients. Partnerships are essential in order to gain benefits and help build position on the market. Choosing the right partner can reduce the risks, expenses and it can enable acquisition of specific resources or activities which cannot be produced by the business itself.

- Cost structure (CS) - Cost structure describes all costs and expenses which occur in activities undertook in a specific business. Those costs can be created while creating value, maintaining partnership relations etc.

2.2. Lean Canvas business model

Lean Canvas is an adaptation of Business Model Canvas, but it is created primarily for new start-up business. It is often referred as a problem-solution oriented approach because of its structure and focus. The building blocks in this business model are somewhat different. The focus is on product and market.
This method is always associated with entrepreneurs and start-ups. The author of the book The Lean Start-up, says that The Lean Startup method teaches one how to start a start-up, how to drive it, when to turn, when to protect and how to grow a business with maximum acceleration (Ries, 2011). Moreover, it is often said that Lean Canvas is the model that helps identify risky parts of a business and find the right solutions in various learning cycles. (Croll and Yoskovitz, 2013) When using this tool, it is important to follow predefined order of actions. Some blocks have to be completed in pairs because they are correlated. It is important to use this model following predefined order of actions and to fill blocks in the bellow written order (Mohapatra, 2013).
Building blocks in Lean Canvas: Problem, Customer Segments, Unique Value Proposition, Solution, Channels, Cost Structure, Revenue Streams, Key Metrics and Unfair Advantage.
They can be divided in two groups, as mentioned: Product and Market. Some of the blocks are the same as in the Business Model Canvas. The different ones are: Problem, Solution, Key Metrics Unfair Advantage, and they will be further explained.

- Problem

In this block it is necessary to list few problems which can be related to the customer segments. Key question for this block is "What is one's problem and does it have a problem worth solving?" It is important to figure if the solution exists before investing time in defining it. The usual number of problems listed is three.

- Solution

Solution block needs to be fill in with solutions to the problems listed before. Each solution needs to address appropriate problem.

- Key Metrics

The key metrics in Lean Canvas model are the activities that move business forward.

- Unfair advantage

Unfair advantage represents something that cannot be copied or bought. This block is very often mixed with unique value proposition. The difference between these two blocks is who they address. The Unique Value Proposition applies to the consumers and unfair advantage to competitors.

3. EXAMPLES OF IMPLEMENTATION OF BUSINESS MODELS

3.1. Canvas in practice

The project “pickwith.us” represents software solution in hospitality services area. It is designed to make easier for users to discover and book place in every restaurant in Belgrade.
The main purpose of pickwith.us portal is to provide easier restaurants booking. It allows users to choose the appropriate restaurant based on desired parameters such as time, date, menu, location, price range etc. In order to book a table, it is required to create account with basic information. The process is simple and intuitive. Users of this portal can be divided in two groups: restaurant owners and guests. There are benefits for both user groups which will be described in Canvas business model.

Users of this portal are both owners of restaurants and guests. There are benefits for both user groups which will be described in Canvas business model.

Mission is to create universal environment which contains all information about restaurants in Belgrade and to attract both tourists and citizens.

Vision is to be the leader in providing new services on the market, in terms of integrated online booking in the multiple restaurants. Also, to fulfill customers’ needs by providing accurate information, educative and interesting contents and to maintain strong relations with partners.

Table 1 : Canvas business model

<table>
<tr><th>Who are your key partners?</th><th>What are your key activities?</th><th>What are your value propositions?</th><th>Your customer relationships?</th><th>Customer segments?</th></tr>
<tr><td rowspan="2">Restaurant owners
Companies
Influential individuals</td><td>Negotiation with partners
Marketing activities
Improvement of service</td><td rowspan="3">Fast, simple and user-friendly process of making reservations
Reducing the time dedicated to processing booking requests
Marketing and promotion</td><td>Reviews
Marketing
Personal relationships
Mass customization</td><td rowspan="5">Citizens
Tourists
Organizations
Companies and employees</td></tr>
<tr><td>Key resources?</td><td>Channels</td></tr>
<tr><td rowspan="3">Project team
Developers
Equipment
Portal
Phone
Mail</td><td rowspan="3">Website
Phone
One on one meetings
Mail</td></tr>
<tr><td>Cost structure</td><td>Revenue streams</td></tr>
<tr><td>Hosting and domain
Marketing
Administrative
Other expenses</td><td>Fixed percentage per transaction
Advertisements</td></tr>
</table>

- Customer Segments

In this project, there are few customer segments and each of them gains different benefits. We divided them in following groups: Belgrade citizens, Tourists, Companies and organizations and Restaurant owners

Belgrade citizens are primary segment because they are end users of the portal. It is important to engage them and to become a part of their routine. The benefits are reflected in: time saving, more information, wider choice.
Tourists are an important segment because they are willing to explore all options that a city offers. They rely on recommendations of other guests and they are looking for easiest way to be informed. Thus, benefits for them are: easier decision making, information, clear insight and cheaper and simpler booking process.
Companies and organizations represent corporate users which can use this service in order to find appropriate place for all kind of events they organize (including balance between restaurant capacity and their needs, menus and prices).
Restaurant owners are specific segment because they represent key for entering the market. They are main relation between end users and portal. Benefits for them are numerous: promotion, better organization, easier booking process, guests' database with useful information etc.

- Value Proposition

The value proposition relates to several benefits: fast, simple and user-friendly process of making reservations for portal users, reducing the time dedicated to processing booking requests for restaurants, reducing costs of marketing and promotion activities for restaurants owners, safe booking and availability of information (about time, free spots, menus, prices etc.)

- Channels

In this project, the main channel is portal. It is the key resource for establishing communication with users. Additionally, other web services such as engines, other websites, emails and social media are used. The phone and one on one meeting are part of communication channels, also. They are primary channel for reaching the restaurant owners.

- Customer Relationships

Pickwith.us portal is based on relationships built with customer segments. Relationships can be reflected in following: Reviews, Marketing, Personal relationships and Mass customization

Reviews are used to provide portal users with real-time and organic opinions. They can be useful for both parties: users can easily make decisions based on reviews, and restaurants can build reputation and improve their strategies.
From the "Pickwith.us" portal point of view, marketing is reflected in activities related to online publishing through Facebook and Google Adds. Google search engine and publishing on Display Network are part of portal strategy. Google search engine includes key words, such as: restaurants, Belgrade, lunch, reservation, contact etc. Moreover, the social networks will be used through Facebook page and moving forward end users of portal will spread a word about pickwith.us.
The partners rely on marketing using pickwith.us portal and its social network presence. The possibilities for promotion are numerous, from restaurant presentation on portal, published special offers and contents.
Mass customization refers to establishing strong relationship between users and restaurants through suggested choices based on customer preferences. Pickwith.us stores a database with information and historical data for every user and, by following their previous choices, gives proposals according to their style.
Also, restaurants can improve their rank on this website through personal relationships. They can point out themselves, increase their visibility and engagement through personalized offers and suggestions.

- Revenue streams

Revenues are expected from several sources. Primary source is paid promotion. Several packages are offered depending on chosen promotional activities such as: special offers, news, promotions on pickwith.us homepage, weekly newsletters, key updates, promotion on pickwith.us Facebook page.
The second source is a fixed monthly subscription made through portal.

- Key Resources

Key resources include project team, developers, portal, phone and mail. Project team is responsible for implementation of business plan, executing the idea, communication with stakeholders, monitoring revenue streams and costs, realization of promotion activities and overall daily duties. Developers

maintain portal and work on its improvements. They manage databases. Portal is the key resource because it is main role in project implementation. Phone and mail are main communication tools.

- Key Activities

Firstly, key activity is portal development and updates in line with trends. Secondly, negotiation with partners, the key activity necessary in order to create a database and content of the portal. Lastly, marketing activities followed by Improvement of service.

- Key Partnerships

In this project, three main partnership groups are: Restaurant owners, Companies and individuals

Restaurant owners through partnership with “Pickwith.us” portal increase number of their visitors, enhance online presence and with that, positively affect target audience awareness. Pickwith.us, as an intermediate between restaurants and guests, make the process of booking reservations simpler for both parties.
One of the groups are companies which tend to after a hard work of their employees provide them opportunity to socialize outside the workplace, with the aim of bringing together and spreading the team spirit within the team. Organization of team events, corporate parties, etc. can be reward and motivational tool for the employees, brings positive atmosphere and helps achieving company’s goals.
Influential individuals can be key point for business growth. This group refers to public figures, people who can spread the information about new portal and indicate to its possibilities and positive effects. The aim is to attract influential individuals by presenting booking software solution and providing welcoming benefits which will have direct positive impact on promotion of the portal.

- Cost Structure

All cost items can be divided to fixed and variable ones, and they depend of numerous factors on a monthly basis. These are: Hosting and domain, Marketing, Administrative and Other expenses

Hosting and domain represent fixed cost item, which will be payed monthly. There are multiple providers with different packages. The provider should be chosen according to the best ratio of cost and benefits in terms of server space, bandwidth, price, number of subdomains, number of e-mail addresses. Goal is to define URL address, so that consolidated name with domain is easy to remember, but also interesting for users.
“Pickwith.us” project requires significant investments in marketing. Costs are variable and depend on a volume of advertisements, Google and Facebook adds, etc. Since viral marketing is an important part of marketing plan, part of the budget is dedicated to the promotion on the Facebook page.
Offline marketing costs include price of flyers that will be located in restaurants and labels on those objects.
Administrative costs are necessary for maintenance of daily operations and business activities. They are not directly nested in the production of services. These costs include staff salaries, rent, equipment costs, electricity and water bills, insurance, etc. Administrative costs are fixed and there is a limited scope in a ability to reduce them.
Other expenses refer to earmarked assets for unexpected costs which are likely to occur. Approximately, 8% of the planned expenditures will be intended for this cost item. The reasons that can initiate occurrence of unexpected costs are numerous, but they will be analyzed after every appearance, for future references and better planning process.

3.2. Lean Canvas in practice

Table 2 : Lean Canvas model

Problem	**Solution**	**What are your value propositions?**	**Unfair Advantage**	**Customer segments?**
Creating a network of restaurants that will be willing to pay for the service they used to get for free. Attract users and become part of their routine	Offering a free trial period for all partners in order to realize all the benefits. Creating digital marketing campaign targeting key audience.	Fast, simple and user-friendly process of making reservations Reducing the time dedicated to processing booking requests	Unique base of users and unique service on the market. Absence of a portal that provides the same set of services at once in Belgrade.	Citizens Tourists Organizations Companies and employees

<table>
<tr><td rowspan="3">The lack of a mobile version.</td><td>Including development of a mobile application in long term plan.</td><td rowspan="3"></td><td>Channels</td><td rowspan="5"></td></tr>
<tr><td>Key Metrics</td><td rowspan="2">Website
Phone
One on one meetings
Mail</td></tr>
<tr><td rowspan="3">Number of sign-ups.
Number of restaurants in the offer.
Number of engagements on Facebook.</td></tr>
<tr><td>Cost structure</td><td>Revenue streams</td></tr>
<tr><td>Hosting and domain
Marketing
Administrative
Other expenses</td><td>Income of paid post
Fixed percentage per transaction
Advertisements</td></tr>
</table>

4. CONSLUSION

This paper presents guidelines for both future entrepreneurs who intend to start online business and those who want to improve their business. Highlighted is the fact that a business model is not just a document that helps obtaining investment, but it's truly a severe examination of whether modeled business idea is viable. Moreover, it can be used as a key tool for planning and control. Also, it is a sort of a guide for enterprise.

Defining all mentioned segments and analyzing each one of them individually and in correlation in the early stages of development of business can save great deal of time and costs later on. It can indicate the weaknesses of start-up idea and give a chance to correct those weaknesses before making any serious mistakes.

Starting a business involves taking responsibility for decision making, becoming increasingly self-reliant, pioneering, adventurous, daring, dynamic, progressive, proactive, opportunist, ambitious and holding values.

Canvas business model includes all steps required for implementation of business, leading from idea to realization and enabling to focus on key segments. Simultaneously, this model can be used for improvement of existing business. Lean Canvas, on the other hand helps users to focus on problems and product itself, and therefore understand the problem. In uncertain, risky and dynamic conditions, most start-ups forget to be analytical and thus fail to observe all potential risks. In example mentioned in this paper, it is shown how these models can be used to present the most important features of a business, thus, we can conclude that both Canvas business model and Lean Canvas can be of significant importance for enterprise. The main benefit of both of them is to have one single view on what a business model is. That way, misunderstandings among stakeholders and time-consuming discussions on the business model will be excluded.

The business model is crucial for any business since it represents the first tangible manifestation of the organizational phenomenon, because it obliges the potential entrepreneur to get moving.

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MEASURING DEMAND FOR IT SKILLS ON THE SERBIAN JOB MARKET

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Abstract: *This paper describes how the demand for certain technical skills in Serbia can be measured. The primary goal of this paper is to investigate the current usage of programming languages and technologies in the Serbian industry and to show how the educational institutions can possibly benefit from monitoring the demand for specific skills. This paper will not answer which programming language is the best, but it could help people make strategic decisions such as choosing a programming language to learn or teach and even which programming language to choose in order to build a new and competitive software system.*

Keywords*: IT skills demand, IT job market, programming languages, technologies, platforms, Serbia*

1. INTRODUCTION

It is doubtless that we are witnessing dramatic changes in the field of Information Technology where certain skills become obsolete very fast. It happens very often that one technology that was considered the best solution for one problem in a very short time becomes replaced with other kind of technology.It has become hard to keep track of all the changes and the needs of the job market both for students and educators.

The information about programming language popularity, for example, is one Google search away but it is most often measured on a global level or in the US. However, the demand for technical skills needed in Serbia and in the US for example, are not identical. This is why we decided to monitor the demand on the Serbian market only.

There are various methods of measuring the popularity of programming languages proposed:

- counting the number of times the language name is mentioned in web searches, such as it is done by Google Trends. The main problem here is that the results may be corrupted because when typing Python, it could be an animal, or a programming language; Java could be an island of Indonesia and a programming language, etc.
- counting the number of job advertisements that mention the language, as it is applied in Indeed.com or TrendySkills.com web sites that are offering statistical data and quantitative representation about trends that job employers and employees seek in the IT industry.
- the number of books sold that teach or describe the language. A good example is Nielsen BookScan, which aggregates point-of-sale data from about 70% of US bookstores, including Amazon, Barnes & Noble, Borders, and many smaller chains and leading independent bookstores.
- estimate the number of existing lines of code written in certain language. Most often, it includes searching the web with the language name as a keyword, gathering code data and analyzing them. (Bieman & Murdock, 2001). The main problem could be underestimating languages not often found in public searches.
- counts of language references (i.e., to the name of the language) found using a web search engine. A good example of this practice is TIOBE.com, that is exploring trends based on the TIOBE index. The TIOBE Programming Community index is an indicator of the popularity of programming languages. The index is updated once a month. The calculation comes down to counting hits for the search query, and only certain search engines and programming languages qualify, by the beforehand defined criteria.
- counting the number of projects in certain programming language on platforms like GitHub (where the rank represents languages used in public and private repositories, excluding fork) and Stackoverflow (where developers often share where they work, what they build and who they are, and their data could be accessed and downloaded at any time).

- counting the number of postings in Usenet newsgroups about the language, since Usenet is a repository for messages posted from many users in different locations, similar to discussion forums.

Various sources are using different methods, and it would be a mistake if only one was declared the best. The most common approach is to combine more of them, depending on what we want to find out. If the question is which is the most popular programming language - combining web searches, lines of code, topics and book sales would be the best solution. Job advertisements are a good indicator of which language there is the greatest demand in the job market for. Job adverts and language references could be a good choice for determining which language has the biggest growth rate, etc.
Despite all that being said, it is not only the companies that are dictating trends, but the developers themselves as well. Attracting skilled developers can be difficult. So using programming languages that developers like and lots of developers know can be helpful for companies.

Taking the popularity of social networks into account, it would be a good practice to consider the data gathered from social network as well, and that certainly is the way the research would go in the future. It is a great challenge to combine more methods, it would require more time, the sources would be unstructured and more difficult to analyze, thus the results would be more accurate.

Based on the assumption that the primary interest of an educational institution is to prepare its students to properly meet the demand of the job market we decided to use the method of counting the number of job advertisements that mention specific technical skills. Since our department is focused on educating students in Serbia, our goal was to measure the demand for technical skills on the Serbian job market. Job adverts could be a useful indicator because they give us ad hoc results, representing the technical skills employers need.

We did not limit the research only to programming languages, because in many cases knowledge of a programming language is augmented by knowledge of specific technologies and platforms. This is why, when we say technical skills we mean: knowledge of programming languages (e.g. Java, Python, PHP), platforms (e.g. Android, iOS..), Quality Assurance, Linux administration and Game Development.

2. DATA SET

We started collecting data on December, 14th 2015. and we will continue to do so every day, because we believe the data will be even more useful as the dataset becomes larger. The data is gathered from a popular Serbian website called Startit where new job adverts are appearing every day.

The gathered data is separated to 13 columns. The date when the data was collected is inserted into the first column, other 12 columns are for the number of job adverts that mention the following IT skills respectively: Java, .Net, C, Android, iOS, Quality Assurance, Linux, JavaScript, Ruby, Game Development. We decided to track these particular skills because they are currently among the most demanded skills world wide. (indeed.com)

This is a data frame representation of the data collected on the first day:

date	java	.net	c	android	ios	qa	linux	js	php	python	ruby	game-dev
14/12/2015	79	39	6	33	27	20	12	67	57	17	10	11

Figure 1: Pandas DataFrame representation of the data

The process of data collection is automated with a python script which is hosted on an Amazon Elastic Compute Cloud (EC2) and is scheduled to run every day at 5:00 PM (CET). The script counts the number of job adverts with the following tags: java, .net, c, php, js/javascript, python, ruby, android, ios, game-dev, qa and linux.

3. DATA ANALYSIS

After plotting the data collected over the last 5 months we can see that the most job offers require knowledge of Java. JavaScript and PHP are not far behind, but it is also noticeable that these two programming languages have made significant growth in position openings in the last few months.

.Net, Android and iOS respectively are the three platforms wanted by the employers with iOS showing some decline in the past few weeks.

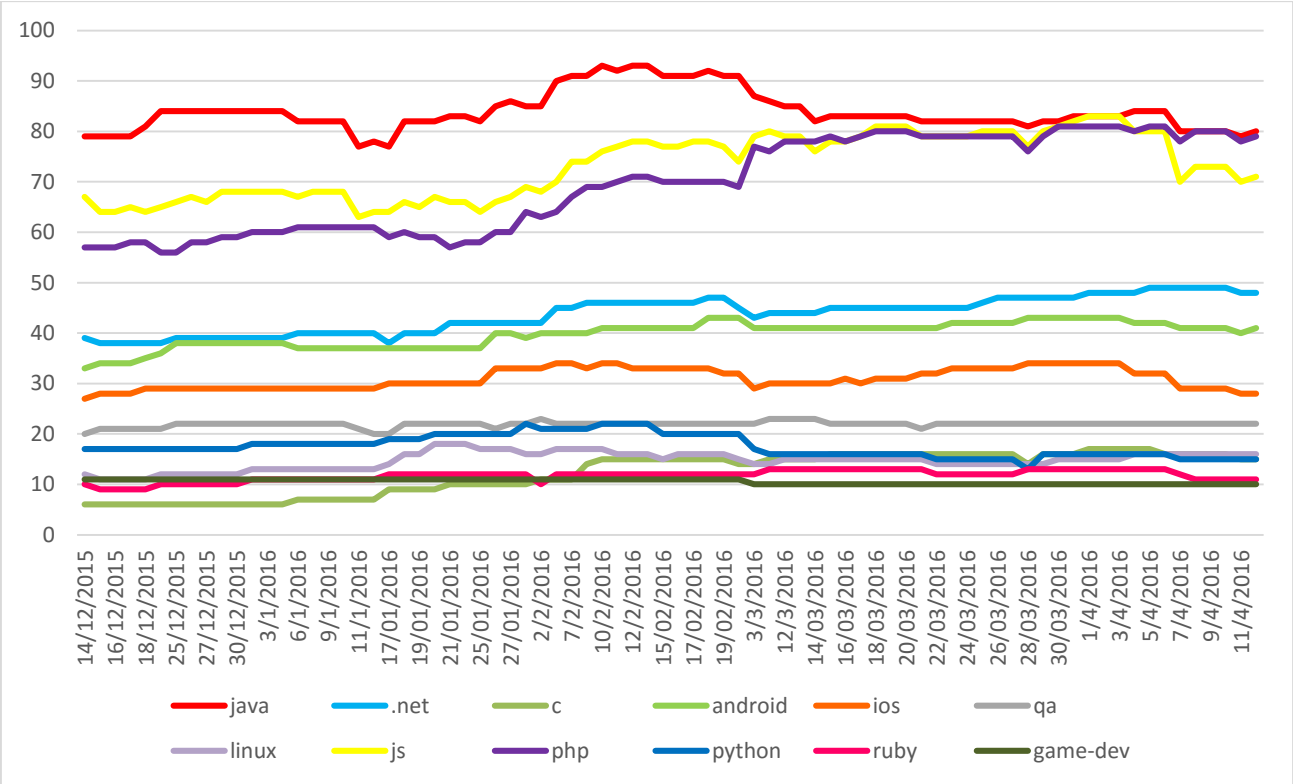

Figure 2: Demand for technical skills through time - Line Chart

When we look at the mean values (number of job posts recorded per day), adverts for Java developers achieved the highest number: 83,88 followed by JavaScript (73,17) and PHP (69.6), .Net (43.7), Android (39.76), iOS (30.97). Than, we have some lower averages, respectively QA - Quality Assurance (21.88), Python (17.56), Linux administration (14.70), C (12.27), Ruby (11.73), Game Development (10.56)

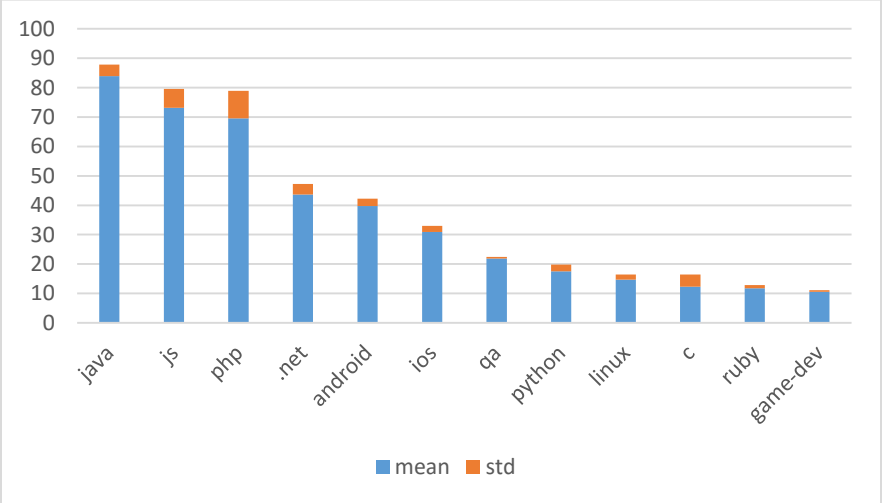

Figure 3: Mean and standard deviation for the number of job adverts for each skill

The largest standard deviation is recorded for PHP (9,32) and JavaScript (6,33) which makes sense because of a significant change in the number of job adverts. The lowest standard deviation was recorded for QA (0,55) which means the number of available jobs that require this skill is near to constant.

When we take a look at the minimal and maximal values we can see that the largest number of positions recorded on one particular date was again Java (93), followed by JavaScript (83), PHP (81), .Net (49), Android (43), iOS (34), QA (23), Python (22), Linux administration (18), C(17), Ruby (13), Game development (11).

The smallest number of available positions recorded was for C (6), Ruby(9), Game Development(10) Linux administration (11), Python (13), QA (20), iOS(27), Android(33), .Net(38), PHP(56), JavaScript(63), Java(77).

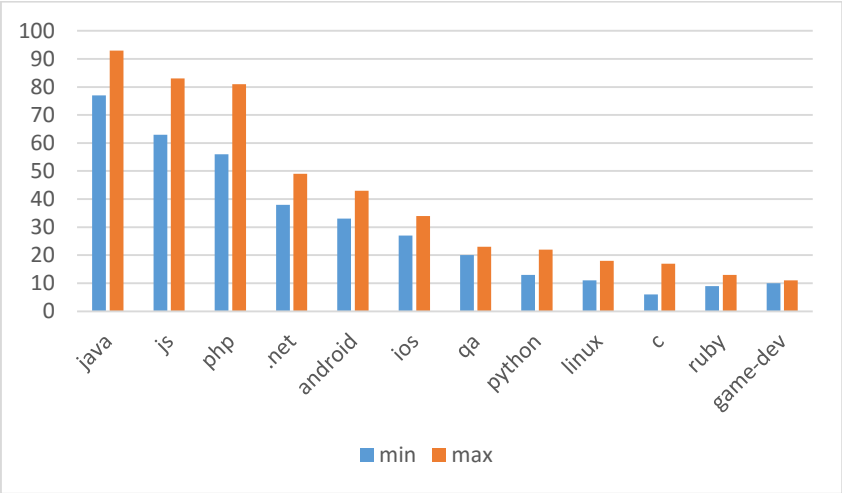

Figure 4: The minimum and maximum recorded value for each skill

On the next chart we visualised the interquartile range (IQR) values for each skill which represents the difference between the upper and the lower quartile. This value gives us the maximum difference between the middle 50% of the data, and in this case it could be interpreted as a metric that describes the amount of change in the number of job adverts that mention the particular skill. This indicates which skills should be monitored, because they have the potential to become more or less popular in the future. In our case, PHP (19), JavaScript (12), C (8,5), .Net (6,75), iOS (4) and Python (4) are the ones for which the demand could possibly grow in the close future. Java (3), Android (3), Linux (2.75), Ruby (2), Game Development(1), QA (0) are the ones with less variability in demand.

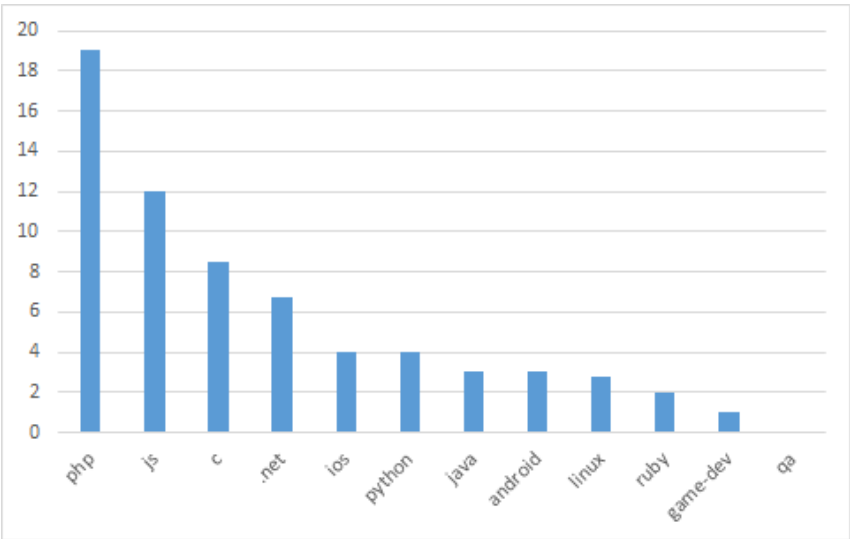

Figure 5: IQR for each of the skills

4. CONCLUSION

It should be noted that the gathered data may not be completely accurate due to the fact that our database was updated every day, but with the current number of job adverts for each skill. This means that if there are 80 jobs that mention Java one day, and 82 the day after, those numbers will be recorded. Therefore we are not aware what is the actual number of unique job adverts for each skill. This is important because of the website's policy which in some cases requires payment for adverts which has an impact on the time a certain advert is active on the page. Consequently, some adverts are counted for a longer period of time. However, the data we have can serve the purpose of measuring the demand for skills through time.

The first conclusion we made is that the job market demand for the majority of skills in question is growing or in worse case is constant. When it comes to particular skills, the most demanded skill for any position today is knowledge of Java, a general purpose programming language mostly used for development of desktop, mobile, web and other kinds of applications (Đurić et al., 2013). The skill for which the demand has made the most growth is PHP which is mostly used for web development (MacIntyre, 2010). A very close growth of demand was recorded for JavaScipt which has also been mostly used for client-side web development in the past, but has infiltrated the server side in the recent years, since the appearance of Node.js (Powers, 2015). All the skills in question can be separated into three groups: High demand, medium demand, low demand. Java, PHP and JavaScript fall into the high demand group., Android, .Net, iOS make the medium demand group and C, Quality Assurance, Python, Ruby, Linux and Game Development can be classified to the low demand group.

We think that from a perspective of Serbian educational institutions in this field at the university level Java, PHP and JavaScript should be a part of the compulsory curriculum. Android, .Net and iOS are worth considering if they are not already a part of the curriculum. But, for discovering the future potential of a skill it would probably be a good decision to compare the demand trends for jobs in Serbia with the demand trends in the US. From a perspective of someone who is willing to learn in order to get a job in the field, the easiest way to employment is to pick Java, PHP, JavaScript, but it could also be more financially awarding to choose a skill where there is a lower supply of workforce. From a perspective of someone making a decision which technologies are needed for the software system depending on the platforms (desktop, web, mobile..) Java and JavaScipt are probably the best option at this moment.

There are several things that we plan to improve in the future. First of all, the data collection process will be altered in order to track the demand changes more accurately by recording every unique job advert. Secondly, the data variety will be expanded in order to track the names of job positions, companies and cities that are mentioned in job posts in order to make even more detailed analysis and in order to grasp new conclusions. Thirdly, the data volume will be expanded, which means the number of technologies, programming languages and other skills will be taken into account because the idea of the system is to identify the appearance and growth of new and currently unknown skills. Additionally, as the dataset grows, we will be able to find out if the growth of demand for one skill impacts the decline of demand for other skills or not. We will also be able to understand which skills when they are combined are most needed by the employers in Serbia. And finally, the data will be collected from several different sources in order to find larger amounts of data and to draw less biased conclusions.

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TRENDS SHAPING BUSINESS MODEL INNOVATION IN TELECOMMUNICATION COMPANIES

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Abstract: *Business innovation is constant process for all companies but Telecommunication companies are facing ever bigger pressure to adapt to fast changing market conditions and improve performance and profitability. Changing user habits and increased regulation of telecommunication markets are putting pressure on companies to change their business practices and reinvent themselves not just to improve but to survive. This article gives an overview of current trends that fuel change in business models of telecommunication companies and analyses case for a freemium-like revenue models. It identifies key components of such a model and proposes changes to some standard practices and new sources for revenue.*

Keywords *, business model canvas, Telecommunication, Cloud computing, Internet of Things, freemium*

1. INTRODUCTION

Term 'Business model' is first mentioned in academic article by *Bellman and Clark (1957)* but it begins to be popular subject only at the end of 20th century. Since then, many authors offered their definitions of the term and tried to establish it's elements.

For the needs of this paper, we will accept definition of the term „business model" and it elements as defined by *Osterwalder, A., Pigneur, Y., & Tucci, C. L. (2005),* in their paper that is widely acknowledged. Their definition of the business model is: „A business model is a conceptual tool that contains a set of elements and their relationships and allows expressing the business logic of a specific firm. It is a description of the value a company offers to one or several segments of customers and of the architecture of the firm and its network of partners for creating, marketing, and delivering this value and relationship capital, to generate profitable and sustainable revenue streams." In the same paper they define nine building blocks of business model as its basic elements.

Table 1: Business model Building Block, *Osterwalder, A., Pigneur, Y., & Tucci, C. L. (2005)*

Pillar	**Business Model Building Block**	**Description**
Product	Value proposition	Gives an overall view of a company's bundle of products and services.
Customer Interface	Target customer	Describes the segments of customers a company wants to offer value to.
	Distribution channel	Describes the various means of the company to get in touch with its customers.
	Relationship	Explains the kind of links a company establishes between itself and its different customer segments.
Infrastructure management	Value configuration	Describes the arrangement of activities and resources.
	Core competency	Outlines the competencies necessary to execute the company's business model.
	Partner network	Portrays the network of cooperative agreements with other companies necessary to efficiently offer and commercialize value.
Financial Aspects	Cost structure	Sums up the monetary consequences of the means employed in the business model.
	Revenue model	Describes the way a company makes money through a variety of revenue flows.

Need for change of the way some companies operate their business may come from many places. Outside factors such as changes on the financial markets, technology advancement, user behavior and others are influencing decisions of management to adapt business models on whom their base their operations. Companies rarely change everything about how they operate – they mostly change elements of their business model to best accommodate their inner organization to new challenges on the market.

Telecommunication companies are subjected to many outside factors forcing them to change the way they do their business, mostly because of fast advancement of technology. That advancement has disruptive influence on the telecommunication market. In this paper we will try to identify trends that influence the change in business models of telecommunication companies, tie them to relevant element of business model and show how companies adapted.

2. TRENDS INFLUENCING CHANGES IN TELECOMMUNICATION COMPANIES

It is important to clearly distinguish business model from business process model. First can be viewed as firm's basic rules and guidelines on creating and commercializing value, while latter is the way business implements a certain process in its operations. Optimization of business process model bring efficiency to work process that is being reviewed. Changes in business model are done to expand overall capacity and competitiveness of the company.

In search for a key change in business model that could improve competitiveness of telecommunication companies in developed markets we identified trends that fuel change in segments of business models and then searched for relevant cases that show how companies adapt to new changes on the market.

Table 2: Business model elements and corresponding trends influencing them

Business model element	**Influenced by**
Value proposition	Integration of content offerings
Target customer	Internet-of-Things and increasing need for M2M communication
Distribution channel	Over-the-top content
Customer Relationships	Social networks
Core Competency	Outsourcing
Partner network	Changes in market regulation
Cost structure	Cloud computing
Revenue model	Success of freemium model in software market, especially apps for mobile devices

Integration of content offerings

"Content is King" is the *article Bill Gates wrote (1996)*. In it, he claims: "Content is where I expect much of the real money will be made on the Internet, just as it was in broadcasting." This is now truer than ever. Lines between service provider, content provider and classic telecommunication provider are getting blurred with each of them expanding its offer with basic service bundled with different content, own or licensed.

In telecommunication world, customers were first offered 'single-play': separate voice, broadband or television service. 'Double-play' was introduced as integration of voice and broadband in a single package. 'Triple-play' included television as third component of the package and in the end 'quad-play' offer was created by including mobile service. In a world where 'Content is King', telecom operators needed to find a new value proposition for their customers who increasingly found this kind off offers to be inadequate

Apple, currently technology company with biggest valuation, is not just selling hardware it selling platform for content distribution. Their iTunes platform is key to their success. In year 2012, iTunes had 64% of paid music download share in USA according to Statista.com (2012).

Importance of integrated content offering is demonstrated by company Layer 3. They are trying to beat Comcast, largest USA cable company by offering content bundle from different content owners and at the same time integrating content from social networks in a seamless way for unique user experience. Although they are yet to produce visible result in terms of market share, key executives of this company are experienced old-cable-company managers that invested their time and money in something they think is a future of cable.

Internet-of-Things and increasing need for M2M communication

Internet-of-Things (IoT), a network of all sort of thing and appliances that are connected through standard internet infrastructure using standard communication protocols, is growing rapidly and will continue to grow in foreseeable future, as pointed out by *Mazhelis, Warma and others (2013).*

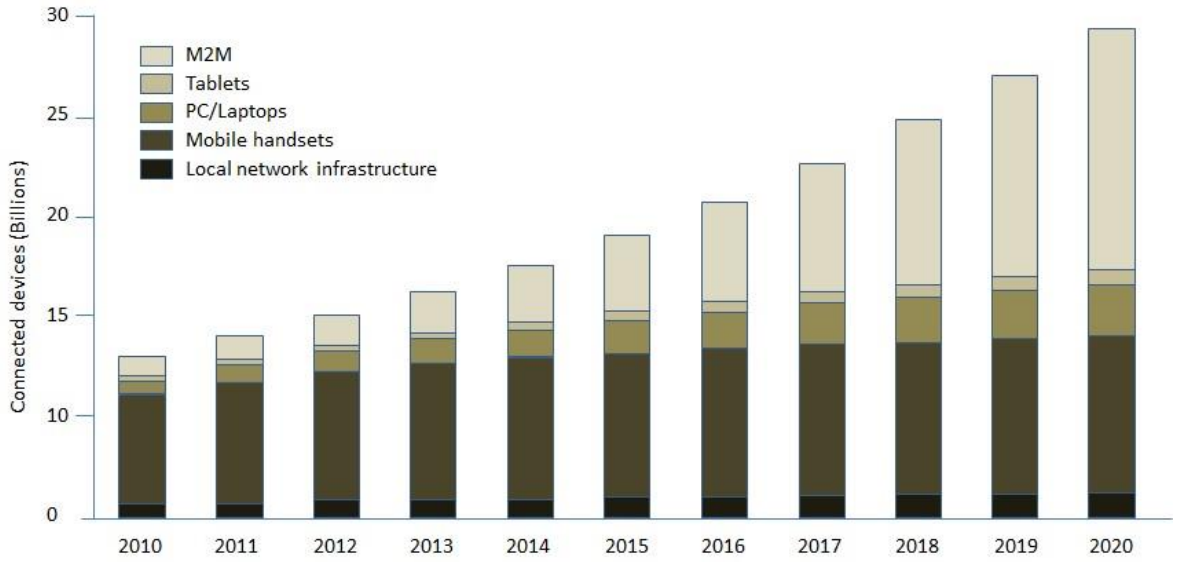

Figure 1: Forecast of growth of connected devices in IoT

It has become increasingly visible thanks to the rise of intelligent devices such as thermostats or refrigerators, smart fitness trackers, and the promise of autonomous vehicles. As Figure 1 shows, predicted growth in number of devices connected is set to grow to 30 billion by 2020, which is nearly three times the number of people on Earth. This growth opens up one complete new market segment for telecommunication companies. Their customers will need to find way to connect all these devices and that is huge opportunity that telecom operators do not want to miss. Telecom operators could exploit this opportunity by developing a flexible platform which will act as an enabler for IoT by providing a 'menu' of services to customers.

Other way to do so is expanding business by entering other sectors by merger or acquisition. The IDC report noted British telecommunication operator Vodafone's acquisition of Cobra Automotive Technologies in 2014 as an example. According to Vodaphone, the acquisition will help them become a global provider of connected car services for automotive and insurance customers. Another example is E2 Hungary, a joint venture utility company founded by MET Holding and Magyar Telekom, which started operating in January 2016. The merging of the two companies' client portfolios has already started with the transfer of Telekom's complete industrial utility business into the new company, which will also supply most of MET's current commercial clients. The 50-50 joint venture utility company will supply natural gas and electricity to more than 4,000 business customers in Hungary. Such a portfolio will put the new company among the most dominant players in the power and gas market. But most importantly it will give it an edge over competition in implementation of smart energy solutions based on IoT concept.

Over-the-top content

An over-the-top (OTT) application is any app or service that provides a product over the Internet and bypasses traditional distribution. Services that come over the top are most typically related to media and communication and are generally, if not always, lower in cost than the traditional method of delivery.

Over-the-top application can be anything that disrupts traditional billing models. Examples include Hulu or Netflix for video (replacing traditional cable TV provider) or Skype (replacing standard telecom operator providing long distance calls).

The creation of OTT applications has led to a wide-ranging conflict between companies that offer similar or overlapping services. The traditional telecom operators have had to anticipate challenges related to third-party firms that offer over-the-top applications. Well known example is conflict between Netflix and Comcast that resulted in Netflix paying Comcast for interconnection to its servers. In effect, OTT services created two-way distribution channel for both digital services providers and telecom operators. Digital service providers use networks of telecom operators as distribution channel for their services but at the same time telecom operators are expanding their digital services to new customers through networks of their competitors.

Social networks

Social networking sites such as Facebook and Twitter have become more than platforms for marketing and advertising. Increasingly, they are also valid and important channels through which customers, both old and new, solicit and receive customer service. According to Nielsen's 2012 Social Media Report, nearly half of U.S. consumers use social media to ask questions, report satisfaction, or to complain. Third of social networks users prefer to make contact over these media then over the phone.

Providing multi-channel support that includes social networks can present real challenges for B2B and B2C companies both large and small as well as opportunities to positively impact sales and customer loyalty. The reality is that customer service expectations are constantly rising and customers are expecting attention that spans from the showroom floor to the Facebook timeline. They require constant communication with companies and prompt answers to their questions. They want companies to be with them 24/7.

Burden put on companies is very high because not only they are required to answer to customer demands instantly through social networks they are required to do so mostly publicly and that demands different set of skills from people in support department then those required for customer support over the phone which was standard not so long ago. This is true for telecommunication companies as it is for any other.

To accommodate to this new demands, changes in internal organizational structure of companies is required. Adaptation of business model, in segment of customer relationship is necessary. Organizations tend to outsource online support, public relations and online marketing to companies that specialize in management of online presence on social network for other companies. As telecom operators provide 24/7 service for their customers, and social networks allow customers to be in constant contact with companies, integration of support, PR and marketing in-house may be necessary to meet this 24/7 level of support over social networks.

This problem is identified by Facebook and other and they are starting to implement AI (artificial intelligence) and bots (automated answering) to try at the same time to make it easier for companies to meet demands of customers and to help users get quality support as fast as they can. In April 2016, Facebook launched automated bot support and provided API for developers to build their own automated support service that will work with Facebook Messenger. At the same time, Microsoft is experimenting with its own AI based support. Xiaoice (Chinese word meaning “Little Ice”) is an advanced natural language chat-bot developed by Microsoft, for Chinese blogging service Weibo. Response of users is overwhelming with 850 thousand followers and average number of user interaction at 60 times a month.

Outsourcing

Outsourcing is allowing Telecommunication companies to focus on core competencies that are different from ones that we can find in more traditional business models, such as technological infrastructure or technological innovation. Outsourcing of services is nothing new and it has been used widely by telecommunication

companies. In a rapidly changing industry ecosystem, heavy investments in hard infrastructure can burden balance sheets and limit growth without outside funding. That is primary reason why we witness change in type of outsourcing where companies are outsourcing what is generally considered as basic core competency for telecom operator.

Leading example of this trend is Bharti AirTel Limited, telecom operator from India and their 'Total outsource' philosophy.

Bharti Airtel Limited is a global telecommunications company with operations in 20 countries across Asia and Africa. The company ranks amongst the top 4 mobile service providers globally in terms of subscribers with 307 million customers across its operations at the end of November 2014. Their core competency is not technology but branding and identifying customer pain points. Telecoms operators are classified as a high technology industry, but Bharti, on the other hand, has little expertise in technology. Their management team made a counterintuitive move: It outsourced network installation, maintenance, and service. Companies like Ericsson and Nokia Siemens Networks are operating core network, and IBM has built and managed its IT systems.

The vendors that were given task of network management are paid only for the capacity utilized by Bharti Airtel, not for the equipment. Bharti's innovative business model converted fixed costs in capital expenditure to a variable cost based on usage of capacity. Through this outsourcing arrangements, Bharti dramatically lowered its costs while ensuring high quality for customers, since vendors had world-class competencies in their domains. This allowed company to focus on marketing and customer acquisition which in turn allowed it to become one of dominant telecommunication operators in Asia.

'Total outsourcing' strategy is not without its downsides. In the last two years, Airtel did see its profit margin decline and decided to lower level of outsourcing and brought control over some of key functions in-house. Their tactics and unusual choice of core competencies allowed them to grow in unpreceded scale and adjustments made are more of evolution of their decade-long business model then deviation from it.

Changes in market regulation

There are many papers covering subject of market regulation influence on investment or service quality (see, for instance *Grajek & Röller, 2012 or Haucap & Klein, 2012*). Trend of increased market regulation for Telecommunication services continues in both USA and EU. New regulations were recently introduced on user privacy, data retention, net neutrality, open access, roaming tariffs. This regulation not only affect how telecommunication companies behave toward customers but also between each other thus directly influencing partnerships between them.

For example, net neutrality rules introduced with FCCs Open Internet order are directly limiting some existing and planned partnerships between companies providing broadband access and those providing digital services. Open Access Rules and Order, comes down to few Bright Line Rules:

- No Blocking: broadband providers may not block access to legal content, applications, services, or non-harmful devices.
- No Throttling: broadband providers may not impair or degrade lawful Internet traffic on the basis of content, applications, services, or non-harmful devices.
- No Paid Prioritization: broadband providers may not favor some lawful Internet traffic over other lawful traffic in exchange for consideration of any kind—in other words, no "fast lanes." This rule also bans ISPs from prioritizing content and services of their affiliates.

Those provisions, especially last one, clearly put some limit on how telecommunication companies in USA can arrange their partnerships with content providers.

In September 2013, the European Commission adopted a legislative package for a "Connected Continent: Building a Telecoms Single Market" with goal of equalizing market regulation in all EU states. In October 2015 the European Parliament's plenary voted in favor to end roaming charges by June 2017. From April 2016, operators are able to charge only a small additional amount to domestic prices up to €0.05 per minute of call made, €0.02 per SMS sent, and €0.05 per MB of data (excl. VAT). From June 2017 they will be forced to

charge same price for domestic and roaming traffic for voice, SMS and data. This regulation directly limits roaming agreements between telecom operators in EU and forces them to completely change this element of their business model and existing relationships with their roaming partners in EU.

General Data Protection Regulation passed in April by European Parliament introduces major reforms on current rules dating from 1995. It will come into force in April 2018 and will have wide reaching impact on how telecommunication companies and providers of digital services can use, handle and transfer user data. Since some telecom operators are trading with user data they will have to stop with that practice and that will have big effect on their relationships with companies from other sectors, especially marketing.

Cloud computing

Cloud computing, term that produced much hype over the last few years is now influencing cost structure of companies in some ways that were hard to predict. Now Cloud computing is now embraced in almost all branches of IT industry and beyond. *Mell and Grance (2011)* identified and classified several types of Cloud computing, but in most of its forms it may be looked upon as outsourcing and is mainly considered as such. There is new situation on the market where telecom operators are at the same time both providing cloud services to others and using other cloud services to provide some of it services to customers. Example for this are OTT IPTV cloud services that more and more operators are offering every day and at the same time more and more operators are providing their IPTV services to the customers based on Cloud platform hosted with the another operator.

There are several big players in the market that managed to provide service for even biggest and most demanding telecommunication companies. One such company is Amazon and its AWS service. Many digital service providers such as Netflix, Airbnb, Pinterest are using its services. Out of telecom companies that use AWS service, Comcast and NTT DOCOMO are probably the biggest.

Comcast is one of the largest providers of video, high-speed Internet, and voice services in USA. When demand for the company's new Xfinity X1 delivery platform exceeded the capacity of its on-premises data centers, they expanded capacity by using AWS. Comcast was able to quickly add capacity with Amazon VPC and Direct Connect, expanding their data centers to meet the scale of new demand.

NTT DOCOMO, Inc. is a leading mobile phone operator in Japan. When the popularity of its voice recognition service caused performance and capacity issues, the mobile operator decided to try AWS as a way to decrease strain on its network. Together with staff from Amazon, DOCOMO created a voice recognition architecture on AWS that helped the company scale for better performance during traffic spikes and accommodate its large and growing customer base.

Those examples show how implementing outsourced Cloud service can help telecommunication companies to quickly expand its capacity without big increase in capital expenditure to cover infrastructure cost.

But such approach has to measured. Those providing cloud services are doing it for profit and there is margin in their price. Companies need to plan volume growth of services they provide based on outsourced Cloud services because cost can increase nonlinearly compared to growth in service usage. Example for this can be found with Dropbox, one of largest provider of Cloud storage for users around the world, and one of most famous former Amazon customer. Dropbox had to move out of the AWS Cloud service to lower its operating costs. Process of moving such large amount of data from Amazon to its own data centers was not easy task. Transferring 500 million customers and 500 petabytes of data took almost three years.

All businesses need to take into account growth projections so in the end they do not lose to operating cost all the savings they managed to make on infrastructure investment. This new in-and-out Cloud strategy, if well managed, can significantly improve how fast and efficiently telecommunication companies can expand their offering to new and existing customers both in terms of new services but also in geographical coverage of their networks.

3. FREEMIUM-BASED REVENUE MODEL

As shown in previous chapter, telecommunication companies successfully adapted segments of their business model to changing market conditions and new trends. Revenue model segment of business model can be decisive factor in success of telecommunication company in competitive market. That is the reason why this subject is treated separately in this paper.

Success of freemium model that has proved itself in mobile apps (Liu, C. Z., Au, Y. A., & Choi, H. S. (2012)) and gaming industry is prompting other industries to experiment with similar models for their own services. Digital service providers such as Zynga (mobile games) and Spotify (music service) have built their entire businesses on the freemium business model. Spotify offers free music streaming to some 20 million customers with some 5 million customers opting to subscribe to Spotify's premium service.

Variations of this revenue model is present with telecommunication companies for quite some time. Operators are luring new customers with free trial offers to get them to sign-up for a service in the hope that customers will be satisfied with the service and decide to pay for it.

For years some telecom operators in USA are offering services in a form that is essentially based on freemium model. In 2013, T-Mobile offered buyers of select Windows 8 laptops free 4G broadband service for two years, but with limit of 200 MB traffic per month and with no strings attached. Once the free monthly data cap was met, trial users could subscribe to one of T-Mobile's premium subscription plans. Although average customer might use up the free monthly allowance of 200 MB in just a couple of hours, with this offer T-Mobile provided glimpse of its 4G service to new customers that otherwise would not event try it, let alone decide to pay for it.

Virgin mobile has experimented with freemium model for its mobile services for years. In 2008 it has introduced option for its prepaid customers in USA to add free minutes to their account when they look at the commercials and fill out surveys on their web portal. Recently, in September 2015, they introduced #Freemium package for users of Virgin mobile in Poland. Free option includes a packet of data of 300 MB, 30 minutes of calls for duration of 30 days, and without any obligation, without a contract. When customer spends this allotment, he can still use the services but according to the price list.

Using business model canvas, developed by *Alex Osterwilder in his publication Business Model Generation (2010)* we will try to present how Business model for telecommunication company with freemium-based revenue model looks like and how it compares with standard Business model for telecommunication company.

There are many examples of different freemium-like models in offerings of telecommunication companies but #Freemium offer by Virgin mobile is so far only true Freemium offer on the market. This may signal bigger change in revenue model of telecoms and soon we may see this model implemented for other services. If we assume that it can be implemented for other services Business model canvas in that case would look like one presented in Figure 2. We can see that revenue stream consists of two income sources: income from premium services and income from direct marketing. For some of services typically offered by telecom operators in triple-play bundle, new direct marketing channels should be developed to increase revenue from direct marketing especially for service like IPTV. Virgin mobile successfully implemented revenue stream from direct marketing for its mobile prepaid users but that model uses direct marketing channels not directly tied to the service itself, but one that uses traditional web-based approach, one that is detached from user’s experience when using mobile phone. Therefore, there is room for improvement on that model that would allow direct marketing through basic voice service both mobile and fixed one.

As we can see in Figure 2, other segments of Business model canvas do not differ much from some standard telecommunication company business model. What is noticeable is that customer segments consist only of end-users because freemium-based model is not well suited for business users that require higher level of service that one that be provided in freemium based model.

What cannot be shown through business canvas is possible change in relationship with key partners. All relationships are there as they would be with any standard model for telecommunication company, but that partnership can be based on different principle. It is standard for telecommunication company to sign contracts for content rights or for upstream bandwidth based on fixed price per unit and for a certain volume. But with

freemium model, that partnership could be arranged in a such way to be completely or partially based on revenue-share model. That would add incentive for all companies that are vertically in provisioning of telecommunication services to support new direct marketing channels by including them in their offers to increase overall income.

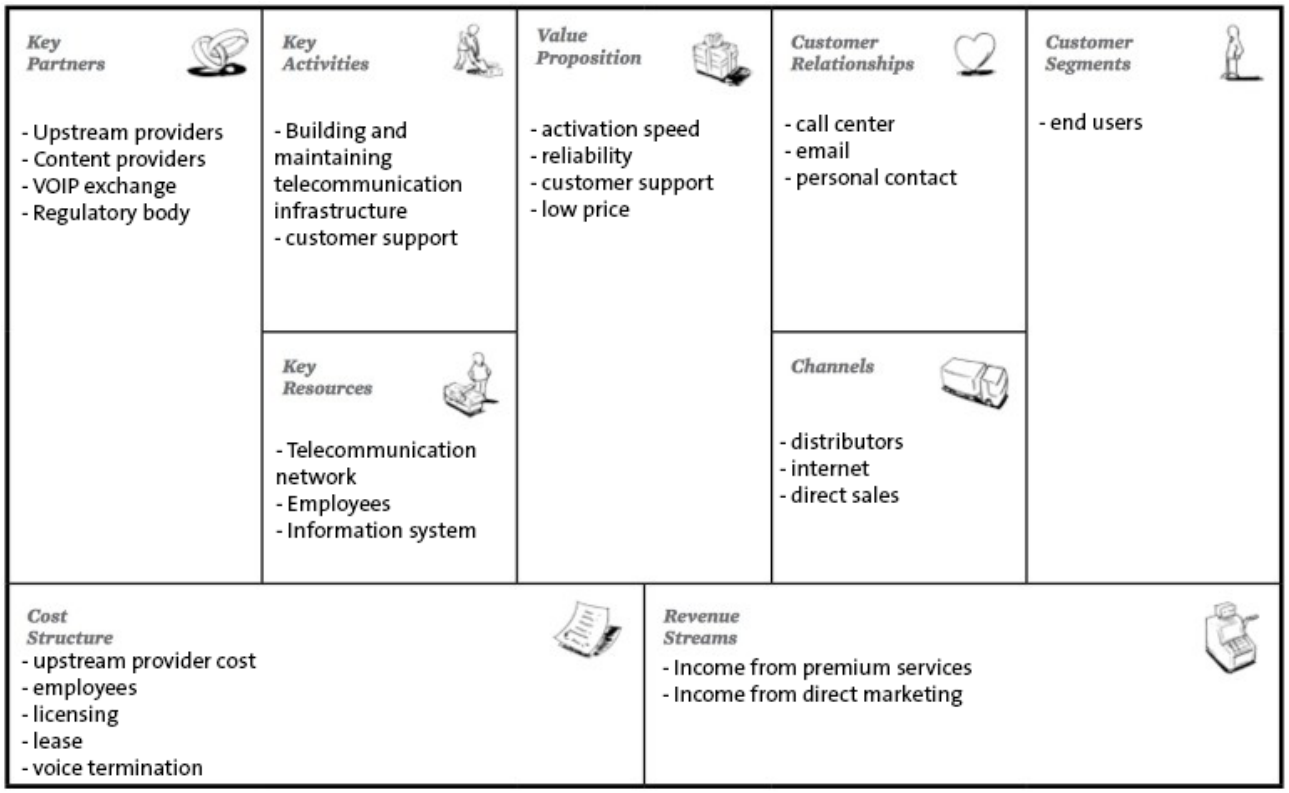

Figure 2: Business canvas model for telecommunication company with revenue model based on freemium-like approach

4. CONCLUSION

We have seen how business models of telecommunication companies are influenced on different levels by different trends. Companies constantly adapt to new surroundings and try to find optimal way to do business and meet customer demand. Every segment of business model is affected by different trends.

To increase competitiveness, telecommunication companies must adapt its revenue streams to include income based on freemium model. Change in other segments of business model is not necessary in that case, but it is recommended to improve its effectiveness. This model was already proven as feasible for mobile operators but there is no reason to think that it could not be implemented for other services offered by telecommunication companies, especially triple-play. Implementation of such a business model would allow companies to compete in saturated market with offer that is different and with very competitive price compared to standard offers.

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RESHAPING THE FUTURE OF BUSINESS PROCESS MANAGEMENT THROUGH SUSTAINABLE CONTENT MANAGEMENT SYSTEM

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Abstract: *Starting from the fact that the use of electronic content is an imperative of our age, and the general opinion that the application of modern information technology can establish a solution for a reliable and simple organization and systematization of documentation, the organization's success depends directly on the achieved level of information management. Bearing in mind that timely, accurate, verifiable, readily available and consistent data are the most important for business activities, the basic problem of the use of these data is not their existence, but the place and manner in which these data are stored and organized within distributed business units. Also, the introduction of information technologies in the conduct of business processes, user data is all over, but the question is the degree of their utilization. The subject of this paper is to improve the management of business processes using electronic content management. And goal of paper is to encourage the leaders of those organizations to think in the direction of improving business performance by investing in information technology.*

Keywords*: ICT, electronic content, content (document) management system, business process, business process management*

1. INTRODUCTION

One of the most important factors for successful business process management is the availability and way of information use. Information and knowledge are essential for successful management at all levels of business organization. And having knowledge means reduces the uncertainty in the activities of business organizations, reduces the cost of material resources and engagement of human resources. Also, in the process of implementation of business processes it is require to exchange some information between business units. Depending on the availability and timeliness, information can affect the acceleration or deceleration of activities realization.

Linking business units through information and communication technology enables access to relevant content in electronic form. Also, linking business units enables mutual coordination, integration, delivery, analysis and presentation of information. All of mentioned contributes that business organization makes decisions timely and quality.

There are no quality decisions without quality information. Information and communication technologies are very developed, so problem is not how to get information but problem is how to identify useful information.

The aim of this paper is to point out the problems in the implementation of business processes related to the use of business documents and information contained in. Also, this paper shows basis for the content management in business process management.

2. LITERATURE REVIEW

The necessity of improving performance and adapting to the modern trends of the digital world requires greater application of document management technology. According Adequate planning and setting requirements and conditions for the introduction of advanced information technologies can significantly contribute towards a more efficient implementation of business processes activities at all levels of business management (Goodwin, 2007).

Due to the development of information and communication technology business organizations need to adapt to the market, in order to be competitive and compatible with the continuous goal to became better and more efficiently (Craig, 2008). In whole market in the modern world of information and communication

technologies, information has a crucial role in their final outcomes. It's the same with business organizations where timely information are critical for business success.

Large business organizations require a good and reliable system for storing and organizing documents, and taking into consideration that business documentation is mainly produced in electronic form, managing with electronic documents by using modern information technologies represents a solution for reliable, quick and easy organization and systematization of data. Use of system for managing electronic documentation aims to solve the problem of managing with structural and non structural types of information, their archiving and re-use (Carmel, 2007). Furthermore, managing with electronic documentation contributes to a high degree of communication and interoperability between business organizations at both the regional and global level.

The success in the implementation of set tasks is in direct conjunction with the management of the information contained in the documentation. If the information is in the documents in paper form, and at the same time, the documents are not in one place but are dispersed over distributed units of business organization, processes and procedures in finding information take a long time, and therefore are too expensive. So, managing electronic documents by using modern technological solutions is the solution for reliable, quick and easy organization and systematization of business documents (EMC, 2012).

First of all, for the purpose of understanding the concept of document management, it is necessary to define the document as a basic entity concept and elements that define it. One of the generally accepted definitions of an electronic document is a form of information that is stored on the computer, but it can be treated as singular information within the database (Milenković, 2015). Unlike databases that are structured and have a precise form and content, the documents are carriers of unstructured data. They are intended for storage and transmission of information that have an arbitrary shape and content, as well as for the communication of organization with the environment.

From the viewpoint of business organizations, a document is a permanent record of a business event or a description of the state of the process at a given time. Examples of such documents are organizational rules and guidelines of the business organization itself, documents from the outer environment that affect business organization and influence its business processes and documents arising from the business processes, intended for business processes within the organization or entities from the external environment.

Electronic documents may contain additional information (Metadata) which is primarily intended for describing the document’s contents and its characteristics (Milenković, 2015). The content of such metadata is arbitrary, depending on the needs of users and the complexity of business processes that are automated through information system, and often they have information about the author, creation date, and modification of documents, of customer and access time, actions that were undertaken on the document, and of business processes, which the document belongs to. Document management is actually an establishment of rules and procedures for handling documents in all phase of their life cycle: development, verification, approval, publishing, distribution, archiving and reuse. Well-defined and well-organized metadata have an incalculable importance for document management in each of the phase in its life cycle.

So, there are numerous problems in dealing with documents in business organizations. Documentation is created in electronic form, but is subsequently printed and exchanged in paper form manually, which considerably slows down the exchange of information contained in the documentation and increases costs. Flow of document procedure from making documents, signing, distribution and implementation of the same is fixed, and there is the possibility of losing them. This contributes to irrational spending of time and human resources in finding the necessary documents, aggravated execution of the tasks and inefficient decision-making in business (Power, 2009, Turban and Aronson, 2001). Finally, the procedure of document archiving and re-access to the same is difficult and requires time and human resources, and the control of access to documents, particularly of confidential documents, is outdated and inefficient.

3. RELATES BETWEEN BUSINESS PROCESS MANAGEMENT AND ELECTRONIC CONTENT MANAGEMENT

The development of information systems and information technology in general allows reducing the documentation generated in paper form, however, the automation of business processes must not ignore the huge amounts of documents from the past, which exists in paper form. It is necessary to digitize documentation in order to allow the existing business documents in paper form to be used in automated business processes. In this way, the future use of paper documents will be reduced to the minimum or will completely disappear (Milenković, 2014).

In organizations whose business functions are branched out and act on multiple distributed locations, effective monitoring and management processes, in accordance with business requirements and standards, is still one of the biggest organizational challenges. Management systems of (electronic) documentation (Electronic Document Management Systems – EDMS), represent the category of specialized information systems for managing documents and their metadata at all stages of their life cycle exclusively in an electronic environment. EDMS provide a systematic solution for entry, organization, management and storage facilities within the business environment. With their use, unstructured information contained in the documentation are managed according to predefined business rules and procedures. With adequate management of documents metadata through EDMS, it is possible to use the same information contained in the documents in a variety of business contexts, which is a common business necessity.

The following results are achieved by establishing the EDMS in a business organization (Milenković, 2015):

- more efficient realization of tasks and successful achieving of business objectives;
- interoperability in communications in the enterprise market is raised to a higher level;
- task planning and reporting on their implementation is better, more economical and more efficient;
- automation of document management of business and workflow shortens the time for their realization, and makes impact on effective business decisions;
- information contained in the documentation are available in almost real time;
- relevant documentation can be accessed from remote (distributed) location;
- increases the efficiency of human resources, reducing personnel costs;
- reduces the spending of time and material resources (space requirements for the archive, fax machines, paper, copiers, maintenance of office operations);
- achieves centralized automatic storage, and management of documents, and prevents the multiplication of documents;
- provides a high level of access control and security of electronic content;
- standardizes document formats; and
- rises the level of the culture of information management within the organization.

The realization of an EDMS in a business organization aims to modernize the business processes through the introduction of electronic office management. Simply put, the realization of an EDMS in a business organization aims to modernize the electronic commerce through the introduction of electronic office management. In the business to business (B2B) and government to government (G2G) e-business models that stands for the exchange of electronic documents between distributed business units with the primary objective to reduce the use of paper documents to a minimum. In the forms of business to customers (B2C), government to business (G2B) and government to customers (G2C) e-business models, the electronic office management stands for the exchange of electronic documents electronically with users outside the organizational structure of business organizations in order to achieve mutual interoperability, standardization of forms and the content of the documents, and the use of paper documents becomes minimized.

According Pelz-Sharpe (Pelz-Sharpe et al, 2010), Content Management Systems (CMS) are often used as a synonym for terms such as Electronic Document Management System (EDMS). In the context of this study, a content management system represents the most sophisticated element management processes electronic data essential to decision-making processes. CMS can be defined as a set of strategies, methods and techniques used for creating, storing, processing and distribution of electronic contents and documents that are part of the life cycle of organizational processes.

The results of the introduction of electronic content management system are to increase the availability and easier to control content, control access to information, more efficient implementation of business processes, saving material and human resources, reduce operating costs, and certainly support the decision.

Managing with the original copies of the documents is very important, but it is essential to ensure the security of electronic copies (backup /recovery system) and electronic archive of documents, including transaction log file. This document management functionality is extremely important in all forms of electronic business because documentation on activities implemented in business processes often must be available for dozens of years after their creation.

In accordance with their needs, every business organization should define the functional requirements that will be implemented within the electronic content (document) management system. There are other ways to define requirements for information system. In situations where the user does not have the necessary knowledge about the possibilities of information technology, the user engages associate to perform an analysis of the processes that should be automated.

In order to make any decision in relation to improving the content management use it is necessary to analyze the real situation of document management in the organization (Klein & Methlie, 2009). It means that it is required to analyze the types of documentation, or the content which the organization has within its business processes, and then estimate where and how this content is stored and whether and how are controlled.

4. USAGE ICT FOR THE CONTENT MANAGEMENT IN BUSINESS PROCESS MANAGEMENT

The main reason for the establishment of ICT is enabling storage and sharing of data contained in electronic form. Forming the virtual organizations that make asynchronous, distributed and collaborative work teams, which cooperate in the development of projects (collaboration), in different places (distribution) and at different times (asynchrony). As the Katuu points out (Katuu, 2013), ICT contributed to the work of many organizations become more efficient and more successful.

The introduction of ICT leads to changes in the processes of governance and decision-making. ICT enables managers to easily and efficiently perform their functions. Changes in management reduce costs horizontal communication, enabling teamwork and flexibility. Monitoring changes in the environment is critical, which means observing the real environment, competition and financial condition of which depend on business processes and technology trends (Klein & Methlie, 2009).

The importance of ICT for the business system is the common use of decision support software, unified information access, enabling electronic communication and data exchange, data management, increase productivity and reduce costs in business systems.

The development of ICT has enabled faster and better communication, improve business processes, secure storage of information, and easy search of information from any location in the world, 24 hours a day. Thanks to ICT, quality computer connectivity organizational units is achieved through the capacity, speed and efficiency of data collection, processing, transmission and data protection. Computer networking of organizational units contributes fallowing (Milenković, 2013):

- the use of common data and a unique understanding and knowledge of the real situation;
- increasing efficiency and cutting the time required for decision-making; and
- increasing the overall efficiency of the organization as a whole.

Some of the essential elements of ICT on which the realization of a CMS depends are (Cameron, 2011):

- storage (a repository) in which content is stored;
- use of electronic services which guarantees the authenticity of the content and authenticity of the authors of electronic files (documents) (such as electronic signature and time stamp); and
- hardware-telecommunication infrastructure that provides reliable and cost-effective use of all computer resources.

As the requirements for future EDMS are defined above, it is equally important to define the requirements for establishing an appropriate data warehouse that will serve as the repository of content and related data (metadata, data on realized transactions, users, on recorded events, and other data that are the result of the business process).

The repository of CMS is a central warehouse of electronic documents of a business organization and all part of the data that relate to documents and their management. Depending on the structure of businesses and the number and degree of distribution of its business units, the appropriate models of architecture of the repository of content are projected (Matthew, 2003). The designed architecture of the repository should be harmonized with the software solution for EDMS (Milenkovic, 2015).

The application of electronic signature opens up new electronic horizons for an even better and more reliable performance of business processes based on electronic documents (Milenkovic, 2015). Electronic signature is a technology whose application in the exchange of electronically signed documents allows inspection of the authenticity of the signer (authentication), protecting the integrity of the electronic message or document that has been signed (integrity), and non-repudiation of the electronic signature of the person who signed the document or message (non-repudiation). Authentication involves checking and confirming the identity of participants in the exchange of electronically signed documents. This element of protection prevents the possibility of impersonation by malicious users. The application of electronic signature to an electronic document does not provide secrecy (confidentiality) of its contents.

The system of electronic document management should be integrated with an electronic service for issuing and managing time stamps (time stamp authority). Time stamp authority is used to create legitimate

evidence that the business transactions are carried out at a certain time that the electronic document existed at that time and has not been edited at a later date. When using the services of the issuer of the time stamps, the prior establishment of trust with the issuer of digital certificates for electronic signature is necessary. Time stamp in combination with electronic signature and corresponding user applications represent a necessary and a sufficient condition to move from paper to electronic business in accordance with the applicable legal frameworks. The most important use of the time-stamping is in the field of archiving electronic documents, as it guarantees the authenticity of electronic documents regardless of the status of the digital certificate of the signer.

The concept of cloud computing is the business model and technology platform that was created as a result of the evolution and convergence of many seemingly independent computing trends that have been created over the last decade, including computing as a service (utility computing) services on demand (on-demand services), network computing (grid computing) and software as a service (Software-as-a-service) (Vujin, 2011). Cloud computing is an infrastructure that can provide great opportunities for the establishment and use of the system for managing electronic documents for the possible use of computing resources as a service. One of the most important features of cloud computing is scalability, and a key technology that enables that is virtualization.

5. CONCLUSION

Management staff has less and less time to makes decisions about the activities of their business processes, because it is burdened with a large amount of data that needs to be processed and distributed. Preference is given to the business organization that decisions about their activities made on basis of timely, reliable, accurate, verifiable, consistent and easily accessible data. The success of modern business organizations largely shapes the way the information are being used. Information is an important factor in business process management. In the realization of business processes, there is a need to share information among business units. It manifests itself as knowledge and the need for effective management at all business levels, which reduces uncertainty in the business activities; it allow to saves material resources and rational use of personnel capacity.

The establishment of two complex systems within a business organization: the management of business content (CMS) and business process management (BPM), effectively solve the problems in the performance of business procedures. As expected, the two systems must be correlated with one another and only the synergy of CMS and BPM can contribute to a successful business organization. In this way, the organization's business becomes more transparent and more efficient.

Supported by modern information technologies, content management is prerequisite for efficient management processes in business organization and contributes to the creation of competitive advantage and increase in profits.

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STAKEHOLDER RELATIONSHIP MANAGEMENT IN E-BUSINESS OF LARGE ENTERPRISES

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Abstract: *The problem researched in this paper is stakeholder relationship management in e-business of large enterprises. The goal is to improve relations with stakeholders by means of modern e-business technologies. The research context is a footwear company whose supply chain is very complex. It needs to monitor the flow of materials from suppliers from different parts of the world, as well as the current production that takes place in multiple locations and countries. The company also coordinates the flow of finished products and organizes delivery for customers located throughout the world. Timely and accurate information and good collaboration among all stakeholders is essential to a successful supply chain. Large distributed companies need well-managed relationships with all stakeholders in order to establish long-term and effective competitiveness of the company's e-business.*

Keywords*: stakeholder relationship management, e-business, large enterprises, e-supply chain*

1. INTRODUCTION

Industrial production of footwear is permanently confronted with problems related to competition in the market. Market requires constant changes: footwear models need to be changed from season to season, new marketing activities need to be realized, and efficiency of the company has to be improved. Therefore typical sets of the goals need to be met:

- Reduce the time of delivery
- Improve the quality of footwear
- Reduce costs
- Accelerate and better direct the flow of movement of raw materials
- Increase the flexibility and time to meet the consumer
- Increase profits

In order for a company to achieve its strategic objectives, it is necessary to review and analyze different interests that stakeholders have, which includes:

- Identification of key internal and external stakeholders
- Analysis of the interests and expectations of the key stakeholders
- Creating management strategies with key stakeholders
- Identifying problems and solving them
- Feedback and control of problem solving.

All this is even more complex when it comes to large enterprises, whose business is spread worldwide. The goal of this paper is to analyze the problem of stakeholder relationship management in e-business of large companies. The specific goal is to present a model for the improvement of these relations which is based on the use of modern e-business technologies. The model is created on an example of a large distributed footwear company.

2. E-BUSINESS OF LARGE ENTERPRISES

Nowadays, it is unthinkable for large enterprises to operate without e-business. Thanks to e-business technologies it is possible to send large amounts of information in a very short period of time. Using different e-business services, large enterprises can significantly reduce costs, increase efficiency and competitiveness in the market, expand business opportunities, speed up work processes, enhance internal and external communication, etc.

Considering the complexity of supply chains of large enterprises, numerous stakeholders can be identified, and e-business technologies can offer tremendous help by providing fast communication and infrastructure

for quick problem solving (Schenkeln et al., 2015). Reduced creativity and reduced entrepreneurial ability frequently occur due to problems of mismanagement in large enterprises. However, it is of high importance to efficiently find creative solutions that can satisfy all the participants in the e-business processes. These solutions often involve compromise, and joint efforts to achieve the goal (Risso, 2010). The structure of relations among stakeholders is crucial to the success of large companies, and this means that each characteristic of a relation need to be considered, including (Bureau veritas, 2016), (Franzoni, 2005) (Il Manuale dello Stakeholder Engagement , 2005):

- Flexibility
- Information exchange
- Synchronization between partners
- Control of the activities
- Equal efforts to achieve the target
- Economic structure relationships.

The exchange of information is very important both within the company and with external partners in order to improve e-business processes and increase the profit of all participants. It is very important that the information is accurate and timely (Aydin et al. 2014).

Efficiency of e-business in the footwear industry improves the production process, technological processes, product development and introduction of new materials. Also, it improves hiring process, the opening of new production facilities and expanding business in general (Mazzola et al., 2015). When a manager uses the obtained information well, they can react promptly and create significant cost savings, and improve the business as a whole. Timely information can affect the sales, reduce marketing costs, influence retention and customer loyalty and attract new customers (Reijonen et al., 2015).

Falc company is a company in Italy engaged in the production of footwear. Falc exists for more than forty years, and each year it became more advanced and expanded. Today the company does all the work related to footwear, from design of footwear models, the development of new products, making knives, soles and insoles, sewing and assembly of finished product. Falc company operates in Ruma and Knjaževac in Serbia under the name Falc East, as well as in Italy and China, and has suppliers from Serbia, Italy, Romania and China. Distribution chain is spread across over fifty countries worldwide. So, it is very difficult to identify and coordinate all the stakeholders, examine their objectives, as they may be different and subject to different legal standards. In large companies it is difficult and complicated to coordinate the supply chain, but it is necessary to make the company perform well.

In Falc East, all business processes are conducted via the Internet. Two main software solutions are used. One is hosted in Italy and to the AS400, which is a complex solution that contains all orders for all manufacturing facilities; complete accounting of the headquarters in Italy, but it does not contain details of the production. The second software solution is adapted to the production and contains all the details of all wholesale customers, the production and materials (Milinovic et al., 2014). Wholesalers through authorized agents make an order, which is through the Internet forwarded to Planning department in Italy. All orders are fed into the AS400 database in Italy, which is then synchronized with the software of the local Serbian Planning department. Then, Purchase department orders the necessary materials from suppliers, it orders the knives, insoles and soles for the products. Then, Planning department creates a plan and program for production using data on expected arrivals of ordered goods. Commercial department provides information to customers on the date of delivery. Software in Serbia is adapted to the production process that takes place in Serbia and is used for data analysis, analysis of stocks, monitoring the production process and other local processes. Also this software can be accessed by management from Italy, so that the production process can be monitored. However, this causes a problem in communication between the various departments. The problem is that departments are not connected adequately, departments in Italy are not fully aware of local problems in Serbia, they are note familiar with timeline of work. For example, if a supplier has a problem with a type of ordered material, this information is not distributed through the supply chain. This could cause deadlocks in production of a certain model, causing delays in production of other models which could have been produced if the information about the first delay had been available on time. Therefore, communication through the chain needs to be enhanced, and adequate means for instant spread of important data need to be researched and implemented.

The analysis of the business process of Falc East helps in identifying the company's stakeholders:

- Suppliers
- Sales Agents
- Customers
- Association for Consumer Protection
- Municipal administration

- Workers
- Dealers in retail stores
- Human Resources Manager
- Technical Directors
- The directors of factories
- Heads of department
- Managing Director
- Technical feature for quality control
- Owners
- Top Management in Italy
- Banks
- Competition

3. MODEL OF STAKEHOLDER RELATIONSHIP MANAGEMENT IN E-BUSINESS OF A LARGE FOOTWEAR COMPANY

Figure 1 shows a model stake holder relationship management for company Falc East. The figure shows stakeholders, as well as services that the company Falc East can use to improve relationships with stakeholders. This model provides a number of e-business services and infrastructure that the company can use to enhance relationships, make successful future projects, improve collaboration and successfully implement strategic plans into action. It also presents services of the company Falc East such as production, marketing, service complaints, sales services and other services that promote, enhance and modernize operations of the company and its stakeholders.

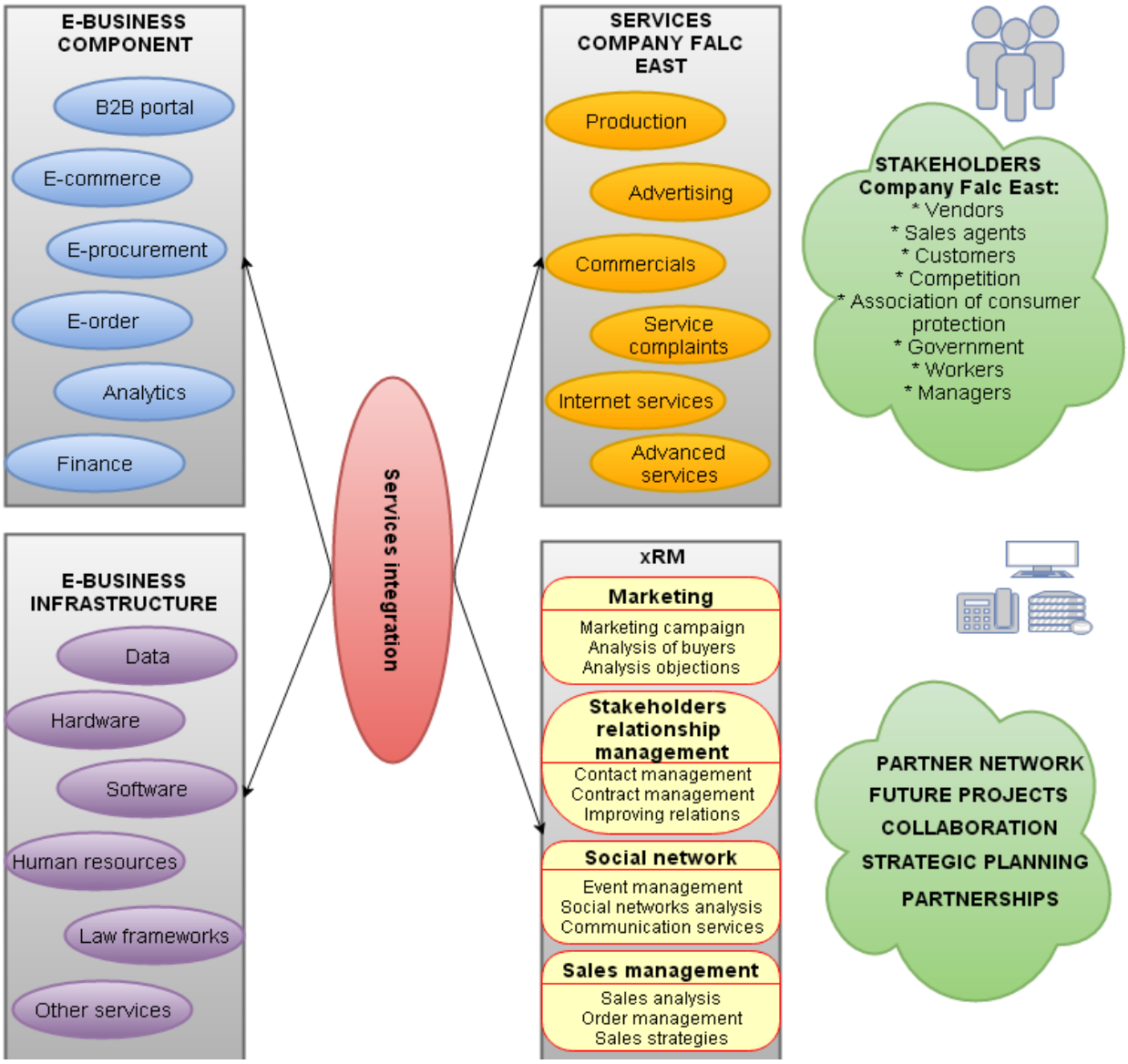

Figure 1. Relationships of Falc East with business partners

3.1 Relationship management with internal stakeholders

Internal stakeholders include management, workers and executives. Figure 2 shows the internal stakeholders in the company Falc East.

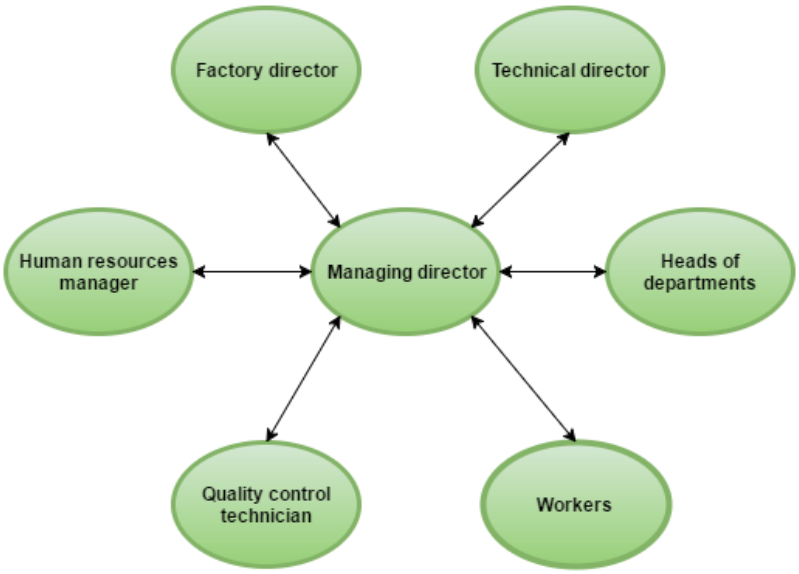

Figure 2. Internal stakeholders in the company Falc East

The analysis of the current situation in the company has showed that the one-way system of communication between the owner, management, managers and workers was used. Internal communication is completely neglected. It is essential that the management creates the environment where employees can express their views, concerns and ideas to improve the company's operations. Solving internal communication problems increases the efficiency of the company, and this is naturally reflected in the final products and therefore to the satisfaction of end users. The introduction of the internal social network would improve the communication between workers and management. It would also improve communication between management in Serbia and management in Italy. Workers would have an opportunity to report a problem or give an idea to make the job easier or more effective, while management would be able to answer and adopt every idea. Using the internet social network all interested parties can share news, comments, and problems and help the development of the company. It is also adequate tool for online team building, because it provides an environment for less formal communication, and therefore a sense of belonging to the company. It could also improve relationships between employees, develop team spirit, improve communication between employees, increase motivation, help in understanding the importance and the impact of each employee, and thus increase the efficiency and productivity.

Mobile services can also improve the internal communication. Company can accelerate the resolution of all small problems in the production, so it is now possible to send messages or images of problems in real time, and it is also possible to get a response. Since the modelers are based in Italy mobile services significantly accelerate troubleshooting in production and thus delays in the production can be avoided. Also, all employees now have constant access to web pages, internet social networks, and other intranet services.

3.2 Relationship management with external stakeholders

External stakeholders are:

- Suppliers
- Sales Agents
- Potential buyers
- Owners
- Top management
- Competition
- Association of Consumer Protection
- Banks
- Municipal administration

Figure 2 shows the external stakeholders in the company.

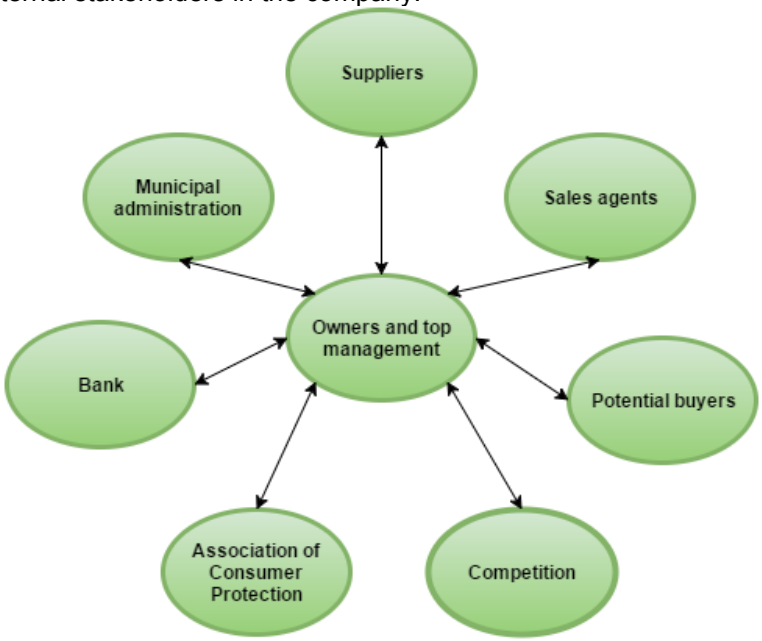

Figure 2. The external stakeholders in the company Falc East

Managing relationships with external stakeholders has multiple purposes, such as:

- The development of future projects such as the opening of new facilities or expansion of existing plant
- Planning to expand markets in Serbia or the opening of new sales outlets
- Strategic planning

Managing relationships with external stakeholders aims to:

- Improving relationships with stakeholders
- Making decisions based on the actual communication with stakeholders
- Prevention of possible future conflicts
- Better business results
- Easier implementation of plans
- Consumer satisfaction
- Reducing the risk
- Increasing Profits
- Increase of sales
- Increase product quality
- Improving the resolution of complaints.

In order to improve operations and reduce costs Falc East company introduced an online business at all levels of operations and with all associates. The first step is to adapt the software to the vendors, create possibilities of electronic invoicing instead of entering all data manually. The quantity of paper documentation should be reduced; the same format of documentation should be applied, leading to higher interoperability of business processes (Chituc et al. 2008). For this purpose ebXML can be used, as well as other specification. Also, higher usage of e-mail or IP telephony should reduce significantly the phone bills, since the orders are made in Serbia and the majority of suppliers are located in Italy and China. Instant messaging can be used for submitting and resolving complaints from suppliers, without misunderstandings and conflicts.

Sales agents should gain access to the central software themselves, so they can make orders remotely, canceled them online if necessary, which would reduce the costs and possibility of errors. Software should analyze all the data in real time, so all employees can update their information on time.

By creating a web site potential customers could buy products online at no additional costs. E-commerce is already a well known concept and Falc is not using the potentials of e-commerce at all. Online sales would improve the sales worldwide, but the distribution network should be carefully organized.

By connecting with consumers through social networks, Falc's management could respond and adopt suggestions and change something in business or in products. Crowdsourcing can be used for gathering design ideas, and online tools could be provided to users so that they could design their own personalized shoes.

Instead of the current flow of information that comes from various parts of the world to the headquarters in Italy, and from Italy to factories in Serbia and other countries, and then returns to Italy so it can be forwarded a particular country, a communication channel which would directly connect the participant in the supply chain should be provided. Direct communication through email, instant messaging and other tools would enable to immediately receive information and get a response. Through social media, management in Serbia would be able to see real time data on all the changes, guidelines for the development of models and the deficiencies that are found on models. Considering that it is necessary to do pre-production pilot test of each model, a pair is sent to Italy. Waiting for the answer takes too much time; this should be improved or changed, since this part of the work can be done very quickly. Pilot trials could be done in Serbia, with online participation of supervisors from Italy or other countries. Supervisor can immediately tell remarks, deficiencies can be corrected quickly and production of that model could start in short time. Also, in the case of certain problems in production of certain models, pictures or video of problems and solutions could be exchanged by e-mail, Viber, web portal or other online tool.

Mobile business can significantly improve operations of large companies. Numerous companies have already recognized the potentials of mobile business and adopted it fully. Falc has a lot to gain through the implementation of mobile technologies. All communication channels could be integrated and delivered via mobile devices, leading to increased efficiency, and increased profit of the company.

4. CONCLUSION

In order to operate successfully, a company needs to manage the relations with all the stakeholders. Understanding the organization, employees, the needs and expectations of all stakeholders, as well as successful and effective communication are essential for the company if it wants to achieve its objectives (Derrouiche et al. 2010). It is necessary to respond to the requirements and needs of the dynamic business environment as well as monitor and control the results of the stakeholder relationship management, to take appropriate actions, remove dissatisfaction and uncertainties. When a company succeeds to manage stakeholders effectively, and manages to develop good relations with all stakeholders, and thus acquires a good reputation, it will influence to creating a good attitude towards the company and greater support. This will further lead to an advantage over the competition. E-business technologies can significantly help in achieving this goal. They need to be implemented to greater extent, and Falc needs to recognize a need for this aspect of innovation if it wants to stay competitive in the future.

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IMPLEMENTATION OF QUALIFIED ELECTRONIC SIGNATURE IN THE PROCESS OF CREATING TECHNICAL DOCUMENTATION

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Abstract: *Signing of technical documentation in paper with personal signature in ink and certifying with personal license seal has been changed and improved with digital signing of electronic document with qualified electronic signature. Purpose of the paper is to present the process of issuing qualified electronic certificate and illustrate a model for practical implementation of qualified electronic signature in the process of creating technical documentation within the process of application for electronic building permits.*

Keywords*: electronic signature, digital certificate, electronic document, electronic building permit, technical documentation*

1. INTRODUCTION

Digital world has influenced ordinary life of each and every individual as well as of legal entity. Internet revolution and new technologies has modified the way business processes are being conducted. Legal entities now have possibility to work on more efficient and transparent level. All those factors have provided a support to the government to determine internal communication as well as interaction with citizens and organizations on one new level. E-government is defined as providing public administration services to the citizens and organizations electronically (Radenković, Despotović-Zrakić, Bogdanović, Barać, & Labus, 2015). Strategy for Development of Information Society in Republic of Serbia until 2020 predicts that on or before 2020 all citizens will be able to electronically contact with government bodies, holders of public authority, courts and health protection system (Stategija razvoja informacionog društva u Republici Srbiji do 2020. godine, 2010).

As per the data published by Statistical Office of the Republic of Serbia for the year 2015 in the Republic of Serbia over 2,950,000 individuals use Internet every, or almost every day (Republički zavod za statistiku Srbije, 2015). When it comes to the electronic services of public authority (e-government) the research has shown that over 1,500,000 individuals and 94.5% of legal entities use aforementioned services.

From the 1st January 2016 one new service has been started – e Permits - Portal for electronic applications for construction permits. This portal, that is available within the Serbian Business Register Agency system (Agencija za privredne registre, 2016), has been developed within the process of implementation of the unified procedure. Unified procedure is a set of procedures and activities that are being executed by competent authority in relation with construction, upgrade or reconstruction of the object, i.e. execution off work (Zakon o planiranju i izgradnji, 2015). The aim of the procedure and implemented service is to establish the mechanism that provides functional allocation of duties within the administrative processes between citizens and government (Vasiljević & Čukić, 2016).

Precondition for using the above mentioned service is that user have issued, valid qualified electronic signature.

2. BASIC TERMS AND LEGAL BACKGROUND

The Law on Planning and Construction of Republic of Serbia defines that exchange of documents and submissions in unified procedure is conducted in electronic form and all related acts, including technical documentation is provided in the form of an electronic document in PDF format, signed with a qualified electronic signature (exceptionally, the technical documentation is provided also in dwg or dwf format, without the obligation of the digital signing) (Zakon o planiranju i izgradnji, 2015). In cases where the verification of the technical documentation or parts of the technical documentation is required by the project organization as well as by responsible and chief designer, with signature and seal of the project organization, or personal licenses seal, electronic document, in addition to being signed by a qualified electronic signature of the responsible person of project organization, or responsible or chief designer, contains digitized seal of design organization, i.e. personal licenses seal.

2.1. Qualified Electronic Signature

Electronic document, as per the Law on electronic document, has been defined as a set of data, consists of letters, numbers, symbols, graphical, audio or video records contained in application, written conclusion, document or any other act that is created by legal entity or individual or government authority in legal transaction or in administrative, judicial or other proceedings by the authorities, if made electronically, digitized, sent, received, stored or archived on electronic, magnetic, optical or other media (Zakon o elektronskom dokumentu, 2009).

The same Law (Zakon o elektronskom dokumentu, 2009) gives the meaning of the term digitalization - converting document from other forms into the digital form.

Electronic signature is a set of data in electronic form that are joined or logically connected with electronic document and that are used for signatory identification (Zakon o elektronskom potpisu, 2004).

The qualified electronic signature is an electronic signature that reliably guarantees the identity of the signatory, the integrity of electronic documents, and prevents subsequent denial of responsibility for their content. (Zakon o elektronskom potpisu, 2004). In order to be qualified, electronic signature must meet the following requirements:

- It is solely linked to the signatory
- Unequivocally identifying the signatory
- It is created using means that the signatory can independently manage and which are exclusively under the control of the signatory
- It is directly linked to the data to which it relates in a manner that unambiguously provides an insight into any changes of source data
- It is formed by the means for creating qualified electronic signatures
- It has been checked on the basis of qualified electronic certificate signer

Digital certificate is an electronic document which represents Identification Card in digital world i.e. Digital Identification Card (Digitalni sertifikati, 2016). The Government has regulated the issuing of qualified digital certificates through Certification Authorities (CA). Each qualified digital certificate contains user's and issuer's data, thus it is a document that confirms relation between data for verification of the digital signature and the identity of the signatory that has been published by CA.

Digitized seal is formed by transferring the stamp on paper into electronic form, or by scanning a paper on which is the stamp.

2.2. Technical documentation

Technical documentation is a set of projects that are developed in order to determine concept of object, elaboration of conditions, method of object construction and for the purpose of maintaining object (Zakon o planiranju i izgradnji, 2015).

There are several types of technical documentation (Vasiljević & Čukić, 2016):

- Main Design
- Preliminary Solution
- Preliminary Design
- Construction Permit Project
- Project for Executing Construction Works
- Built Design

Regardless the type of technical documentation, it includes:

- Main Notebook and
- Projects

Projects in addition may include elaborations and studies.

2.3. Legal framework in Europe with example of best practice

Digital signature technology is most often used in order to determine the document origin. In general, digital signature is a legal act that can confirm signatory identity and that the signatory has recognized the content of the file (Huang & Zhang, 2013). Most of the countries have defined standards and regulations within this area in order to assure authenticity, integrity and non-repudiation when said signatures are applied (Breier & Pomothy, 2015)**.**

In 1999 European Union has passed Directive on electronic signatures (Directive 1999/93/EC, 1999), that represents legal base for implementation of electronic signatures for the member countries as well as for other countries that have adopted their legal framework in accordance with mentioned directive.

In 2014 European Parliament and Council have passed Directive (EU) No 910/2014 on electronic identification and trust services for electronic transactions for the inner market (eIDAS Directive) that repeals previously mentioned Directive 1999/93/EC and provides a comprehensive legal framework for electronic identification and authentication of services (Regulation (EU) No 910/2014 EC, 2014). Directive aim is to develop system of mutual recognition of national identification systems of member countries and to provide improvement of efficiency and trust within the European inner market for public and private cross-border electronic services and e-commerce.

eIDAS Directive provides mutual recognition of electronic trust services (electronic signature, electronic seal, time stamp, electronic registered delivery, website authentication) and electronic documents (Berdić, 2015).

eIDAS Implementation chronology is presented in table below.

Table 1: eIDAS implementation chronology (adopted from **(Berdić, 2015)**)

Date	eIDAS regulations
September 17, 2014	Directive has entered into force
September 18, 2015	Period of voluntary recognition of eIDAS regulation
July 1, 2016	Implementation of rules for trust services
July 1, 2017	Qualification authority shall submit a conformity assessment report to the supervisory body in order to stay as QA
September 18, 2018	Mandatory recognition of eIDAS

As per the data of Doing Business Report 2015 Republic of Macedonia is ranked on the first position in Europe and Central Asia for the system for issuing building permits (Doing Business, 2015). Application of electronic signatures in construction area has been started from 2013 and as per the statements of Chamber of certified architects and certified engineers of Republic of Macedonia, all active engineers in Republic of Macedonia have qualified electronic signature and for the period of two years it has been submitted 8.700 applications through the subject system.

3. ISSUING OF QUALIFIED ELECTRONIC SIGNATURE

Within the Register of certification authorities there are six Certification Authorities (CA) that are accredited for issuing digital certificates (Vulić & Prodanović, 2014):

- CA Post
- CA Ministry of Interior Affairs of Republic of Serbia (CA MUP RS)
- CA Ministry of Defense and Military of Republic of Serbia
- CA Chamber of Commerce of Serbia
- CA Halcom (HALCOM BG CA)
- CA E-Smart System (ESS CA)

Certification Authorities issue qualified electronic certificates to individuals and legal entities and for the needs of organization in which the certification authorities are formed. Except CA MUP RS, all certification authorities are commercial and issue resource certificates and certificates that are oriented on area of their business

Certification Authority of Ministry of Interior Affairs issues qualified digital certificates on ID card with chip, without any cost. Procedure of issuing qualified digital certificate is not significantly different among other certification authorities in terms of submission of request, selecting the media, expiration date of certificate and the amount of cost.

Implementation of qualified digital signature in the construction has been started from 2016, upon the entry on the force of the Law on planning and Construction of Republic of Serbia. Electronic unified procedure includes centralized information system (System for application of electronic submissions) with an aim to improve efficiency and transparency of the process of issuing electronic building permits. For the first three months of 2016 in Republic of Serbia have been issued 725 electronic building permits, as it was stated by the the-then Minister.

According to the Review of 10 most common mistakes of applicants of the requests in unified procedure that has been published on 19th April 2016 on the web site http://gradjevinskedozvole.rs/ on the first place is that submitted documents are not certified with qualified electronic signature. Second most common mistake is that technical documentation is not submitted in dwg or dwf format. Later on, the sixth ranked mistake is the absence of digitized seal of project organization, responsible and chief designer and the seal of the investor on the attachment of the decision of appointment chief designer. With rank eight is that attached digitally signed documents in PDF are missing personal signature in ink of responsible and chief designer.

Having in mind all above mentioned issues of implementation of qualified electronic signature within the process of creating the project and technical documentation, there is an obvious need for more detailed presentation and explanation of procedure of model for digital signing of technical documentation.

4. MODEL OF DIGITAL SIGNATURE APPEARANCE

Traditional model of signing the technical documentation was the process that have included several steps:
- Creating the technical documentation
- Printing the technical documentation
- Signing and applying the seal on multiple pages within the technical documentation by several persons
- Scanning the technical documentation
- Delivering technical documentation in person or sending the by mail/courier, or sending by electronic communication means

Now, with the possibility of implementation of the qualified electronic signature, the aforementioned process has been improved - shortened and accelerated, and include only three steps:
- Creating the technical documentation
- Applying the qualified electronic signature into the technical documentation
- Sending the technical documentation by electronic communication means

The following model provides to engineers who poses license that within presentation of data of qualified electronic signature integrate digitized personal license seal and signature.

Model of data presentation of qualified electronic signature assumes that following conditions are fulfilled:
- Signatory has valid qualified electronic certificate
- Signatory has at least one engineering license
- On the signatory's computer all necessary software and hardware for qualified electronic signing is installed and set up
- Technical documentation is prepared in PDF, i.e. PDF/A form.

Model has been developed in the last version of Adobe Reader DC software that can be downloaded for free from the official website. Adobe Reader DC allows digitally signing of PDF (PDF/A)

After the program installation it is necessary to set up few parameters within the program in order to certify PDF document with qualified electronic signature.

One of the steps referees to setting up the signatory appearance, which is the subject of the said model.

Model is based on the following steps:
- Scanning personal license seal and signature and saving in PDF form
- Within the setting up program parameters, selecting the item Edit, and in the dropdown menu selecting Preferences option.
- In the Preferences form, select category Signatures.
- Field Creation and Appearance provides setting up appearance of the data of qualified electronic signature
- Selecting the option Create New Appearance

Considering the possibility of creating several different appearances of data of digital signature, it is necessary to define unique name to the subject appearance, in order to provide easier access in the moment of signing.

Within the graphical configuration field, it is necessary to select the option Imported Graphic, and to upload previously created PDF which contains scanned personal signature in ink and personal license seal.

After this step, unchecking all offered attributes that refers to text configuration.

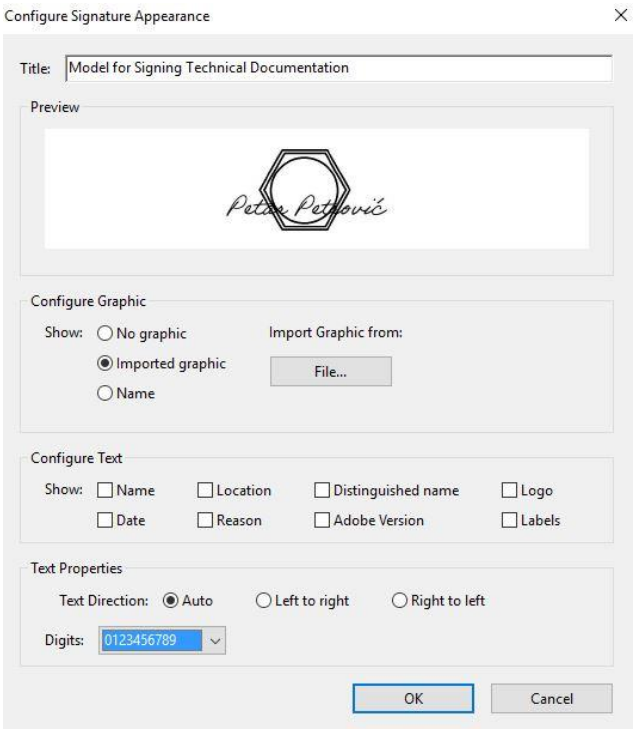

Figure 1: Creating Appearance for Digital Signature

The following paragraph briefly describes procedure that includes standard steps of the process of digitally signing of PDF documents with qualified electronic certificate, and it is also applicable to the technical documentation.

- Previously prepared technical documentation saves in PDF form
- Connect Smart Card Reader with PC and insert the smart card, i.e. connect USB token to PC
- In Adobe Raeder DC program, in the Tools section, select option Add Signature
- Select the area on the PDF where the signature data will appear
- Select previously described and defined appearance - Model for Signing Technical Documentation and confirm the selection
- Enter the Private Identification Number code (PIN code)
- Save digitally signed technical document.

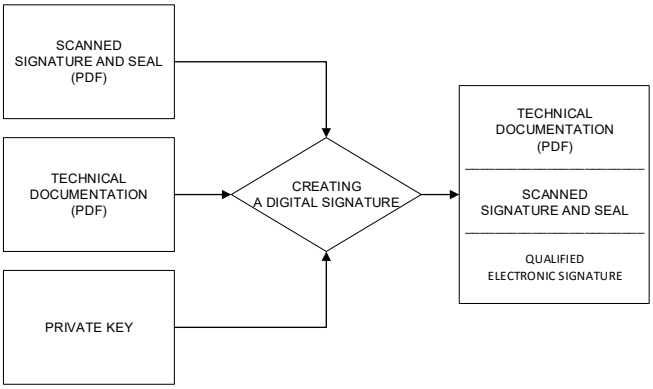

Figure 2: Model for implementation of digital signature in technical documentation

This kind of approach provides to the signatory to secure also the appearance of his personal data on the digitally signed document. PDF document, i.e. technical documentation, now contains all necessary elements as it is stipulated and regulated with respective Laws and Regulations. It is understood that the signatory has the unique access to his digital signature and personal license seal, and by integration of traditional and modern process of signing, the model acquires its practical implementation.

5. CONSLUSION

Advantages of the model are as follows:

- Model integrates traditional way of signing the technical documentation with a modernized way of electronic signing
- The model is flexible and adaptive to other systems
- The model is in accordance with the Laws
- The implementation of the model is simple
- Model offers the possibility of having an identical document in paper form and document in electronic form

From another point of view, the model has certain disadvantages:

- A qualified electronic signature increases the file size by 0.7 MB in average
- It is necessary to pre-define space for displaying data of qualified electronic signatures, in order to maintain the proportion of display stamp and handwritten signature

Having in mind the fact that the technical documentation consists of several parts and that every single part is being signed by several engineers, the question in the matter is the size of the final PDF document generated after adding all qualified electronic signatures.

From the one point of view, the Regulation stipulates that the technical documentation has to be signed and certified with personal signature in ink and sealed with personal license seal on all the places where predicts the Regulation, and the document also have to be digitally signed only once. This method means that the technical documentation should be previously prepared and printed, after which it is being signed with personal signature in ink and certified with seal for all involved engineers and responsible persons, then it is scanned, so finally, in the end it is being signed with qualified electronic signature.

From the other point of view, one of the objectives of the implementation e Permits service is the improvement of the efficiency of the process of issuing building permits and cost reduction.

The presented model has already, to some extent, found its practical application, which can be determined by examining the records of the Central Registry of the unified procedure.

In the future, it is expected the harmonization of the national Laws of Serbia with the European Directive in terms of digitalization of the seal and integration of the centralized information system for electronic building permits with the unique database of engineers.

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MANAGEMENT INFORMATION SYSTEMS: E-LEARNING AT THE UNIVERSITY OF NOVI SAD

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Abstract: *With the advances of information-communication technologies and its intensify usage, it is critical to assess and improve the efficiency and accuracy of management information systems. E-Learning platforms are utilized by many universities to improve information exchange, communication, student collaboration, as well as to better support learning management. Owing to limited IT budget and the need to justify the investment in e-learning platform, assessing the benefits of these is an important filed in research and practice. Accordingly, this study proposes an integrated model for evaluating the effectiveness of e-learning platform from a student point of view. This model is based on updated DeLone and McLean IS success theory. Structural Equation Modeling (SEM) methodology is applied on responses from students' who used Moodle e-learning platform at the University of Novi Sad, Serbia. System quality positively influence user satisfaction. Academic institutions can use the results of this research to assess the success of their e-learning platform implementations from their students' perspective.*

Keywords*: E-learning, IS success, DeLone and McLean, SEM, Moodle*

1. INTRODUCTION

With the advances of information-communication technologies and its intensify usage, it is critical for Universities to assess and improve the efficiency and accuracy of e-learning information systems. E-Learning platforms are utilized by many universities to improve information exchange, communication, student collaboration, as well as to better support learning management. Owing to limited IT budget and the need to justify the investment in e-learning platform, assessing the benefits of these is an important filed in research and practice.

The e-learning systems have received excessive attention in information systems (IS) literature and are mainly examined from the standpoint of effectiveness (successfulness) (Marjanovic, Delić, & Lalic, 2015). Since e-learning systems are type of Information System (IS) (Chen, 2012; Hassanzadeh, Kanaani, & Elahi, 2012) they can be assessed with the updated DeLone and McLean (D&M) IS success model. The model is applicable to the assessment of IS effectiveness in the Internet environment (DeLone & McLean, 2003).

This study presents an empirically validated model for measuring the success of an e-learning system at the University of Novi Sad by using the D&M IS success model. The focus is on testing a model to assess the success of e-learning systems by quality triad constructs and their impact on user satisfaction. The proposed instrument can be used to assess the success of university e-learning systems from the perspective of the students.

2. E-LEARNING EFFECTIVENESS

2.1. Applicability of the updated D&M model

The updated D&M (2003) IS success model consists of six interrelated and interdependent dimensions of IS success: system, information, service quality, system use, user satisfaction and net benefits (see Fig. 1). The revised D&M model is one of the most widely used models of information-systems success and has been used for various information systems: e-learning (Chen, 2012; Hassanzadeh et al., 2012; Marjanovic et al., 2015), mobile data services (Shin, Lee, & Lee, 2016), IS among SMEs (Ghobakhloo & Tang, 2015), electronic Portfolio (Balaban, Mu, & Divjak, 2013), e-government (Stefanovic, Marjanovic, Delić, Culibrk, & Lalic, 2016; Wang & Liao, 2008). The model is applicable to the assessment of information system's effectiveness in the World Wide Web environment.

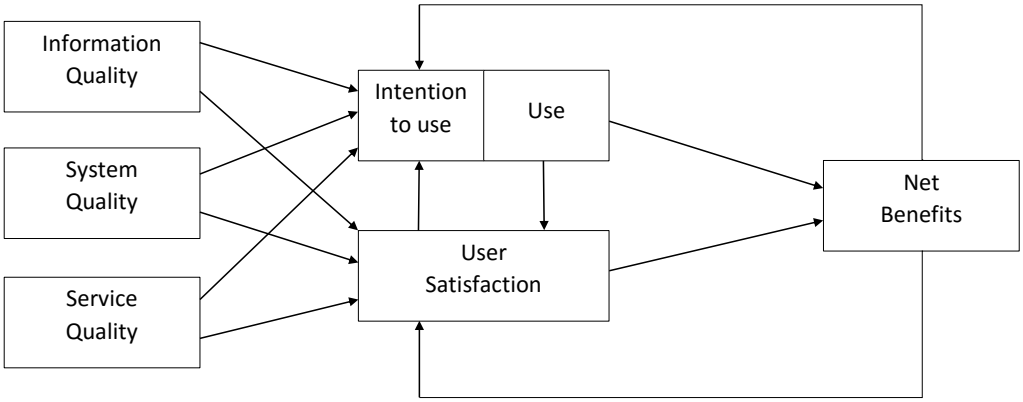


Figure 1: The updated DeLone and McLean IS success model (DeLone & McLean, 2003)

2.2. User Satisfaction

User satisfaction is one of the key components of success (Urbach, Smolnik, & Riempp, 2010) and can be defined in different ways. User satisfaction is the basic idea of the individual about the system (Wang, Wang, & Shee, 2007). Other authors define user satisfaction as a feeling of satisfaction or dissatisfaction arising from all the advantages that a user hopes to gain from interacting with the information system (Shin et al., 2016). User satisfaction represents feedback of a user after using the system, in other words, what an individual thinks and feels about the system (Marjanovic et al., 2015). Various instruments have been developed to measure user satisfaction and has not established a consensus, which would be the best instrument for measuring user satisfaction. The authors emphasize that the user satisfaction key dimension of success, but they are necessary and other dimensions to measure the success of information systems (DeLone & McLean, 2003).

2.3. Quality triad

As the e-learning platform becomes increasingly important in communication between the academic institutions and its students, it is essential for faculty personnel to provide quality services that minimize adoption barriers and maximize benefits. The D&M model suggests that the quality triad contains three elements that are important to the success of any information system: system, information and service. While this triad is composed of three elements, each can be considered individually to determine the strengths on which the academic institution capitalizes and shows where they need to make improvements.

System quality represents the technical quality of e-learning platform and measures technical success (DeLone & McLean, 2003). A higher system quality is expected to lead to higher user satisfaction, thus leading to positive impacts on individual productivity (Dong, Cheng, & Wu, 2014). For instance, if an e-learning webpage requires an extra click from the user, it might make a difference to, or have a lasting psychological impact on the user. Thus, the effect of system quality as a motivator in facilitating user satisfaction increase may be significant. System quality was measured in terms of ease of use, user friendliness and functionality (Dong et al., 2014; Marjanovic et al., 2015).

The content that an e-learning platform or information system has the more successful it will be due to more recurrent visits (Dong et al., 2014). Information quality, the quality of the information provided to the users by IS (Petter, DeLone, & McLean, 2013), is considered to be a key factor affecting IS success. Information is the reason most students use e-learning platform. In the e-learning platform context, information quality insinuates delivering up-to-date, useful and complete information (DeLone & McLean, 2003; Dong et al., 2014). It is proposed that the higher the quality of information, the more potential students would visit and browse e-learning platform.

Service quality refres to quality of service that users of an e-learning system receive from IT personnel (Petter et al., 2013). In addition to system and information quality, this construct measures the general quality of an e-learning system from the perspective of readiness of personnel to provide proper service, safety of transactions when using the e-learning system, availability of the system to users, individual attention of IS personnel and providing specific needs for users.

2.4. Conceptual model and hypothesis

In this paper, we tried to use the concepts and models mentioned in similar studies, taking into account the views of students, and provide a model for measuring the e-learning effectiveness, extending previous research. As e-learning system is considered to be an aspect of IS (Marjanovic et al., 2015), their success can be analyzed with the updated D&M IS success model. Based on a review of previous research results (Chen, 2012; Hassanzadeh et al., 2012; Marjanovic et al., 2015), we designed the initial conceptual model, presented in Fig. 2.

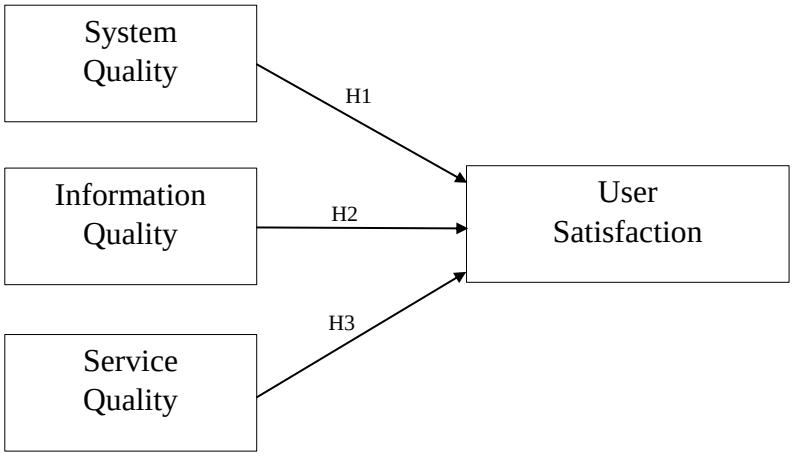


Figure 2: Conceptual Model

According to the Fig. 2, four dimensions from the updated D&M are used in this study: the quality triad elements and user satisfaction. Our hypotheses about the relationships in the model are presented below:

H1: System quality of e-learning system has a positive effect on user satisfaction of students

H2: Information quality of e-learning system has a positive effect on user satisfaction of students

H3: Service quality of e-learning system has a positive effect on user satisfaction of students

3. MATERIALS AND METHODS

The data used to test the conceptual model were obtained from a sample of senior students from the Faculty of Technical Sciences (FTS), University of Novi Sad, Serbia. The focus was on students that have used the faculty e-learning system Moodle. Following Dillman's et al. (2014) recommendations of applying the total design method of surveys, we emailed 500 students via the SurveyMonkey online survey tool. A total of 165 responses, that were using e-learning system Moodle during winter semester, were received over a period of ten weeks, representing a response rate of 33%. After conducting non-engaged bias analysis, 17 responses were deleted and the remaining 148 useful responses were available for data analysis, yielding a 29.6% usable response rate. Approximately, 68% of the respondents were female. Age distribution was as follows: under 23 (77.0%), between 24 and 28 (18.2%), between 29 and 33 (2.7%), and over 33 (2.0%). Detailed descriptive statistics relating to the demographic characteristics are shown in Table 1.

Table 1: Demographic details of the respondents (n = 148)

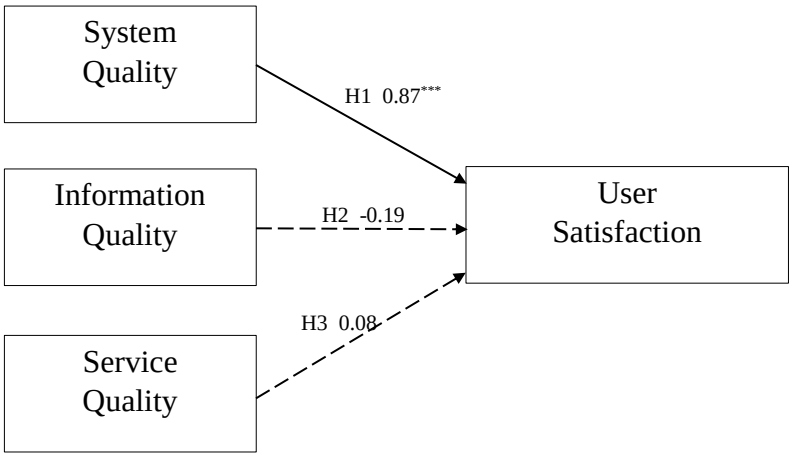
Measure	Items	Frequency	%
Gender	Male	48	32.4
	Female	100	67.6
Age	<23	114	77
	24-28	27	18.2
	29-33	4	2.7
	>33	3	2.0

4. RESULTS

In general, the Structural Equitation Modeling (SEM) technique was conducted in SPSS Amos to examine the model fit for each construct (to assess the measurement model) and to test the relationships among the constructs (to test the hypotheses in the structural model).

Reliability was evaluated by calculating Cronbach's alpha coefficients (Nunnally & Bernstein, 1994). The reliability of each factor collected by the survey instrument was as follows: system quality = 0.853; information quality = 0.843; service quality = 0.939; user satisfaction = 0.943. And the reliability of the whole instrument was 0.947. In addition, the reliability and convergent validity of the factors were estimated by the Composite Reliability (CR) and Average Variance Extracted (AVE). All the Cronbach's alpha coefficients and composite reliability values satisfied the minimum criterion value of 0.70 or greater, as suggested by Hair et al. (2009). The average variances extracted were all above the recommended 0.50 level (Hair et al., 2009), which meant that more than one half of the variances observed in the items were accounted for by their hypothesized factors. CR was greater than AVE for each factor. Thus, all the factors in the measurement model had adequate convergent validity. Discriminant validity can be evaluated by examining the Average Variance Extracted (AVE), Maximum Shared Variance (MSV), and Average Shared Variance (ASV). Following the Hair et al. (2009) recommendation, MSV not greater than AVE, ASV not greater than AVE, and Square root of AVE greater than inter-construct correlations will lead to discriminant validity. None of the factors had convergent validity concerns. In summary, the measurement model had adequate reliability, convergent validity, and discriminant validity.

The following set of fit indices was used to examine the structural model: ($\chi 2$=169.00 with df=84, AGFI=0.819, NFI=0.911, CFI=0.952, RMSEA=0.081). All fit indices values are in the acceptable range, indicating a good fit of the model. The standardized path coefficient, p-values, z-scores, and variance explained are shown in Figure 3.



Note. statistically significant ——; statistically non-significant -------; ***p < 0.001

Figure 3: Structural model

System quality is related to user satisfaction (β = 0.87, p < 0.001), providing support for hypotheses 1. Information quality and service quality are not related to user satisfaction (β = -0.19, p > 0.05; β = 0.08, p > 0.05), thus, hypothesis 2 and 3 are not supported.

Henseler et al. (2009) suggested using the coefficient of determination (R^2) of the endogenous latent variables as the essential criterion for structural model assessment. R^2 was 60% when the quality triad was used to predict the user satisfaction.

5. DISCUSSION

Based on our model and structural equations, it can be said that technical system quality is one component of measuring the success of an e-learning system in a university and, through a direct effect on user satisfaction, it can also affect the success of these systems. Hence, whenever the technical quality of an e-learning system is higher, user satisfaction of the e-learning system is higher. Instructors and system designers should make full use of user friendliness, ease of use, and functionality of the system to increase user satisfaction when it

comes to e-learning systems. This is in line with previous research that also found a positive influence of system quality on the user satisfaction (Hassanzadeh et al., 2012; Marjanovic et al., 2015).

This study presented an empirically validated model for measuring an e-learning system success. Our instrument can be utilized to assess the success of university e-learning systems from the student perspective. This evaluation will provide fast and prompt feedback to the university. IS managers that are handling e-learning processes within the university can use taxonomy that consists of system quality, information quality, service quality and user satisfaction, to improve their understanding of the level of e-learning success and take corrective actions for enhancement if necessary.
E-learning managers responsible for developing and implementing e-learning systems at the university can use the proposed model which consists of the system quality, information quality, service quality and user satisfaction, to improve their understanding of the success of these systems and, if necessary, successfully undertake corrective measures for improvement. Based on the relationships in the model, universities can assess to which dimensions they need to pay close attention to improve the success of the implementation and students' satisfaction from the e-learning system. For instance, if the instrument indicates satisfaction as a problematic dimension, the university can take advantage of that to improve the quality of the system in order to improve student satisfaction and make the e-learning system more effective.

The audit process and its application to the example of the e-learning system does not differ greatly from other IS in the organization. All IS within the organization should be fully integrated, that is routinized into the organizational processes, to produce the expected benefits (Armstrong & Sambamurthy, 1999). Bearing in mind that the audit process usually takes from 6 months to 1 year after initial implementation (Markus & Tanis, 2000), IS success assessment is twice recommended in the first year. Afterwards, if the results are satisfactory, the instrument could be administered on an annual basis, after each school year.

6. CONCLUSION

This research paper examined the IS success of a faculty e-learning system on the individual level of analysis from the students' perspective. A field survey was conducted at the Faculty of Technical Sciences, University of Novi Sad, Serbia to test the model. The empirical results verified the validity of the D&M success model in the context of e-learning in the transitional country such as Serbia. Our analysis showed that only one out of three quality dimensions (i.e., system quality) had a positive impact on user satisfaction.

Limitations to this study are in the areas of sampling. The sample was drawn from a highly homogenous group belonging to a single faculty, probably lacking the diversity that can be expected from a comparable sample chosen from different universities. Future studies should be conducted to evaluate the resulting models, using a sample from the entire Serbia.

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IMPLEMENTATION OF THE CROWDFUNDING CONCEPT IN HIGHER EDUCATION

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Abstract: *The subject matter of this study is the implementation of the crowdfunding concept in higher education. Part one of the study covers the basic characteristics of crowdsourcing and crowdfunding. Technologies necessary for the implementation of this concept have been discussed, as well as current business models and projects based on them. In part two, the possibilities for applying crowdfunding in higher education have been analyzed. The possibility of integrating the concept into formal educational flows has been analyzed in particular. Part three gives a proposal regarding the implementation of the crowdfunding concept in the School of Electrical and Computer Engineering of Applied Studies in Belgrade, on the Kickstarter platform. Paper offers a description of the most popular crowdfunding platforms to initiated project and crowdfunding project of schools and students in high education.*

Keywords: *crowdfunding, e-education, kickstarter, crowdsourcing, web 2.0*

1. INTRODUCTION

The advance of the Internet, as an information and communication technology, which is today present in all human professional and other activities, has entered a new phase at the beginning of the third millennium, known as: web 2.0. Unlike the early phase, when web contents were merely electronic catalogues intended for users, without a possibility of a more significant interaction with users, web 2.0 is based on an idea of a higher level of collaboration between users, who have the opportunity to post contents, shape the user interface and set in motion various global initiatives. Thanks to web 2.0 the Internet has become the most democratic media, because for launching an initiative into motion one needs a good idea, and the resources are often available free of charge (Jones, 2008).

Web 2.0 is the framework for the appearance of the crowdsourcing concept, which was designed several years ago and which has an increasing application in various fields of modern life. Crowdsourcing is a group of people who attempt to ensure the common good in the absence of a central body. In the case of crowdsourcing in e-education, this common good is in the form of video recordings, music or encyclopedic knowledge freely available to everyone. In the academic world, attention is the main currency within the online community, and status and acknowledgement have proven to be very important motivators for contributions.

In this study special significance is placed on crowdfunding as a model of crowdsourcing. Crowdfunding implies mass funding or raising funds from a large number of people via the Internet. Crowdfunding is a form of alternative funding, that originated outside the framework of traditional funding. In literature, crowdfunding is often referred to as funding of the 21st century.
In recent years the interest of users for crowdfunding has led to the implementation of this concept also in education. The launching of a crowdfunding project may greatly contribute to the advancement of education, especially in terms of education in underdeveloped countries.

A case study was presented in this paper which refers to the implementation of the crowdfunding concept in the School of Electrical and Computer Engineering of Applied Studies in Belgrade.

2. LITERATURE REVIEW

Crowdsourcing is an act undertaken by a company or institution in the form of an open call with the aim of transfering the function of employees and outsourcing to an undefined (and generally large) network of people, connected on the Internet (Howe, 2006).
Crowdsourcing is an online distributed problem solution and a model of business production (Brabham, 2008).

Crowdsourcing implies the existence of four main elements:
- A person, usually called the crowdsourcer, who designs, launches and manages the project (manager);
- A group of people, backers, who work on the project (crowdworkers);
- The market, usually called the crowdmarket, a place where managers and backers engaged in the project can meet,
- Sites (Internet platforms) used for implementing the process (crowdsites).

The issue of motivating the public, participants in the project, can be of crucial importance regarding the decision of an individual to participate in the project. The motivation can be personal satisfaction, review of acquired knowledge and skills, acknowledgements and awards in the form of appropriate certificates and public recognition or promotions on the Internet. Furthermore, monetary compensations can also be a motive for certain people, however, money awards for this work are usually small and depend on the complexity of the work and the amount of work put into the project.

Jeff Howe defined the taxonomy of crowdsourcing which enabled the defining of four main models (Howe, 2006):
- Collective intelligence or Crowd wisdom is one of the two most common models of crowdsourcing, where the „crowd“ comes together and shares knowledge.
- Crowd creation work is an open call to the „crowd“ to find new and useful solutions. It is applied when there is an insufficient number of experts in a certain field and when more different ideas are necessary.
- Crowd voting occurs when opinions on a certain topic are collected on the web, with the help of large groups of people.
- Crowdfunding is a special model of crowdsourcing. Unlike the aforesaid models, which imply that people contribute to a copyright through their work and services, crowdfunding refers exclusively to financial contributions.

Crowdfunding is an open call via the Internet for providing funds, either in the form of donations, or in exchange for some kind of award to support an initiative for special purposes (Belleflammea, Lambert & Schwienbacher, 2014). Crowdfunding refers to the attempts of entrepreneurs, individuals and groups from the field of culture, music, arts and non-profit organizations to fund their endeavors relying on relatively small contributions of a relatively large number of individuals who use the Internet, without standard financial intermediaries (Mollick, 2014).

One of the key principals of crowdfunding is the „rewarding“ of donors, i.e. compensation for financial support which mainly implies that, upon the completion of the copyright project, the donors can download a film, album, video-spot or some other funded product (Bannerman, 2013). Crowdfunding is very common in the music, film and video-game industry, where individual projects probably couldn’t even be carried out if their funding depended only on „corporate channels“ (Poetz & Schreier, 2012).

2.1. Types of Crowdsourcing

The motivation of crowdworkers significantly contributes to the success of a crowdfunding project. It often depends on the applied type of crowdfunding. Hereinafter different crowdfunding types are presented in brief. There are four types of crowdfunding:
- Equity-based Crowdfunding – Enables the crowdworkers to fund a startup company and small enterprises in exchange for capital. Crowdworkers donate money for business operations and receive ownership of a small portion of that business.
- Reward-based Crowdfunding – Crowdworkers exchange donations for present or future products or services. Individuals or enterprises who launch a project can motivate crowdworkers by giving them various products, like tee-shirts, copies of products which are the result of a project, or even only by issuing them letters of recognition (Ahlers et al, 2015). Platforms for crowdfunding mainly differ according to whether they endorse the principle „all or nothing (AoN)“ or the principle „Keep it All (KiA)“. Some of them offer both solutions, and leave the choice to the crowdsourcer (the person who designs the project). In the first case, funds are withdrawn from the account of the donor only if the financial goal is achieved, and in the second case the author of the project is allocated a sum regardless of the attainment of the specified amount. Often the raised sum exceeds the initially defined goal. This type is one of the most popular and most common types of crowdfunding.
- Leading−based crowdfunding or Credit−based crowdfunding – Crowdworkers invest donations which are returned to them after a specific time period.
- Donation−based crowdfunding is a type of crowdfunding where crowdworkers as individuals donate money to charitable causes.

2.2. Platforms for initating crowdfunding

Crowdsourcing can be initiated from different Internet platforms: web sites; specialized web platforms; social networks; blogs; microblogs; and a significant role in the implementation of a project can be played by locations for multimedia sharing (YouTube; Flickr; Picasa; Pinterest). However, when it comes to crowdfunding as a model of crowdsourcing, platforms that are used for launching such projects are mainly specialized web platforms (crowdfunding platforms). The reason for this are the financial transactions carried out via such sites.

On crowdfunding platforms, the author posts their project, explains the financial goal, and then promotes the idea through video recordings or other multimedia modes, while the circle of potential donors is spread via social networks. Site visitors support the desired project by donations which they pay with credit cards for on-line purchases, and if the author managers to raise the planned amount, the crowdfunding platform takes app. 5 percent. There are several sites where individuals can safely invest money. The following sites can be regarded as such: Kickstarter, IndieGoGo, GoFindMe, RocketHub, iStockphoto, etc.

Kickstarter.com is one of the most popular crowdfunding platforms on the Internet. It has several million members who donate billions of dollars for funding creative ideas in the field of arts, music, film and video, games, design, technology etc. (Kuppuswamy & Bayus, 2015). Kickstarter is the leading crowdfunding platform in the USA where so far more than 2 billion dollars have been raised from more than 10 million crowdworkers and 100,000 creative projects have been launched (Figure 1) (Statistics on Kickstareter, 2016). Kickstarter operates on the principle of "AoN - All or Nothing", which means that the creator of the project needs to reach their financial goal before the expiration of the project.

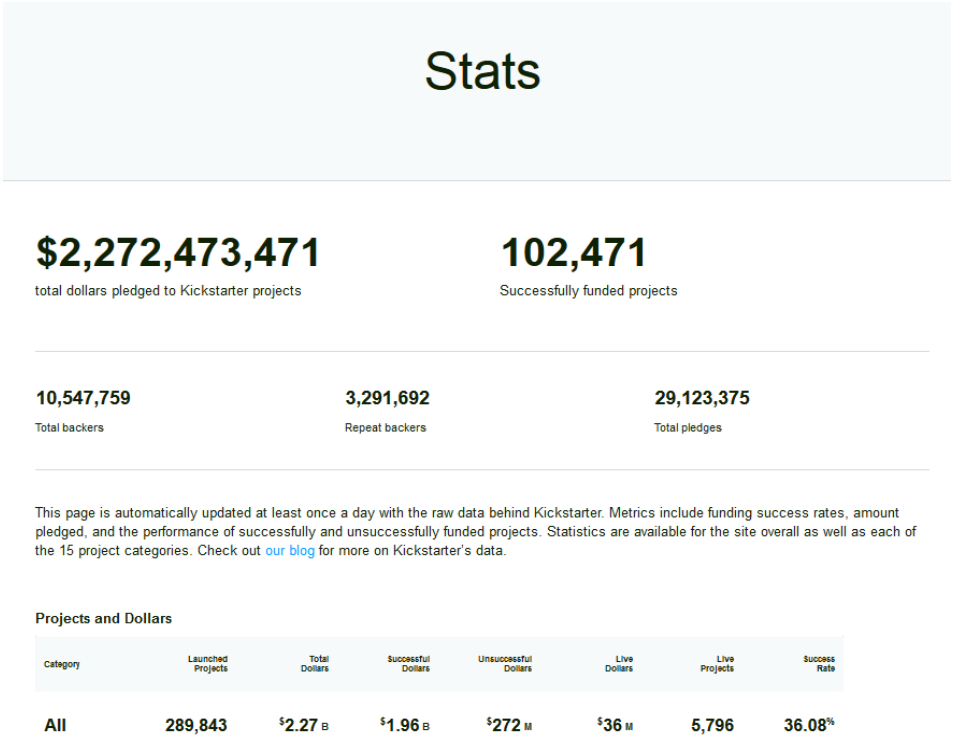

Figure 1: Review of the number of launched and the number of unsuccessful projects at Kickstarter (Statistics on Kickstareter, 2016)

On February 14, 2013, Kickstarter published an iOS application named Kickstarter for iPhone. This application is intended for users who create and donate projects. Thus, for the first time, Kickstarter acquired also a mobile version of the platform. At the end of January of this year, an application for Android OS was also created.

Kickstarter charges a commission fee of 5% of the total amount of raised funds. A payment processor calculates an additional tax of 3-5% on donations. Unlike many other forms for raising funds or investments, Kickstarter does not take ownership of projects. Web pages of projects launched on the site are permanently stored and are available on the Internet. When funding is completed, the projects cannot be altered or removed from the site.

iStockphoto.com is a web-based company which sells photographs, animations and video recordings. In order to become a photographer for iStockphoto, a user must fill out an online form, submit proof of their identity and submit three photos to be evaluated by the employees in iStockphoto. Photographers can post their photos on the site, which are stored in databases under key words (model: Crowd creation work). Visitors of the site browse through the stocks of photographs which they mostly intend to use on their web sites, brochures, business presentations etc. Those visitors of the site who are interested in purchasing, must firstly buy points (1 US$ per point) which they need to purchase photos they are interested in on the site (model: crowdfunding). The platform uses a business model of payment via credit cards (Visa, Master) and Pay Pal. Photographs of standard format and quality can be purchased for a price of one to five points, and high resolution photos, oversized photos and longer video recordings can cost up to 50 points.
Photographers receive 20% of the sale price every time one of their photos is downloaded from the web site. Some photographers, who become active members of the online community, are usually engaged for maintaining the databases, and can earn more by signing exclusive contracts with iStockphoto, where they receive 40% of the sales price for their photos. iStockphoto is a community composed of both amateurs and professionals who work in that field.

GoFundMe.com enables users to create their projects. During this process, members can explainthe goals of fundraising, can define the category, define the expected amount, can post photographs or video recordings etc. After the launching of a project on the GoFundMe platform users are given the opportunity to share their projects through integrated social networks (Facebook, Twitter etc.) or by e-mail. Also available is the GoFundMe mobile application for iOS and Android operating systems.
Millions of people have raised more than 2 billion dollars in the last 365 days.
Crowdworkers can donate money via the platform using debit or credit cards (but not PayPal, as on most other crowdfunding platforms). Those who donate can leave comments on the site as support for the project. GoFundMe generates income by automatic deduction of a 5% commission fee from every donation on the project. The compensation for processing donations is app. 3% per donation.

3. CROWDFUNDING IN E-EDUCATION

In institutions of higher education crowdsourcing is mainly used in logistics, and much less for studying and training purposes. However, use of crowdsourcing for studying and training can contribute to innovations in the teaching process and help develop learning and professional skills of students.

In terms of e-education, crowdsourcing can be defined as follows:
- A group of people (students, lecturers, administrators) who serve as a source of information, instead of depending on only one person as the authority.
- Team work focused on all members who contribute to the project by their knowledge.
- A tool used for managing ideas where ideas can come from any member of the „crowd“; everyone works together to solve a problem.

Some Universities have already launched crowdsourcing programs within their Faculties for various purposes. Information regarding subjects in all fields and disciplines are available on the Internet. According to the ComScore site, as average YouTube browser follows more than 180 online videos each month on topics like learning languages, programing and many others. Two years ago, YouTube launched YouTube EDU where many Faculties and Universities have their own channels. Visitors can find more than 125,000 videos with over 63,000 hours of recordings with different levels of academic material which can be accessed, commented and shared by students (Sclater, 2006).

When it comes to crowdfunding, as a model of crowdsourcing, in the field of education it is mainly used as a source for funding various projects, students' tuition fees, equipping of schools etc. Such crowdfunding projects can be launched on different crowdfunding platforms which offer funding in the field of education. Crowdfunding is a good way for students with good references and qualifications in underdeveloped countries to enlist in prestigious Universities, without tuition fees becoming a limiting factor (Abbey, 2013).

The first time crowdfunding appeared in university circles was in 2012, when a partnership was formed between the University of Utah and the RocketHub crowdfunding site. The first set of projects launched within the scope of this partnership raised a total of $ 32,000 and attracted more than 210 donors. The same year the University of Virginia initiated a crowdfunding platform. In addition to raising donations, they attempted to determine what motivates donors to invest in launched projects. Using crowdfunding the Universities were able even then to use their creativity and individuality, as well as the Internet, to recruit new

donors. It should be noted that the success of a crowdfunding campaign usually depends on the use of social media.

An example of using crowdfunding in education is the launching of a crowdfunding project, on the Kickstarter platform, for funding tuition fees for Emily-Rose Eastop, a master degree student at the Oxford University. The required amount defined in the project was £ 26,000, and after completion of the project the amount raised was £ 26,581. On the other hand, a master degree student, Nick Gaven, who also launched a project for funding his tuition fee on the GoFundMe platform, managed to raise only £ 700. This indicates that there are no guarantees when it comes to crowdfunding. A project should be concisely defined, the appropriate crowdfunding platform should be selected, a good promotion should be devised via social networks and other channels of Internet marketing, etc. (Llorente, Morant & Garrigos-Simon, 2015).

In recent years, budgets of higher education institutions have been reduced, thus schools have increasingly been turning to this method of fundraising. Many lecturers and students achieved success by creating crowdfunding projects on DonorsChoose.org, ClassVish and other similar crowdfunding platforms which are exclusively dedicated to funding in the field of education.

3.1. Examples of crowdfunding in e-education

Givology.org was founded in 2008 by a group of graduate students from the University of Pennsylvania. It is a crowdfunding platform where small donations are given (several dollars) as support for student projects and student scholarships in developing countries. It operates on the principle of "All or Nothing (AoN)". Givology connects donors on the Internet with non-governmental organizations and universities from all over the world, and also enables them to stay in contact through the platform blog. In addition, accounts are also created on social networks (Facebook, Twitter, LinkedIn) where there is wide interaction between students and donors.
Givology has raised over 300,000 dollars for support to more than 2,800 students in 26 countries. The goal of the site is to lower transaction fees to ensure that students receive the largest possible amount of donations. This means that a 100% of donated amounts goes to charity, while zero percent goes to covering expenses, i.e. site commission fees. Compared to other crowdfunding platforms which charge a commission fee of app. 5% of the total raised amount, this crowdfunding platform operates on a voluntary basis. Another interesting fact is that Givology has a separate fund for raising money which is used for covering banking transaction fees, which amount to 2-4% per transaction.
The Givology platform applies the Electronic Wallet principle, which simplifies the donating process. Google Wallet is used. The transfer of money into the e-Wallet is simple, and can be done in only one step. By depositing money into the e-Wallet, funds appear in the account of the donor who can then donate the funds to selected students and student projects. Donors who do not have time to search through the database of numerous students and projects, can use an option where the platform generically selects students who will receive the donation by using specific algorithms. Of course, the names of donors appear on donor lists for students and student projects. When students and projects are fully funded, Givology sends a check to a partner organization in charge of delivering funds to students or student project leaders. As intermediaries, these organizations regularly update information presented in the form of video recordings, photographs, correspondence with students etc. Givology staff then posts this information on line so that the donors can see their roles in the project, and by doing so the platform demonstrate that it promotes transparency of information.

DonorsChoose.org is a non-profit organization from the USA which enables individuals to directly donate to schools and school projects. At that time, DonorsChoose was among the first such crowdfunding platforms. Today, this site has over 2,000,000 crowdworkers, i.e. donors, and more than 690,000 funded projects involving app. 17,700,000 students.
DonorsChoose enables lecturers to post on the platform requests for necessary material and resources for their laboratories and projects, which are available to donors. Each project has a well-defined detailed description of the project, of the required budget and the necessary items for the implementation of the project. Donors can donate $ 1 or more to selected projects, which they can search by school name, lecturer's name, location, area and key words. DonorsChoose then transfers donations directly to schools where the projects were launched. This platform operates on the principle of "All or Nothing".
Of the total amount of raised funds for a specific project, the platform charges a 1,4% commission fee, while 4.4% of the total amount goes to cover transaction fees.
All donors receive photos of implemented school projects and a letter from the lecturers. Donors who donate $ 50 and more to a project receive a hand written letter of recognition from the students.

ClassVish.com is a non-profit and crowdfunding platform engaged in raising funds for equipping schools. Unlike the DonorsChoose crowdfunding platform which deals in funding higher education projects, ClassVish exclusively deals with financial aid to primary and secondary school education in the USA. On this crowdfunding platform lecturers and school principals can launch projects where they define a list of required resources for equipping their schools. Donors have the possibility to browse the site and find schools according to cities and states, according to school codes or names of lecturers who launched a project.
For covering transaction fees 2.9% and 30 cents are deducted from each donation. After the completion of the project, the ClassVish platform procures resources from the school requirement list by purchasing those resources at reduced prices from partners which have signed contracts with the platform. The difference between the reduced and regular prices is in fact the profit of the platform, i.e. the percentage its takes from every implemented project. The platform operates on the principle of " Keep it All (KiA)". When the defined time for funding a specific project elapses, the platform selects the resources which will be purchased based on the raised amount and the requirement list defined by lecturers or school principals. In case the platform is not able to purchase resources defined in the requirement list, the raised funds are paid directly to the school, reduced for 5% commission fee taken by the platform.

4. AN IMPLEMENTATION OF CROWDFUNDING IN HIGHER EDUCATION

Higher education is under the influence of constant changes. New technologies and innovations impact the concept of education forcing it to undergo constant transformations. The principle of obviousness in teaching, for the sake of a vivid understanding of the essence of the subject matter presented to students through teaching programs, has become multidimensional, with the dynamic development of digital multimedia and the possibility to virtualize and simulate a large variety of complex activities and processes, which are being studied in theoretical and applied studies of modern times. The School of Electrical and Computer Engineering of Applied Studies (VISER) in Belgrade has seven contemporary undergraduate study programs and six post-graduate study programs. It has twenty laboratories, eight of which are for general purposes, equipped with desktop computers using Windows 7, Windows 8 and Windows 8.1 operating systems, as well as 12 laboratories for special purposes, one of which is equipped with twenty Macintosh computers. Teaching activities within all study programs take place at the same location – the school building.

The School Board and the Governance Body of the School have decided to equip the ground floor auditorium, with 140 seats, and turn it into a general purpose smart classroom. Smart Classrooms represent synthesis of technology, user interface and traditional lecturing methods. New generations of Smart Classrooms are equipped with high technology and they become necessary for performing teaching processes at universities. Smart Classrooms have audio-visual equipment which enables transferring the knowledge by using a wide spectrum of different media (Gligoric, Uzelac, & Krco, 2012).
The amount of 12,000 dollars is provided by the School from its own resources. The amount of 8,000 dollars will be obtained through donations made by individuals and organizations who respond to a public call placed via crowdfunding. The project will be launched on the Kickstarter.com web crowdfunding platform. The project is launched for the purpose of fundraising in the form of donations for equipping a smart classroom. No limits are set in terms of donation amounts. The duration of fundraising through donations is limited to sixty days.
The defining of a project on the Kickstarter platform requires several steps. The first step is to define the field of the future project and its name. The name of the project is Equipping a smart classroom at VISER in Belgrade, in the field of Technology. In the next step it is necessary to input data relevant for creating an account on Kickstarter (name, e-mail address and password). There is also the possibility of logging in via a Facebook account.

As stated hereinbefore, Kickstarter is a crowdfunding platform operating on the principle of "All or Nothing (AoN)". If the project is successfully implemented, the Kickstarter platform charges a commission fee of 5% of the total amount of raised funds. There is also a 3-5% online transaction fee. More precisely, 3% + $ 0.20 per donation, except for donations under $ 10, which have a discount as micro-donations: 5% + $ 0.05 per donation.

Figure 2: Launched crowdfunding project of VISER on the kickstarter.com site

Promotion via the Internet of the launched crowdfunding project on the Kickstarter platform is automatically posted and SEO optimized on the Facebook, Google+, Instagram, Twitter social networks, where the accounts were created by Kickstarter.

Once the project is created, Kickstarter informs about the rules of the platform which the crowdsourcer, i.e. the project manager must comply with. The rules are the following: the project that is being created must share something with others; the project must be reliable, clearly posted and presented; the project cannot raise funds for charitable purposes by proposing financial initiatives or presenting prohibited products/services.

Since the duration of the project is still in progress, the results will be published in one of the following research. After the implementation of smart classroom, participants in the crowdfunding project will be awarded letters of recognition for their donations and for participating in the project in a .pdf format which will be sent by e-mail. Participants in the project will also receive a cover letter containing the web address of the posted photo gallery from the opening of the smart classroom. On the School channel on the YouTube platform will be posted a short film with the mouth and the satisfaction of students, as well as the usefulness of smart classrooms.

5. CONCLUSION

Crowdfunding is a model of web 2.0, which, due to its usefulness and wide range of applications, has been undergoing intensive growth on a global level during the past few years.

Individual donations for launched crowdfunding projects influence the final financial value and outcome of the project. Each donor also contributes to the promoting of projects that their donates to and believes in. They will occasionally play the role of donors oriented towards supporting social projects and charity projects. In some cases, they will become shareholders and will contribute to the development and growth of a business. Motivation for user participation is a result of various sentiments, such as: to be at least partly responsible for the success of initiatives made by others (desire for sponsorship); to be part of a social initiative (desire for social participation); to request payment from financial contribution (desire to invest).

When it comes to the implementation of crowdfunding in education, compared to traditional forms of creating innovations or fundraising for a specific project in education, the following benefits can be pointed out:

- Easy access to flexible crowdworkers i.e. donors
- Funding of young and creative talents and support for educational institutions
- Greater efficiency (cost savings since there is no job creating; no salary payments and state contributions)
- Shorter time to enter the market and faster delivery of the project.

On a global level, today there are not many case studies regarding the application of the crowdfunding concept in the field of education. However, crowdfunding is a very flexible concept and its application in the field of education has good prospects. Education is a constantly evolving process, in accordance with curricular changes, changes in teaching methodology, new scientific disciplines and new courses.

In terms of online funding, crowdfunding is regarded as a premature conclusion. At a certain point in time, in a not so distant future, an increasing number of educational institutions, lecturers and students will launch crowdfunding projects on the Internet, which will be funded by people who they might never meet, and who will be credited for student scholarships or modernly equipped schools.

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ILS LEARNING STYLE MODEL AND MULTIMEDIA E-LEARNING

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Abstract: *Contemporary trends in education are heading towards the learner-adapted education. Some research issues dealing with adaptive forms of education refer to the establishment of efficient adaptation criteria. This paper presents the results of the research aimed at identifying the correlation between the students'learning styles, based on Felder-Silverman ILS learning model, and multimedia e-learning styles. The research was carried out in October 2015, at the ICT College in a sample of 64 students. The results showed that currently no correlation can be identified between the learning style according to the ILS model and any of the four types of multimedia e-learning. Furthermore, the research pointed out the tendency of some students towards specific forms of multimedia e-learning. These conclusions can be used as the basis for the definition of criteria and the development of adaptive learning.*

Keywords*: learning styles, adaptive learning, multimedia e-learning, e-learning*

1. INTRODUCTION

The process of education and self-improvement is considered to be one of the basic elements in the society and represents the foundation of social prosperity and development. Consequently, the approaches which will ensure the efficient and effective educational process have been intensively developed. Contemporary trends in education are heading towards the learner-adapted education. The education process is adapted to meet the requirements and habits of a learner. It must be designed to best use the characteristics of a learner which are relevant for the learning process, to motivate the learner and to ensure the long-lasting retention of acquired knowledge.

Following the trends in education, the research was carried out at the ICT College in Belgrade, in October 2015, with the aim to consider the opportunity of introducing the adaptive forms of education into the teaching process. The ultimate objective of the research is the integration of multimedia e-learning styles into certain courses according to suitable adaptation criteria. This paper presents the results of the research aimed at identifying the correlation between the students' learning styles, based on Felder-Silverman ILS learning model and multimedia e-learning styles.

This paper is divided into several sections. After the Introduction, Section 2 presents the theoretical framework as the basis for the research. In Section 3, both the research and the research results are presented and analysed. The conclusions are given in the last section.

2. ADAPTIVE EDUCATION

Learning is a set of constructive processes which a person uses to activate himself, individually or in a society, and to elaborate, build and organize knowledge. On the basis of experiences and knowledge acquired through the learning process, a person's behaviour has undergone some permanent changes and thus his approaches towards situations are also changed. According to Vulfolk, Hujuz adn Volkap (2014) factors which affect the learning outcomes can be grouped into seven categories.

- Intellectual factors. The intelligence level is not universal for all segments of knowledge. This accounts for the fact some students acquire high grades in one field compared to lower success in acquisition of other fields of science.
- Learning factors. These factors are described through the correlation of knowledge and skills a learner acquires. Former bad knowledge in a specific field brings about the troubles in acquisition of new knowledge.
- Physical factors. Physical conditions such as disability and fatigue affect learning and acquisition.
- Mental factors. Mental fatigue and mental flaws also affect the learning efficiency.
- Emotional and social factors such as current mood, relationship with other participants in the classroom, motivation for learning, attitude towards the study topic, are only some manifestations of these factors.

- Teacher's personality and his/her approach towards a learner affect the attitude the individual has to the learning material, and the learning process. The teacher leads the learner through the studying process, and provides support, assistance and the feedback.
- Environment. Environment may be encouraging for the learner. Well-equipped environment in which a learner can without difficulties realize his objectives in the learning process has a positive influence on learning.

The way a person studies varies from person to person. Each individual has his/her own unique way of learning and uses different methods and techniques of gathering knowledge and processing the data he/she wants to learn. The way a learner studies describes his learning style. Learning style is commonly described as a learning strategy.

According to Felder and Silverman (1996) ILS (Index of Learning Style) model there are four dimensions, each containing two categories which define learning styles:
- information processing dimension with categories of active and reflective learners,
- information perception dimension with categories of sensing and intuitive learners,
- information repetition dimension with categories of visual and verbal learners,
- information understanding dimension with categories of global and sequential learners.

Information processing dimension includes two categories of learners. One category comprises learners who learn best through practical examples which apply the knowledge they must learn (Reflective learners). The other category includes Active learners who require an active participation in the learning process. Reflective learners gather and analyse knowledge before taking any actions. They are more prone to observe the work of other learners than to set themselves to some action.

Information perception dimension defines learners described as sensing and intuitive. Sensors are patient, good at memorizing facts and doing laboratory work. They like to solve problems by using pre-defined methods, they do not like complicated comparisons and unpredictable situations. Intuitive learners are better at accepting new concepts and more comfortable with abstractions. They like innovations and do not like contents and actions to be repeated. Sensors are more practical and more cautious than intuitive learners who are faster in work. The difference in approach to the lessons is reflected in additional materials which were "at hand" to sensors, while the intuitive learners' lesson contents were enriched with formulas and block diagrams.

The information reception dimension describes both visual and verbal learners. The former retains the subject matter through photographs, diagrams, maps and demonstrations that should be learned, while the latter memorizes through written text and verbal production.

Information understanding dimension describes sequential and global learners. Sequential learners follow the course section by section in linear way while global learners often skip parts of lessons and refer directly to the materials they find complex without too long pondering over simpler contents.

According to Hamada (2012) and Hwang (2014) learning style can be used as a criterion of learning process adaptation. Adaptive approach is realized through adjusting of particular elements of educational process to pre-defined criteria.The criteria that are set result from individual features of learners, level of motivation, learners' fatigue, features of working environment, instruction materials used in learning process. The most often used criteria in the research of adaptive educational environments are the level of learners' motivation, psychological personality traits, learners' interests, physical state of fatigue of students at a given moment, the style used by a student in the learning process. Adaptive environment for learning should be designed so as to recognize relevant information and to adapt, by using appropriate criteria, the learning process to learner's needs. The changes introduced by the system to adapt the learning process to a student can be of either statistical or dynamic type. Static changes are unchangeable over time and are defined at the beginning of educational process. The dynamic changes modify the educational process over time and constantly adapt it to a learner.

2.1. MULTIMEDIA E-LEARNING

Eysink et al. (2009.) describe multimedia e-learning as the type of learning that uses different sources of information of both visual and auditory type aimed at better understanding and easier retention of the contents to be acquired. Visual content represents video content, photographs, illustrations and graphs while auditory content includes sound recordings, printed or produced words. It is possible to observe 4 types of

multimedia e-learning: hypermedia e-learning, observational e-learning, self-explanation based e-learning, inquiry e-learning.

Hypermedia e-learning represents computer-based environment in which the multimedia contents such as pictures, animations and videos are kept in certain system nodes interconnected and accessed by hyperlinks. The multimedia components offer information through different text forms and photographs that are used to address other auditory and visual contents carrying information. Learners alone decide which information they wish to follow or ignore. The learning pace is individual and the sequence of pieces of information to be followed is determined by the learner. Hypermedia e-learning provides high level of interactivity between the students and the system and offers students high control of the e-learning process. As much as the e-learning process control is positive, it still has some negative aspects. The most important is that students alone should assess the relevance of information he/she gathers which in case of inexperience in the studied field can lead to flaws in learning.

In order to implement successfully this type of studying, a learner should recognize knowledge and skills he/she would like to acquire. A learner expects the outer support in this way of e-learning through leading in the selection of materials for studying and providing appropriate control of access to the contents depending on previous knowledge possessed by the learner.
The knowledge available to a student is represented in different forms. To enable an adequate approach to such information, the student is required to identify the missing knowledge. Information received from the e-learning system must be harmonized with the previous learner's knowledge and presented adequately so as to enable students to detect the missing knowledge. Only then, the learner can focus on obtaining of desired information, planning the search for them, reviewing on the available data in order to reach the desired information and finally to take actions to retrieve the desired data. The last step is verification of the conclusions.

Observational e-learning is a type of e-learning that occurs through observing of others while performing tasks or solving problems. The learner observes an expert, envisages and tries to adopt the applied process to perform a task. The observational e-learning implies also activities from the cognition domain. This type of e-learning implies engagement of an expert who explains process of reflection to a learner, which leads to drawing of certain conclusions, as well as a series of additional explanations including the reason why and when a certain strategy is to be applied. Through this type of e-learning students can practice tasks through mental reconstructions of previous problems and tasks. In computer environment the experts who present knowledge can be real life experts or animated personalities. The disadvantage of this type of e-learning is that learners are passive observers and do not participate actively in construction of mental models of knowledge they receive. Additionally, learners do not possess knowledge on the relevance of information in perceptually rich environment.Outer factors that can positively affect this type of e-learning refer to the increase of motivation with students.

In multimedia environment, most often used are animations or video material that describe which knowledge should be acquired. In case of problem solution the animation contains steps that lead to a solution. A student watches and follows the animation, verifies the steps of animations and listens or reads why a certain problem is solved in the presented way. Upon the completion of the animation, a student should analyse it and repeat an exercise in order to integrate the procedure and conclusions in the mental picture.

Self-explanation based e-learning relies on learning by example and self-explanation. By worked out examples a student is presented a problem that hides knowledge that a student should acquire. Through examples presented to a learner, a problem to be solved is formulated, principles for its solving are introduced together with the steps which lead to a solution and to a final problem solving. Teaching is not stopped on one sole example, but a student is introduced a series of worked out examples. It is thought that this learning approach is very effective because the learners can direct their cognitive potentials to problem understanding and not to searching for accurate solution. This way a learner is stimulated to explain to him/herself the process of reaching the solution and the solution itself. The learners who actively participate in the process of self-explanation based e-learning learn more than the students who do not take part in the process.

In multimedia environment, a learner reads, watches and filtrates information available to him and perceives the steps that lead to solution of the subject problem. In the course of work a learner is asked questions that explain how she/he perceives and understands the steps that are presented as solution. That way learners are stimulated to think about concepts and causal relations behind the procedure that is presented and that way he/she creates a mental picture and fills in his/her knowledge gaps.

Inquiry e-learning is defined as a learning process in which students state their own experiences with the respective subject. A student reveals concepts and features that refer to the subject matter of learning placing the subject in the experimental environment. Based on such data students draw conclusions. The process of learning consists of several phases: orienting, generating hypotheses, experimenting and drawing of conclusions. Due to insufficiently correct performance of an experiment, wrong conclusions can be drawn and incorrect hypotheses can be accepted.
In order to implement an appropriate experiment, a learner must rely to his/her previous knowledge related to the investigated subject matter. Based on previous knowledge, learners form hypotheses, as well as plans on how to examine and test such hypotheses. By comparing the results of different experiments a mental image of knowledge is generated which has to fit into previous knowledge. If it turns out that additional data are needed to complete the mental image, new experiments are to be implemented.

3. RESEARCH DESCRIPTION

The described theoretical concepts served as a basis for implementing the research aimed at examining whether learners who prefer particular learning style more often choose some of the four types of multimedia e-learning. The aim of the research was to establish connection of the learning style and selection of an appropriate type of multimedia e-learning.
The research was performed at the ICT College of Vocational Studies in Belgrade in October 2015. An overall of 66 second-year students participated in the study. They completed a 25-item questionnaire. The application used was Survey at the social network Facebook.

The questionnaire was organized in three parts. The first one included the questions regarding age and gender of the respondents as well as personal assessment of the computer literacy level. The second part encompassed the questions of the standardized Felder-Silverman LSQ. The standardized questionnaire according to the ILS model has 40 items. According to the research in 2007 the key questionnaire items were selected based on which it is possible to optimize the number of questionnaire items. So only 16 items were used to establish learning style according to the ILS model.The last part encompassed the questions in which the respondents could choose a type of multimedia e-learning according to the situation described in the question.

The answers obtained in the study were subject to statistical data processing and consequently the conclusions were drawn.

4. RESEARCH RESULTS

Based on the results obtained in the research it was not possible to establish correlation between the learning style according to the ILS model and forms of multimedia e-learning. This conclusion should be taken questioned to some extent. The sample of 66 respondents provided certain conclusions, but they could not be efficiently confirmed statistically. Due to specificity of the researched field and great number of categories that are statistically processed it is necessary to include larger sample in order to reliably accept or reject the initial assumptions of the research.

The software tool used for data processing was SPSS (Statistical Package for the Social Sciences). The descriptive statistics was used with cross-tabulation option of Chi-test. Based on the second part of the questionnaire, a profile of the learning style according to the ILS model was designed for each individual respondent. These answers were compared with the response to the questionnaire item “In your opinion, which is the most efficient way to understand and acquire certain knowledge?”.The four options of the answer to these questions were in correlation with the respective form of multimedia e-learning. These were the offered options:

- Reading of as many books and linked materials from the field to be learned (hypermedia e-learning)
- Observing experts using knowledge from the field to be dealt with and learned (e-learning by observation)
- Analysing as many examples as possible related to the subject matter (self-explanation based e-learning)
- Work with simulators and testing of simulation from the studied fields (inquiry e-learning).

The following results were obtained:

- Active learners mostly chose inquiry e-learning (13 respondents out of 24 active students opted for this type of e-learning)
- Learners equally described as active and reflective opted least for hypermedia e-learning (only 2 out of 24 students)

- Reflective learners almost equally chose all four forms of multimedia e-learning.
- Sensors chose to the greatest extent hypermedia e-learning (19 of the 42) while intuitive learners mostly chose self-explanation based e-learning (an overall of 7 out of 9 students).
- Visual learners mostly chose inquiry e-learning compared to other types of multimedia e-learning (17 out of 36 students). Learners who are both visual and verbal, as well as the dominantly verbal students equally chose all four forms of e-learning.
- The sequential learners mostly chose hypermedia e-learning (8 out of 22students) and inquiry e-learning (7 students out of 22). The learners who are equally sequential and global dominantly chose inquiry e-learning (13 out of 26) while global learners chose more inquiry e-learning (8 students out of 16).

The above results are presented in the table.

Table 1: Cross-tabulation for all domains of ILS learning according to the multimedia forms of e-learning

	Type of e-learning				
	hipermedia e-learning	observational e-learning	self-explanation based e-learning	inquiry e-learning	**Total**
Active	5	2	4	13	24
Active & Reflective	2	6	7	9	24
Reflective	5	2	3	6	16
Total	**12**	**10**	**14**	**28**	**64**
Sensing	7	9	7	19	42
Sensing & Intuitive	4	0	3	6	13
Intuitive	1	1	4	3	9
Total	**12**	**10**	**14**	**28**	**64**
Visual	8	3	4	7	22
Visual & Verbal	1	4	8	13	26
Verba	3	3	2	8	16
Total	**12**	**10**	**14**	**28**	**64**
Sequental	5	6	8	17	36
Sequental & Global	4	3	3	7	17
Global	3	1	3	4	11
Total	**12**	**10**	**14**	**28**	**64**

5. CONCLUSION

The implemented research provided important guidelines in the field of adaptive and multimedia e-learning. Although no statistically significant difference between the ILS model and multimedia forms of e-learning has been confirmed the authors' stance is that this attitude should be additionally researched. This type of research requires larger sample to obtain statistically significant conclusions. Nevertheless, the importance of this research is reflected in the results that indicate that there are grounds to support claims that certain dimensions pertaining to ILS model can be correlated with the choice of an appropriate form of multimedia e-learning. So, inquiry e-learning was mostly chosen by active, visual and global learners. Hypermedia e-learning was chosen by sensing and reflective learners, self-explanation based e-learning was chosen by the intuitive learners while observational e-learning was chosen by both visual and sensing learners. These stances should be additionally corroborated by the research that would take into account more respondents and consequently provide a statistical confirmation of the said assertions.

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CRM MODEL IN E-BUSINESS FOR NON-COMMERCIAL ONLINE RADIO

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Abstract: *Non-commercial online radio stations require ICT support so they could promote themselves in today's turbulent times. The fact is that listeners don't have time to listen shows that do not belong to their interest group. This paper describes an idea that aims to raise the quality and increase the listening of non-commercial thematic online radio. For this purpose, we used the advantages of the concept of CRM and social media. From broadcasters of the online radio is expected to raise the level of professionalization of the narrator, and broadcast interesting and useful audio content. Worrying about the audience will be job of the CRM system, so that the management of the radio can be 100% focused on the quality of the audio broadcast. Interested listeners will show their satisfaction by giving the recommendations. Feedback on the overall activities of the listener will lead CRM system. CRM model described in this paper will be able to establish two-way communication with the audience: the audience will be divided into interest groups, and the show will be classified in a particular category. Example of CRM system for non-commercial online radio in this work is shown in the case of online radio Blagovesti.*

Key words: *CRM services, online radio, mobile applications, online surveys*

1. INTRODUCTION

In the Internet space is difficult to promote non-commercial online radio station. For the purposes of broadcasting, technology most commonly use one-way communication from the emitter to the listener. Electronic media are using modern ICT technologies that use two-way communication model where users can actively manage the content of program. This concept is more applicable for TV media then for the online radio. However, this concept is recommended for non-commercial online radio stations that do not have a budget for marketing. By using modern ICT technologies, it becomes easier to attract potential listeners and give them the opportunity to try the experience of two-way communication. The first step is to publish online surveys, which aims to get the contact information of potential listeners, who are interested in a particular topic. Contact information from the survey are going to be entered in a CRM system, and since then the CRM system takes care of them.

The paper has a detailed description of the CRM model that allows you to manage the relationship between broadcasters and potential listeners. Defined CRM radio model is for themed online radios that have, for example: scientific, historical, cultural, educational, medical or religious programming content. Since this is about non-profit radios, they are heavier visible to potential listeners. After registering and creating a personal profile on the online radio, the listener is identified as a member of the radio. The listener then has to install the mobile app on his smartphone and in that moment was started a two-way communication between broadcaster and listener. The CRM system takes care of the listener, sending him reminders on his mobile app with the time appointment of thematic programs. Listener can recommend online radio to his contacts. When the contact recommendations of satisfied listeners log on the system, CRM module will record and award recommendation.

2. REVIEW OF AVAILABLE SOLUTIONS ON THE WORLD MARKETPLACE

Customer Relationship Management (CRM) is each application or initiative designed to help the organization to interact with users, customers, suppliers or potential customers via one or more points of contact - such as call center, seller, distributor, branch, Web or email - with the intention of retaining or increasing the number of customers (TDWI 2000). CRM is based on the assumption that users are the core of business and the success of any company depends on the effective management relationships with them. Relationship exists if there is "a series of interactive episode between two or more parties over a period of time" (Buttle 2009). In case of our CRM model, whose use is on the online radio, it is clear that the interactions are very common. Using the information collected about users is aimed at increasing their loyalty and satisfaction, and the relationship gets better, longer-lasting and more profitable for companies. The important role of CRM in the

business of electronic media has been recognized in numerous studies. In the (Larose, 2004, 2010), the authors emphasize the importance of analyzing the specific characteristics of the audience, especially their habits. Also, the importance of determining the model of customer behavior in the digital environment is discussed (Webster, 2011). The authors discuss the structure and method of providing content to customers, but also they want to point out that the convergence of media and integration of the best solution.

On the world marketplace there are numerous solutions in our research field, and some of them are: WO Sales, Media, Radio workflow, InfluenceFM Radio Management Software, Salesforce, SalesTouch, Media Sales.

WO Media Sales. [1] This solution stands out as the main benefits:

- *The multi-layered architectures* - in terms of access and control of large organizations that operate on multiple markets with a large number of media.
- *Control of user accounts* - access to customer data, their habits, to create and monitor schedules and plans.
- *Create schedules and plans* - for each station and the market individually.
- *Research* - to easily create detailed reports based on the collected data.
- *Ranking data* - separation of data per significance.
- A clear order of work process: knowledge of listeners, campaign creation, contracting marketing, acceptance of bids, monitoring performance, the acceptance of the final results.

Radio workflow[2].

This CRM system is intended primarily for radio stations. Contributes to reduce costs, increase productivity and income, to implement quality processes, contributes to better communication. In the support of this CRM system is going great number of world famous stations that use it: Virgin Radio, Shore 104.3 FM Classic Rock 101, Zinc 96.1, Hot 91.1 FM.

InfluenceFM[3].

The CRM solution is for radio stations. Some of the functions that allows tracking user activity, obtain notification depending on client activity (cancellation, customer dissatisfaction, etc.), planning the interactive calendar, the integration of Gmail and Outlook calendars, tracking all levels of the sales process, the automatic creation of reports, work on a large number of devices (Windows, iOS, Android).

Media Sales[4].

Comprehensively CRM solution has the following functionality:

- Monitoring of the company, contacts and products
- Work with user accounts
- Create messages and e-mails
- Work with your calendar, plan

Supplied solutions have proven to be very effective in communicating with a large number of users, so it's our conclusion that we should follow the world trends and offered solutions, but also to harmonize the product for our customers and their needs in order to increase the listening of the radio and the listeners happiness.

3. CRM MODEL FOR ONLINE RADIO STATIONS

Announcing the campaign on social nets it is possible to reach the potential listeners, which are interested for thematic online radio stations. By forming the central web portal for presenting non-commercial thematic radio stations, potential listeners will have a chance to choose the thematic radio station depending on their interests, for example: Radio for fishermen, Radio for gourmands, Radio about history or religion.

[1] http://www.wideorbit.com/wideorbit-products/wo-media-sales/
[2] https://www.radioworkflow.com/
[3] https://influence.fm/
[4] http://www.wedelsoft.com/en/mediasales-software/crm-for-media-companies/

When the potential listener has decided for specific thematic online radio, he receives the link for downloading mobile application which he has to install on his cell phone. Mobile application will offer survey questions and corresponding answers will determine the specific group of listeners. CRM system is grouping listeners' profiles in specific groups staggered depending on the level of interest for the specific theme. For example, for a listener who started the online radio for gourmands, there are these specific groups: Mediterranean dishes, Seafood, Mexican specialties, etc. When the specific group of listeners is determined, then the CRM model for announcing listeners' profiles by using pop-up messages on a mobile phone is activated. Messages are related to timetable of categorized programs dedicated to specific internal groups. Every single day, within CRM module, will be created the list of programs for the next day, which will contain a scheme for broadcasting. Like for example:

The list of programs divided in specific groups for the „Radio for gourmands", for the next day will be:

Group MD – Mediterranean dishes: 02h, 05h, 15h
Group SF – Seafood: 18h, 19h
Group MS – Mexican specialties: 20h, 22h

When the mobile application gets this list from the CRM module, it will inform the listener with reminder, half an hour before the program starts.

CRM module subjects are:

- Online radio administrator
- Narrator
- A potential listener
- Listeners

An administrator – of non-commercial online radio organizes professional narrators for the specific subject of that online radio. It confirms and agrees that a specific audio program can be placed on the online radio server by a narrator. The administrator creates 24h program scheme. PHP scripts will do the technical job, put the 24h program on the shout cast server. The administrator follows BI statistics.

Narrators – will produce mp3 files and categorize them in specific categories. Narrators will put the specific prefix in the mp3 file's name by which they will categorize the program, for example: Program about preparing seafood will have the prefix „SF", program about Mediterranean kitchen will have prefix „MK", and etc.

A potential listener – potential listeners are contacted through social media. They have a choice of one of offered non-commercial thematic online radio stations. After registration, they are downloading smartphone application and are becoming active listeners, members of online radio. They are becoming the part of CRM system.

Listeners – are registered radio members which have a possibility to listen to the radio program, but also to be informed on time about interesting programs next day. They also have a possibility to recommend non-commercial online radio to their contacts and use the possibility to take a part in a radio program as loyalty members.

CRM system guides the listeners' profiles (groups with different interests) and audio program (categories). It will create relationships between the program and a listener. The information about the belonging of a listener to a specific group will allow the CRM system to inform a listener at the time (30 mins before the program starts) by the pop-up message on his mobile that the program from his group of interest will start soon. Statistics will be notifying the number of listeners and will be informing him about eventual need for a group change.

3.1. Architecture of a proposed paper

Potential listeners, and listeners

- Fill in the survey when choosing the thematic radio
- Decide which specific non-commercial thematic online radio want to listen
- Register for that radio
- Download smartphone mobile application
- Choose the area of interest – belonging to a specific group of interest

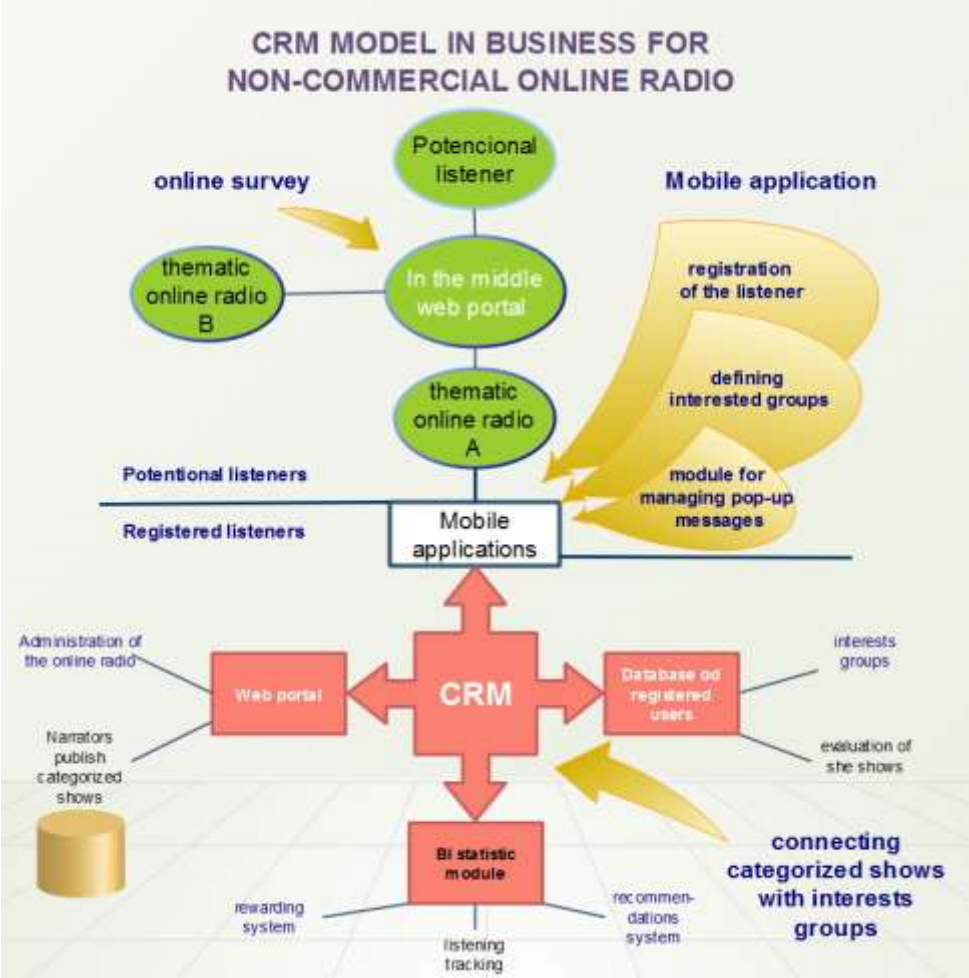

Figure 1. Model of CRM online radio

Mobile application

- Online radio player
- Overview of a program scheme for the current day
- Module for management with a reminder for thematic programs interesting for a listener
- Statistical module measures the listening time and accepts listeners' marks
- Implemented module for managing with recommendations

CRM system

Application layer

- Administrative panel for managing the program scheme
- Narrators categorize a program and using WordPress put them on a Web panel
- CRM module links the programs categorized by narrators with the correct groups of interest
- CRM module informs a mobile application with a registered user's profile with a list of programs that needs a reminder sent to listener and inform him about interesting programs

Data layer

- Database of registered listeners classified in specific groups of interest
- Database of categorized mp3 audio programs

Statistical layer

- Statistical data of the number of listeners
- Statistics recommend an eventual change of a group of interest
- Evidence of recommendations of a registered listeners

4. THE EXAMPLE OF THE IMPLEMENTED CRM ONLINE RADIO

The project of online radio Blagovesti uses advantages of the ICT technology stated in this paper. It is related to a religious theme. Potential listeners have been contacted through social nets, and they have left their profile data by filling in online surveys. CRM has divided them into groups of interest. The radio administrator sends some thematic texts to narrators. They read them, categorize them into specific categories and put them on the web portal made in WordPress.

During the next day, narrators are putting audio programs on the web page. At the end of the day the radio administrator puts the program scheme for the next day. PHP script that implements the program for the next day is automatically activated at midnight.

When the PHP script is done, CRM system has the access to the data with the list of categories of programs which will be downloaded by mobile applications. For example, categories: programs with spiritual messages will be broadcasted at 01h, 03h, 07h, 09h, category Reportage will be broadcasted at 02h, 15h, 18h, category Program about the history of the Church at 17h, 19h, category Programs about health at 22h, 23h. Regarding statistical data, the average number of listeners (IP addresses) connected to the online radio Blagovesti is approximately 40, i.e. 80 listeners constantly. They usually spend approximately 180mins on the radio what implies that approximately 800 listeners access the online radio.

Figure 2. Web site

On the web portal of the radio Blagovesti, there is a program scheme for the next day on the right-hand side, and in the middle, broadcasts are placed by narrators. Programs are available for off-line listening, which means that all of them can be listened by choosing the web page or by downloading it in the mp3 format. Reproduction of the program starts automatically by accessing the web page. A player as a WordPress plug-in is incorporated in the web page.

Mobile application: A dedicated Mobile application “Radio Blagovesti 2.0” has been created and it serves as a player for online radio Blagovesti, but also for the two-way communication between CRM system and a listener. By using a mobile application, a listener is defining his interests, and the CRM system contacts the application about the lists of the programs dedicated to a group of interest to which a user’s profile of a mobile application belongs.

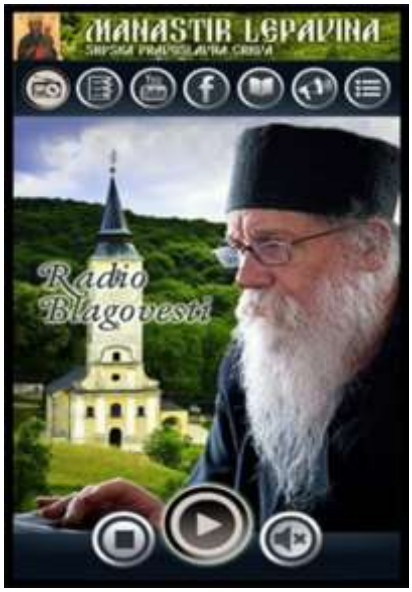

Figure 3. Mobile application
“Radio Blagovesti 2.0”

Mobile application has several functions:

- Audio player
- An overview of the radio broadcasting scheme
- Access to the administrative Facebook page
- Access to the YouTube canal
- Archiving of the web links of audio programs which belong to the listeners’ group of interest
- CRM functionality: incorporated reminder system
- CRM functionality: accesses users’ profile data
- CRM functionality: defines and changes listeners’ groups of interest
- CRM functionality: manages recommendations

5. CONCLUSION AND DISCUSSIONS

By using CRM functionalities thematic non-commercial online radio stations could easily reach their listeners and make a two-way communication with them, which is important nowadays when a listener wants a better quality service. Listeners do not have time to listen non-commercial radio program the whole day, and it is needed to be in touch with a listener and inform him about the programs which he specified in the survey as interesting. A mobile application will archive web links of those programs which are of exceptional importance for a listener’s group of interest. This way we respect our listeners’ time and take care of them.

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WEB SITE INTEGRATION INTO ORGANAIZATIONAL STRUCTURE OF THE LOCAL TOURIST COMMUNITY

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Abstract: *In the operations of the local tourist community, Web site represents a central place where visitors can be informed. Based on the impressions they have gained there, their decision whether to visit the destination or not will be made. Since site is significant for business, two elements should be defined: site integration into the organizational structure of the local tourist community and methodology for evaluating the quality of the site, as well as its success in the business environment. The paper proposes a model of Web site integration and defines the methodology for its quality evaluation. Evaluation of the site has always been problematic because there is a large number of subjective factors that affect its quality. In this paper, Elements of Quality of Service (QoS) are separated from Quality of Experience (QoE) in addition to the analysis of other criteria. Thus separated Methodolog of evaluation, provides the opportunity to mesure quality of website more precisely.*

Keywords*: site integration model, site evaluation, local tourist community*

1. INTRODUCTION

In modern environment, the existence of local tourist community without a well-conceived Web site is almost impossible. First of all, it is necessary to present, in one place, local tourist community, as well as to display all options for informing visitors. Marketing and promotion of local tourist community is business which has to be organized with an aim of presenting the offer in the best way. Also, it is a place where local service providers (hotels, motels, apartments, caterers and others) should set their links, so visitors can find all relevant information in one place. Individual facilities generally have modest Web sites without additional options such as payment services or loyalty schemes and it is in their best interest to connect with the environment, so they can use those additional features. Local tourist community website should be a portal, where all local service providers can connect and get advanced features and services. They can achieve this by placing their link on the site of the local tourism community. By using a website, local tourist community acts as a single unit with unified offer of all services relevant for visitors with a main goal to promote all its associated members engaged in providing tourist services and place them in an equal position.

2. LOCAL TOURIST COMMUNITY WEB SITE

Website of the local tourist community is a part of system and its task is to integrate several elements of the tourist offer, as well as to deliver information to the customers-tourists and to be one of the focal points of their connection with the environment. In order for the Website to function, it must be intensively supported by the local administration, which means that part of the services must be involved in the development, implementation and maintenance. Base initiative must be generated at the local level, and someone has to fund the initial development of the website, define the basic concept requirements and do the initial version of the site. It is possible to assign the site development to local experts employed in the local administration, but in most cases, to outsource these jobs.

In order for Website to function, it is necessary to form the background department whose task is to prepare materials that will be shown on the Website. This is a serious and thorough work which has to be constantly harmonized with the management of the local tourist community. It implies that rules for the preparation and approval of the materials that will be shown on the site must be agreed between the background departments and local tourist community. Control over this process should not be given to employees in background department, because materials prepared in such a way may conflict with the decisions and policies of the local tourist community and because it is not advisable to deny previously published information. Site is a public way to communicate, so any published information has to be confirmed as valid and has to be in accordance with the interests of the entire community. This means that all materials prepared by background department have to be present to relevant persons in local tourist community, and only after obtaining their consent, be published on the Website.

In order for a Website to function in unity with the environment, it is necessary to connect it with environment so that booking system, payment system and loyalty scheme could be involved in the business. This connection is established through a background department (back server), because the part of the local

booking systems that apply only to the local community can be serviced locally, but if you need to include payment systems or loyalty schemes, then there must be a connection with these systems. (Daglas, P (2015)).

The second set of information that should be collected and refer to local tourist community are information collected from sensor networks. Placement, collection and distribution of information such as air and water temperature, humidity, pollen, parking places in the city, etc. is usually made within the information systems of the local tourist community (Smart city), but their processing and distribution is made through the website. This further means that collected information should be analyzed and prepared for posting on a website. These data can be made available through other channels too, but it is required that they be placed in order to have all information in one place.

Data collected in this way can be used to prepare the proposals for tourists and suggest them what to do on particular day. Based on the weather forecast (sunny, cold, windy) it is possible to suggest visiting places of interest, or to offer to organize entertainment events. Website or background department that receives and distributes information, should be a central place for organizing offers for events to be held at particular destination. Relevant information may also contain suggestions on to what to do in certain cases (where to go if it is raining).

The third set of the information are articles, pictures and multimedia materials that should be available on the site. This is something that is dealt by journalists, photographers and staff responsible for multimedia presentations. This kind of work should be delegated to marketing and branding sector of local tourist community. It implies linking all facilities that have their own separate sites and integrating them vertically into existing infrastructure.

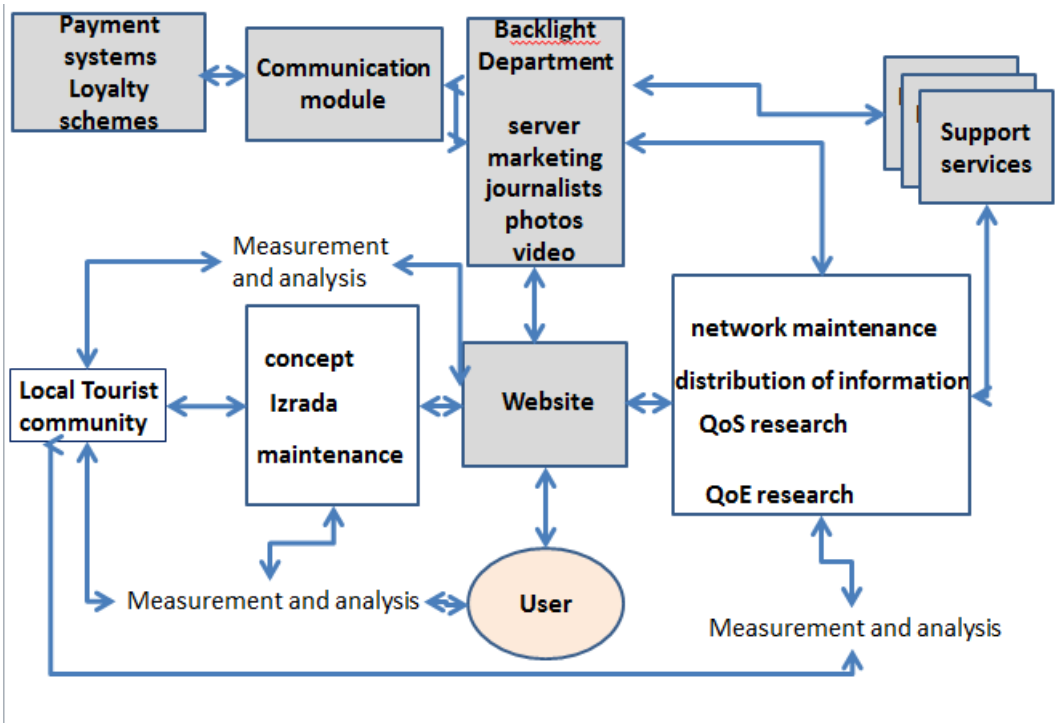

Figure 1: Model integration site into the structure of the local tourist community

In order for site to successfully perform its function, it has to be well organized so that information can be easily found. This especially applies to accommodation at the relevant destination, and offered entertainment events, which should all be supported with pictures. Pictures should be large and well-chosen in order to have an emotional impact on visitors. Pictures can say a lot more than the text so they should be chosen with special care, because their main goal is to awaken the desire to visit the destination. Besides pictures, video materials are something that can significantly complement the emotional involvement of users, particularly if they are accompanied by appropriate music and well prepared text (spoken and written). It is important to display guests at particular destinations in pictures and video materials, because it increases the emotional experience and potential tourists desire to visit the destination. Special attention should be paid to the segment of population that the site is intended for. Before the preparation of the material, detailed analyses should be made of visitors' habits, preferences and experiences. This further implies that there

should be a specialized sector within the local tourist community conducting research work on who the visitors are. Significant part of these information can be collected using social networks, based on the information which users themselves place. By following this information and by direct contact, users can be motivated to share their positive experience with local tourist community which, at the same time would gain insight into what should be done in order to improve the offer. Simple and elegant design of the site which includes maps, hints and tips on what to do and how to spend the time at chosen destination, significantly enhances operations of the local tourist community. (Buhalis, D., & Lawb, R. (2008)).

On the other hand, a large number of questions and requests ca be expected from the users. This means that some of the answers can be found in the "frequently asked questions" part of the site, but they should also have at their disposal "Call Center", phone or agency for any additional questions or problems solving.

Site means continuous work and in order for it to function in accordance with the business environment, it is necessary to have a methodology to evaluate its effectiveness and quality.

3. WEB SITE QUALITY EVALUATION OF THE LOCAL TOURIST COMMUNITY

Since the appearance of Internet, there is a constant need to evaluate sites and to measure their quality. Problems that occur in these estimates are primarily in the complexity of the criteria and the specifics of the web sites impact in different business environments. This further means that sites in certain industries can be quite satisfactory and same concept in others does not give good results. Web site is a place of communication with users. In order to allow evaluation of their quality, different methodologies have been used. (Malak, G., Bader, L (2004)).

In order to enable a comprehensive evaluation of the sites quality it is necessary to separate two different views in the methodology, QoS (Quality of Service), which include technical elements of the site quality and the quality of user experience QoE (Quality of Experience).

Quality of Service (QoS-Quality of Service) depends primarily on the technical capabilities of the network through which users have access. In addition to these limiting parameters, the service quality is also affected by the size of graphics, video materials and all the multimedia elements that require a large amount of transmitted information. Multimedia materials, that are needed on the site significantly increases load of the communication channels, so they are expected to have a large bandwidth, sufficient bit rate where there will not appear delay or packet loss when it comes to the live broadcast. Special category that should be mentioned here is the ability to access the site using different devices. Increased presence of mobile devices and access to Internet services through these devices requires the site to be adjusted in such a way that will ensure its display on these devices. This emphasizes the need to take into consideration communication channels when evaluating the quality of the site. Set of parameters for QoS includes additional services such as social networks, connection with the environment and e-marketing.

On site e-marketing represents an additional load because this includes demanding multimedia presentations, video and audio materials of high quality graphics which significantly loads communication channels.

Since QoS does not consider the quality of network performance from the standpoint of customer perception, QoE (Quality of Experience) concept has been introduced to improve the quality of the customer experience. QoE in this case should serve as a metric to qualify quality of service and network administration from the perspective of customer perception but also to analyze other criteria that make users satisfied. In this case QoE presents a measurement of the quality of the customer's perception. In this way acceptance of the placed materials and services can be identified. Thus, the fundamental difference between the concepts of QoS and QoE is their network relationship so it can be said that the QoE is user-oriented, and QoS network-oriented concept. Of course, these two concepts cannot be seen isolated one from another. (G Sarada P., V. Pallap 2015)

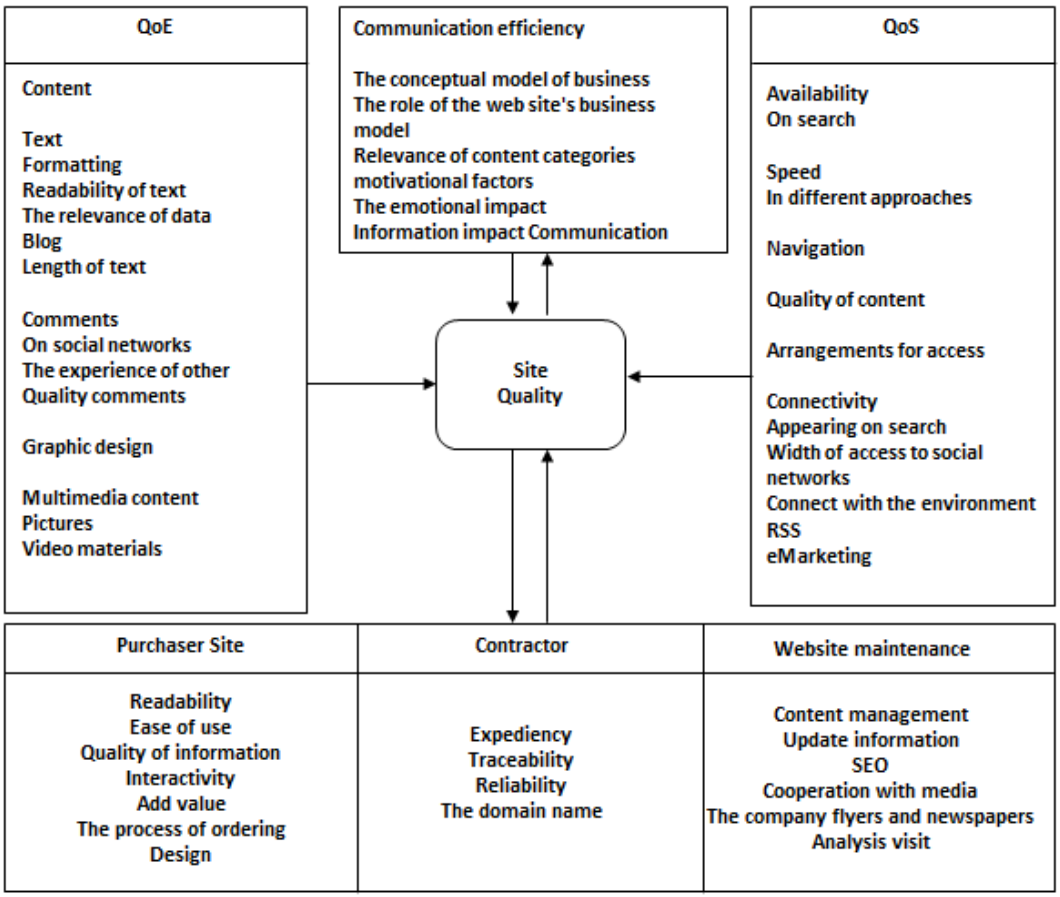

Figure 2: Categories for assessing the quality of the Website

QoE (Quality of Experience) includes a whole range of criteria that significantly affect customer satisfaction. The most important is quality level of graphical design that affects QoE. Well blended color, legible text and appealing design are the basis for high-quality design. Multimedia is almost obligatory part of the site, and it is directly related to QoS. Position of the pictures and all the other visual elements of the site must be easily recognizable and user friendly. All that is shown on the website should focus user on the main goal of website and its offer.

Compatibility is meant to be fully achieved. This means that site is available for different browsers and can work on different operating systems.

The next category which is important for evaluation of the site is communication efficiency. The conceptual model of the company should be primarily analyzed in order to comprehend the role of the Web site in its business model. Business model can include a larger number of categories, for each of them capacity allocation is needed to avoid overlaps. On the other hand, depending on the business model in certain industries (tourism, for example), sites emotional impression on the visitor has a dominant influence. Multimedia content has the special role in this case. The combination of emotion and information creates prerequisites for successful business connections.

Last but also very important category is associated with the development and maintenance of the site. When planning creation of the site, it is necessary to define a set of criteria that the site should achieve. Program requirements should be defined in advance so they can be aligned with main purpose of site and services planned to be implemented. This criteria can be applied only with monitoring of website in long period of time and knowing the organizational structures of development of site. Out of categories available on the site, legibility (the ratio of background colors and letters), the quality of information, additional features and design can be evaluated.

Evaluation of team, that was tasked to create a site, also belongs to this category. Reliability of the site and its stability can be estimated within a long period of observation. The domain name is also very important but even today it is quite difficult to find a suitable free domain.

The specific element of this group is maintenance. This segment can be very well monitored and evaluated since the changes on the site can be easily tracked.

It is significant to note that there are several limitations that such evaluation makes questionable. First of all, all data collected for the evaluation are based on a limited number of access to each site at a particular time, beside the fact that the Web is a highly dynamic and changeable medium. Similar studies in different periods of time can show different results. Evaluation like this will also shed some light on whether there is a divergence or convergence of Web activity over time. If only technical parameters can be evaluated, QoS would be the only parameter that can be measured. Analysis of "log files" is also reliable data and detailed research and comparison can be performed based on this data.

Another problem is the subjective evaluation of the factors and assigning weight coefficients, which introduces subjectivity in this analysis. Interviewing employees can improve the allocation of weight coefficients, because only they know how much individual categories are relevant to their business. Once assigned weight coefficients can be later modified in order to obtain objective research.

4. CONCLUSION

The tourist industry depends on the quality of communication with their visitors. Website, as a central place where visitors can be informed, thus it must meet all their requirements, provides information and also initiate emotions. Website integration into business environment presupposes that the organization has prepared itself. First of all the scheme of preparing material that will be on the site, procedures for compliance and approval of materials that will be posted, must be defined. The website is a public service and for all that is placed on it someone has to be responsible. Technical personnel that maintains website cannot be held responsible, but the responsibility is on the competent management of the local tourist community. There must be a mechanism for coordination and methodology of harmonization in order to avoid conflict. These sites are typically advertising destination or local tourist community and if there is a favoring of certain market participants, conflict of interests must be taken into consideration. The rules must be set, before the commencement of work. Periodic control of quality implies that there is a methodology for evaluation on the ground of which periodic control is made.

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APPROACH TO COLLABORATIVE MICROLEARNING BASED ON CROWDSOURCING

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Abstract: *This paper presents integration of crowdsourcing and microlearning in higher education. The goal of this paper is to develop a model of collaborative microlearning based on crowdsourcing. The suggested integrated model can be applied in smart learning environments. The implemented crowdsourcing microlearning project is student-centered and it provides students with opportunity to be both knowledge creators and knowledge users at the same time. The evaluation of results was based on the data collected from survey. The students showed remarkable readiness and interest for participation in collaborative and crowdsourcing projects. Furthermore, it was found that students with higher tendency to participate in crowdsourcing by participating in more crowdsourcing projects have increased intensity of satisfaction and intrinsic motivation. It also influences their perception of the usefulness of crowdsourcing on the dimensions of learning and acquiring skills. On the other hand, the higher tendency for participation in crowdsourcing projects reduces the intensity of perception of reward as extrinsic motivator.*

Keywords*: crowdsourcing, collaborative microlearning, microcourses, creation, attendance, smart learning environment*

1. INTRODUCTION

Development of information and communication technology resulted in different changes in education. It is obvious that the number of classical “face-to-face” lectures was being reduced at universities. At the same time, the level of individual students’ learning is increasing. This type of students’ learning is usually conducted through the use of Internet and must be stimulated with different resources like video materials, individual activities for learning with self-evaluation, etc. (Coccoli, Guercio, Maresca & Staganelli, 2014). The present need to reduce time for learning resulted with development of microlearning and microcourses, and it leads us toward the “micro-era” (Wei, Yang, Zeng & Yu, 2015). There had been changes in the learning styles of students as a result of interactive world around us as well as the increasing popularity of social media which stimulates students to share knowledge in the form of social and collaborative learning (Coccoli et al., 2014). The growing gap between technology and students' motivation for learning (Heusler & Span, 2014) resulted in the necessity for the creation of student-centered educational environment. Smart educational environment accompanied with physical environment enables creation of situations and events necessary for stimulation of individuals to study and find solutions for different problems, to socialize within the group, to exercise and think (Koper, 2014).

As a collaborative model for knowledge creation, crowdsourcing has been used for creating and broadening of knowledge. The examples of using crowdsourcing in the process of education can be found in collaborative projects, supplemental instructions, open educational recourses, public content, peer assessment, problem-based learning and serious games (Anderson, 2011). Development of crowdsourcing has been facilitated by the use of web technologies which help individuals to solve individual, organizational and social problems. Crowdsourcing is characterized by dynamically formed group of people who respond to call from crowdsourcer (Pedersen et al.2013). Further characteristics of crowdsourcing include openness towards the group, participation of a large number of individuals and the use of different platforms (Hosseini et al., 2014). In the process of e-learning, the term crowd is used for describing students. On the other hand, in certain crowdsourcing projects the term can also be used for teachers, alumni, associates, etc. The aim of crowdsourcing is to take an advantage of collaborative work, joint goals and collaboration of students. In higher education, four key models of crowdsourcing can be distinguished: crowdteaching, crowdlearning, crowdfunding and crowdtuition (Llorente & Morant, 2015).

As a new form of education, microlearning can be implemented as a crowdsourcing project in two phases: phase of creation and phase of attendance. Development of online crowdsourcing community fosters collaborative learning. Furthermore, students are in interaction among themselves and with the crowdsourcer. They can create content, share ideas, knowledge and skills, virtual and physical resources, evaluate certain activities and content, vote, etc. Microcourses or microlessons are the forms of online web

video courses which are developed around key points of knowledge (Wei, Yang, Zeng & Yu, 2015). Microlearning shows positive effects on acquiring targeted knowledge and it is adjusted to human attention span (Sun et al., 2015). For that reason, duration of microcourses is usually between 5 and 8 minutes (Wei et al., 2015). Microcourses can be used for online, blended, and face-to-face learning (Hou, Gou & Gao, 2016). Microcourses are primarily based on video materials and they can be formed around the points that can represent problems and difficulties for students at that course (Shen & Shen, 2015). Additionally, microcourses provide students with the opportunity to study anytime and anywhere they want and to adjust learning according to their time (Hou, Gou & Gao, 2016). Social media and specialized platforms can be used to support microlearning. These platforms enable creating, publishing and attending microcourses, among which Coursmos, Daily Bits Of and Grovo are important examples.

Crowdsourcing and microlearning conceptually offer different possibilities and approaches to teaching and learning, but their integration offers the improvement of individual students' work and learning. In this paper we developed a model of crowdsourcing creating and attending microcourses in smart learning environment. In such environment, students are knowledge creators and knowledge users at the same time. The aim is to integrate crowdsourcing into overall process of microlearning. Implementation and evaluation of this project has been conducted at Laboratory for E-business at Faculty of organizational sciences in Belgrade. Evaluation of results indicates significant influence of crowdsourcing mechanisms for creating and attending microcourses on students' satisfaction, perception of acquiring skills, studying and acceptance of the used technology.

2. MODEL OF CROWDSOURCING MICROLEARNING

Integration of crowdsourcing and microlearning in educational process implies design of integral model that will respect performance of existing physical environment, adaptive crowdsourcing mechanisms and readiness for implementation of crowdsourcing collaborative network as a way of upgrading existing e-education.

Microlearning through microcourses can have two dimensions: collaborative learning through creation of microcourses and individual learning through microcourses attendance. Identified crowdsourcing mechanisms in creation of microcourses are: group work, identifying hierarchical/demographic group work, interaction in the group, rewards and relation to crowdsourcer. Within the microcourses attendance the following crowdsourcing mechanisms are significant: comments about content, evaluation, recommendation for others, sharing microcourses on social media, giving recommendations for related microcourses, brainstorming for new topics, rewarding and relation to crowdsourcer.

Adaptive crowdsourcing mechanisms of microlearning have a potential to strengthen participative role of students so that educational environment gains new dimensions and functionalities. Smart learning environment is defined as physical environment enriched with digital, context aware devices in order to advance the process of learning. Such environment has got an educational goal to create productive, smart and responsible members of society (Spector, 2014). In reference to smart environment it can be said that such system should be designed to focus on human and to use all available technologies for sustainability, reliability, mobility and flexibility. Smart solutions should be personalized, adaptive and interactive, and available at any moment, from any place and from any device (Coccoli et al., 2014). In his work, Spector (2014) suggests theoretical framework for conceptualized smart learning environment. It is mostly realized through Internet and Things (IoT) which connects things and devices from real world to the things from virtual world.

Integrated platform for microcourses in smart learning environment should integrate services and applications of crowdsourcing platform, mobile applications, social media and IoT platform (Figure 1). Integrated system should have the following characteristics: availability, adaptability, interoperability, reliability, and possibility of reuse.

The users of integrated platform for microcourses in smart learning environment are students, professors and crowdsourcer. The users can access the platform from different devices like smartphones, tablets, laptops and applications for such devices. The two main ways to access the platform is through web and mobile application. The users can access directly to integrated platform for microlearning or through certain parts of the system (e.g. social media or IoT platform).

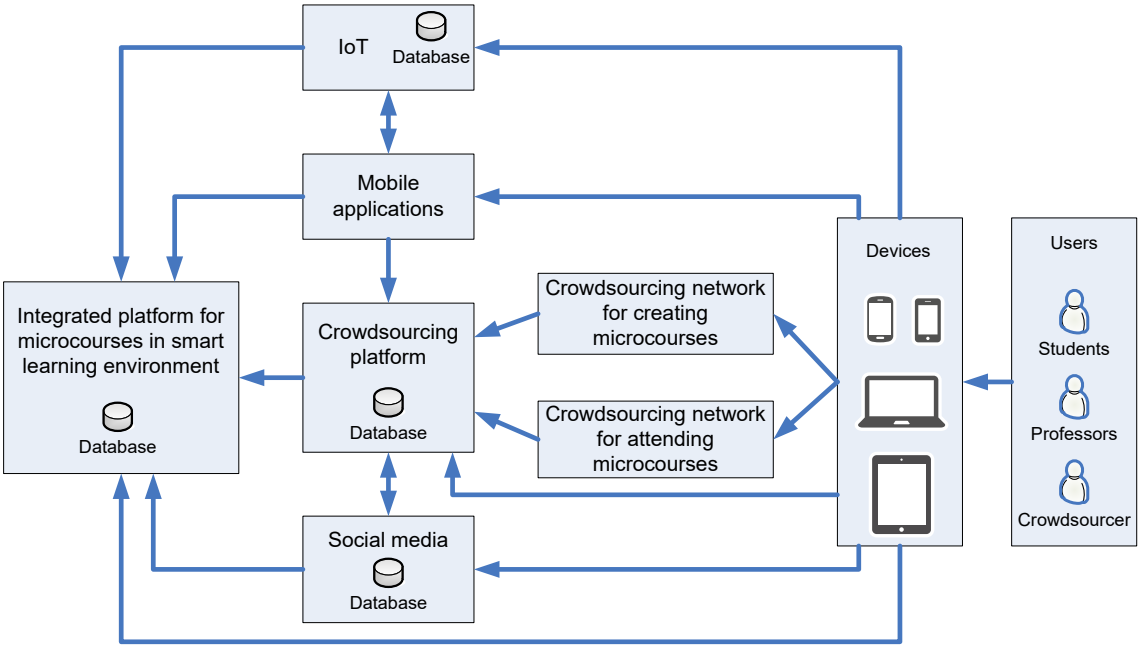

Figure 1: Model of crowdsourcing microlearning in smart learning environments

Crowdsourcing platform, which represents a part of integrated platform, gives an opportunity to the users to become a part of crowdsourcing network for attending or creating microcourses, and to participate in other crowdsourcing activities. The role of social media within the model refers to the possibility to engage networked group of people or to share final results of crowdsourcing activities (e.g. microcourse). Integrated crowdsourcing platform should have an option for personalized tracking of students' activities in real time of the crowdsourcing process. IoT platform can enrich integrated platform with different sensor data in reference to educational environment, localization of students' activities, etc**.**

3. MATERIALS AND METHODS

The project of crowdsourcing microlearning and evaluation of crowdsourcing mechanisms for e-learning through microcourses has been conducted as part of the study course E-business at Faculty of organizational sciences, University of Belgrade, year 2015/16. Crowdsourcing task referred to creation and attendance of microcourses. The procedure of crowdsourcing microlearning implementation is represented at Figure 2.

The project has been planned, implemented and evaluated under supervision of E-business department professors. The professors had formed a team of five members to represent crowdsourcer. The crowdsourcer had the tasks to: identify and publish potential topics, organize students' applications, form groups together with students, help students, examine the final microcourses, choose a platform for microcourses and to publish good quality microcourses. The project team chose the open platform for microcourses – Coursmos. This platform offers possibility to create free and paid microcourses, and it also provides online certificates for students, testing of students, etc. (Coursmos, n.d.).

The students were invited to participate voluntarily in creating and/or attending microcourses. Both activities were rewarded with bonus points for the final exam.

The task was to create a video microcourse lasting 5 to 7 minutes. The microcourses were created by using software for screen recoding. The period for creating microcourses was two weeks. Totally 123 students participated and 46 microcourses have been created among which 44 had been published on Coursmos platform. The professors evaluated published microcourses according to two criteria: educational and technical quality.

Totally 127 students attended microcourses. Their task was to attend minimum two microcourses, to comment and evaluate microcourses.

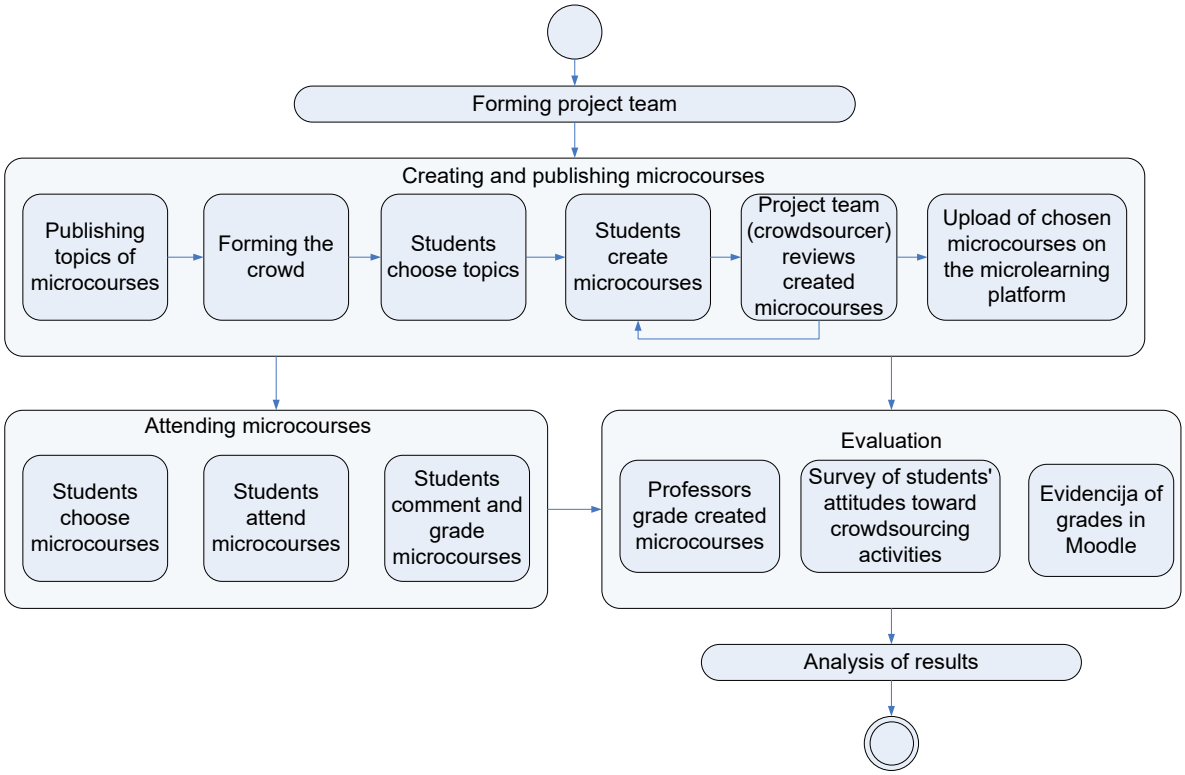

Figure 2: Procedure for implementation of crowdsourcing microlearning

Experiment was conducted as a part of broader experiment in which all students had been included in real conditions. Data were collected through the survey which was given to students at the final exam. The students who attended microcourses were identified through data collected from Coursmos platform. Moodle provided data concerning marks and structure of points at the subject.

The survey was filled out by 271 students, among which 71 created microcourses (sample "created"), and 74 attended microcourses (sample "attended"). Since 39 students created and attended microcourses (stratum "created and attended"), two more strata have been identified: "only created" and "only attended".

The sample "created" included 57.7% of population, and the sample "attended" included 58.3% of population. Characteristics of the samples and strata are given in Table 1. There are missing data on the average grade of students.

Table 1: Characteristics of the sample

		Sample			Stratum		
		Whole sample	**„Created"**	**„Attended"**	**„Only created"**	**„Only attended"**	**„Created and attended"**
Number		271	71	74	32	35	39
Gender	**M**	95 (35.1%)	28 (39.4%)	24 (32.4%)	14 (43.8%)	10 (28.6%)	14 (35.9%)
	F	176 (64.9%)	43 (60.6%)	50 (67.6%)	18 (56.3%)	25 (71.4%)	25 (64.1%)
Study programme	**ISIT**	173 (63.8%)	65 (91.5%)	56 (75.7%)	28 (87.5%)	19 (54.3%)	37 (94.9%)
	ME	98 (36.2%)	6 (8.5%)	18 (24.3%)	4 (12.5%)	16 (45.7%)	2 (5.1%)
Average grade	**6-6.99**	4 (1.5%)	0	0	0	0	0
	7-7.99	96 (35.8%)	19 (27.9%)	23 (31.5%)	5 (16.7%)	9 (25.7%)	14 (36.8%)
	8-8.99	126 (47%)	28 (41.2%)	34 (46.6%)	13 (43.3%)	19 (54.3%)	15 (39.5%)
	9-10	42 (15.7%)	21 (30.9%)	16 (21.9%)	12 (40%)	7 (20%)	9 (23.7%)

The survey had 3 parts. The first part was filled out by all students, the second part was for students who created microcourses and the third part was for the students who attended microcourses. The central part of all 3 parts of the survey included measuring students' attitudes on a five-point Likert scale.

The first part of the survey measured the students' attitudes (initial perception) about the relation of collaborative learning and dimensions of e-education, such as: the influence of collaborative projects on e-learning, results of individual/collaborative learning, acquisition of skills and usefulness of accepted technology. Each dimension contained multiple items. This part of the survey also included questions like gender, study programme (ISIT – Information systems and technologies and ME – Management), learning orientation, usage of social media and ranking of motivation factors in collaborative work.

The second part of the survey measured attitudes of students who created microcourses about the influence of collaborative creation of microcourses on the following dimensions of e-learning: satisfaction, learning, skills and incentives. It also measured the characteristics of crowdsourcing activities of individuals and groups.

The final part of the survey involved the group of students who attended microcourses and it consisted of three sets of items. The first set of items measured the influence of attending microcourses on the following e-learning dimensions: satisfaction, learning and usefulness of accepted technology. The second set of items contained students' evaluation of attended microcourses, while the third set of items was used to measure the platform functionalities. Moreover, the following data were also collected: number of attended microcourses, the average time needed to complete microcourse, characteristics of microcourses and activities on the platform.

Cronbach's Alpha was used to investigate internal consistency of the survey for measuring attitudes of students who created and attended microcourses. Cronbach's Alpha values for samples „created" and „attended", as well as for all strata are in interval from 0.832 to 0.922. Furthermore, each question in Cronbach's Alpha if Item Deleted is in the range 0.799 to 0.926. All these coefficients indicate an acceptable level of internal consistency of the used measuring instruments (higher than 0.7).

4. ANALYSIS OF RESULTS

4.1. Analysis of influence of creating microcourses on e-learning

Descriptive statistics was used to analyze the influence of creating microcourses on different attributes and dimensions of e-learning for the whole sample (C), strata "created and attended" (CA) and "only created" (OC) (Table 2). The identified attributes are divided into four dimensions: satisfaction, learning, skills and incentives.

Mean values of eleven attributes are higher for stratum "created and attended" when compared to stratum "only created" and the whole sample. Only the mean value of attribute "bonus points" is higher for stratum "only created". It is obvious that students who participated in the entire project have greater intensity of attitudes regarding influence of creating microcourses on different dimensions of e-learning: satisfaction, learning and skills, as well as on the attribute "recognition of colleagues".

Of all the attributes, "satisfaction related to participation" has the highest mean value for the sample as a whole, as well as for strata "created and attended" and "only created" and it represents the most important attribute. On the other hand, attributes from „incentives dimension" have the lowest mean values for the whole sample and the both strata. Reward in the form of bonus points has the lowest mean value for the whole sample and stratum „created and attended". Attribute „recognition of colleagues" is the least important attribute of creating microcourses for stratum „only created".

„Administrative support of crowdsourcer" is second rated attribute for the whole sample and stratum „only created", and it is the third rated attribute for stratum "created and attended". High average grades of this attribute show high level of understandability of the project for both strata.

Regarding the influence of creating microcourses on "learning dimension", the most important attribute for both strata is "stimulation of creativity". The biggest difference between the strata in this dimension refers to the attribute "stimulation for making an effort for the subject".

There are relatively big differences in mean values for attributes in "skills dimension" between two strata. For stratum "created and attended" the most important attribute is "preferring collaborative skills", while for the whole sample and stratum "only created" it is "advancing teamwork skills". The least important attribute in this dimension for both strata is "advancing scientific-research skills".

Table 2: Influence of participation in microcourses creation on different dimensions of e-learning

Attribute	Mean		
	C	CA	OC
Satisfaction dimension			
Satisfaction related to participation	4.31	4.38	4.22
Administrative support of crowdsourcer	4.06	4.15	3.94
Learning dimension			
Adjustment to learning orientation	3.92	4.03	3.78
Stimulation of creativity	4.00	4.08	3.91
Stimulation for making an effort for the subject	3.73	3.97	3.44
Skills dimension			
Advancing social and communication skills	3.82	4.03	3.56
Preferring collaborative skills	3.97	4.23	3.66
Advancing analytical skills	3.76	4.05	3.41
Advancing teamwork skills	4.03	4.15	3.88
Advancing scientific-research skills	3.54	3.82	3.19
Incentives dimension			
Bonus points	3.17	3.15	3.19
Recognition of colleagues	3.30	3.54	3.00

T-Test was used to determine whether there are significant differences between the two strata regarding influence of creating microcourses on various attributes of e-learning. It was found there are significant differences between these strata ($p < 0.05$) in terms of:

- stimulation for making an effort for the subject($p=0.02$, eta=0.07, effect size=medium to large);
- advancing analytical skills($p=0.02$, eta=0.07, effect size=medium to large);
- advancing scientific-research skills ($p=0.03$, eta=0.07, effect size=medium to large).

4.2. Analysis of influence of attending microcourses on e-learning

Descriptive statistics of influence of attending microcourses on e-learning was used for the whole sample (A), strata “created and attended” (CA) and “only attended” (OA). The three dimensions of influence of microcourses on e-learning were identified: satisfaction, learning and usefulness of accepted technology. The mean values of these dimensions are given in Table 3.

Mean values of all attributes regarding influence of attending microcourses on e-learning for stratum „created and attended“ are higher compared to stratum „only attended“ and sample as a whole. „Acquiring new knowledge“ is the most important attribute for both strata and for the whole sample. The least important attribute for the sample as a whole and the two strata is "adjustment to learning styles“.

Table 3: Mean values of attributes of attending microcourses

Attribute	Mean		
	A	CA	OA
Satisfaction dimension			
Satisfaction related to participation	4.19	4.26	4.11
Learning dimension			
Acquiring new knowledge	4.46	4.51	4.40
Adjustment to learning orientation	3.95	3.97	3.91
Adjustment to learning styles	3.91	3.92	3.89
Stimulation for making an effort for the subject	4.09	4.15	4.03
Usefulness of accepted technology			
Improvement of educational environment	4.28	4.31	4.26
Sharing on social media	4.11	4.28	3.91
Using mobile applications	4.12	4.28	3.94

Regarding attributes in the „learning dimension“ there are no important differences between mean values for the two strata, as well as for the whole sample.

The most important attribute in dimension “usefulness of accepted technology” for the whole sample and the two strata is “improvement of educational environment”. The stratum “created and attended” has the same average grade for attributes “sharing on social media” and “using mobile applications”. Sample as a whole and stratum “only attended” consider “using mobile applications” on platform is somewhat more important when compared to “sharing on social media”.

T-Test results showed that examined population of students who attended microcourses is homogenous in terms of all attributes, so there are no significant differences in attitudes between stratum “created and attended” and “only attended”.

4.3. Comparative analysis of the influence of creating and attending microcourses on e-learning

There are three common attributes identified for samples “created” and “attended”: satisfaction related to participation, learning orientation and stimulation for making an effort for the subject (Tables 1 and 2). By comparing mean values of students’ answers it is found that creating microcourses has higher level of satisfaction and a greater perception of compliance with orientation towards learning than attending microcourses. However, attending microcourses encourages students more to make an effort for the subject than creating microcourses.

Correlation analysis using Pearson coefficient demonstrated the following:

- between all considered attributes for creating and attending microcourses there is statistically significant positive correlation for samples „created“ and „attended“, and for stratum „created and attended“;
- for sample “created” there is moderate to high positive correlation (0.5-0.75) between all included attributes;
- for sample “attended” there is a strong positive correlation (r>0.75) between attributes „adjustment to learning orientation“ and „stimulation for making an effort for the subject“, and moderate to high correlation between attributes „satisfaction related to participation“ on one hand and attributes „adjustment to learning orientation“ and „stimulation for making an effort for the subject” on the other hand;
- for stratum “created and attended”:
    - low to moderate correlation (0.25-0.5) between attributes „satisfaction related to participation“ and „stimulation for making an effort for the subject”, and moderate to high correlation between attributes „adjustment to learning orientation“ on one hand and „satisfaction related to participation“ and „stimulation for making an effort for the subject“ on the other hand;
    - satisfaction in creating microcourses is not associated with satisfaction in attending microcourses;
    - correlation between attributes „adjustment to learning orientation“ in creating and attending microcourses is moderate to high;
    - correlation between attributes „stimulation for making an effort for the subject“ in creating and attending microcourses is low to moderate.

5. DISCUSSION

Implementation of the microlearning project in academic environment confirms that student collaborative projects and crowdsourcing represent important fields of e-education which are oriented towards development of students' participative mechanisms and improvement of educational processes. The identified crowdsourcing mechanisms of microlearning represent adequate framework for using students’ collective intelligence in creating and broadening of knowledge. Students showed readiness and interest for participation in collaborative and crowdsourcing projects (Kapp, 2009).

During the experiment, the group of students who participated in both crowdsourcing projects (creating and attending microcourses) clearly stood out. It was found that students with higher tendency to participate in crowdsourcing by participating in more crowdsourcing projects have increased intensity of satisfaction and intrinsic motivation. It also influences their perception of the usefulness of crowdsourcing on the dimensions of learning and acquiring skills. On the other hand, the higher tendency for participation in crowdsourcing projects reduces the intensity of perception of reward as extrinsic motivator (Hosseini et al., 2014). These findings confirm the mean values of all attributes in identified dimensions of e-learning in both projects.

A particularly important attribute in creating and attending microcourses for all students is "Satisfaction related to participation". This confirms that students accept this way of learning and participating. On the

other hand, the motivation mechanisms through bonus points and recognition by other students proved to be the lowest graded attributes of microlearning.

Acquiring new knowledge is one of the most important functions of microlearning. Students' orientation towards learning is in compliance with activities of creating and attending microcourses. However, creating microcourses encourages students to a lesser extend to make an effort for the subject compared to attending microcourses.

In terms of students' attitudes toward acquiring skills in project of creating and attending microcourses, it is confirmed that the mean values of all attributes of the group that created and attended microcourses are higher than in the group that only created microcourses.

There is a significant difference between strata "created and attended" and "only created" regarding attitudes toward influence of creating microcourses on the following e-learning attributes: stimulation for making an effort for the subject, advancing analytical and scientific-research skills.

Limitations of the research include identification and selection of dimensions and attributes of crowdsourcing creating and attending microcourses, which are mostly based on our own observations of students' behavior and our own model, and to a lesser extent on results of other researches. Indicators of influence of crowdsourcing microlearning on e-learning attributes are based on survey of students' attitudes which limits the interpretation of results. The other limitation of the research results arises from the fact that the experimental population consisted of students who volunteered to participate in this project. While the survey included most of the students who created and/or attended microcourses, we used a convenience sampling, which is a limitation of the research results. Also, implementation of the crowdsourcing project and research was conducted in one higher education institution, so the conclusions can't be fully accepted as generalized, but rather as indicative.

6. CONCLUSION

Integration of collaborative learning and students' collective intelligence through implementation of microlearning project and evaluation of crowdsourcing mechanisms in creating and attending microcourses represents a new approach to e-learning in higher education. An integral model of crowdsourcing microlearning in smart learning environment is developed. Implemented student-centered crowdsourcing model provides an opportunity for students to be both creators and users of knowledge. Crowdsourcing approach to microlearning confirmed interest and willingness of students to collaborate and produce good quality content. It also confirmed high level of self-organization among students. Students who tend to participate in more crowdsourcing projects gave higher grades to influence of microcourses on different attributes and dimensions of e-learning. Identification of students based on these attributes could be predictor variables for their involvement in other crowdsourcing projects.

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AUGMENTED REALITY AND MOBILE LEARNING

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Abstract: The concept of mobile learning has been gaining popularity in new lecture planning methods owing to the advancement and the increased use of new devices and technologies, such as smart and tablet devices. Augmented reality (AR) nowadays represents one of the possible applications of smart mobile devices. New technologies should not serve only as a tool for learning, but as a means to provide students with easier access to information, to increase the level of active learning, to improve cooperation, enable interaction and increase motivation in students. The AR technology offers a new experience when accessing the exiting data which, in itself, represents an additional motivational factor. This paper consists of potential uses for AR technology integrated into smart mobile devices, for the purposes of education, with emphasis on mobile learning.

Keywords*: augmented reality, mobile learning, smart devices*

1. INTRODUCTION

Increasing usage of mobile devices can be promptly directed to an entirely new direction, the direction of education, consequently, implementing education into a new way of life and consciousness of young generations. On the other hand, the users of wireless mobile devices, in accordance with their growing requests regarding everyday choice of services, will inevitably insist on the possibility of education in this way. Current development of technology is on the level which can respond to such requests (Štrbac, Grgurović, Jelić, 2010).

The increase in numbers of smart mobile devices, as well as applications for these devices, open a new dimension of everyday use, from reading different materials, to observing, to taking in some of the materials. Most educational applications are developed so that they respond to the interests of school children, but students should not be left out either, as well as adults, in the program of lifelong learning.

M-learning is a contemporary form of education and training using mobile devices. The concept of m-learning has become popular in lecture planning because of the advancement and increased use of new devices as technologies such as tablet and smart devices (Alioon, Delialioglu, 2015). With the development of smart devices, the number of educational mobile applications has increased as well. Generations of school children are growing up with mobile devices, using them for communicating, connecting, sharing data, gathering information, education.

Augmented reality, on the other hand, enables the superposition of objects in real time, which makes it possible to add digital information to physical objects. Contemporary smart devices, owing to their performance specifications, enable AR displaying, which opens the possibilities of using AR for educational purposes, via numerous real-time actions, such as:

- Displaying materials in real time,
- Geo-locating users,
- Using stored data in a device,
- Recording real objects,
- Combining the aforementioned actions.

It should also be emphasized that AR technology-supported mobile devices enable using only one (mobile) device, instead of using numerous peripheral devices designed for AR. Mobile devices also represent an ergonomic improvement in mobile device applications for learning, as they include sensors for displaying AR (GPS, inertia sensors, accelerometers, compass, Wi-Fi).

Designing and implementing new approaches to learning require careful surveillance from both perspectives, technical and pedagogical. The pedagogical aspect can be assessed through the following six elements: integration of ubiquitous technology into the system, theoretical basis, research on programming and

coordination, teacher accessibility, adjustment of activities to the configuration and characteristics of a device, and evaluation (Jairak, Praneetpolgrang, Mekhabunchakij, 2009).

The technical aspect includes mobility, immediacy, individuality, connection,and accessibility as main characteristics of mobile devices around which mobile learning revolves (Korucu, Alkan, 2011).

Many authors have researched different aspects of mobile devices. This includes, above all, their role and use, as well as their efficiency in educational domains. Aside from these roles, the readiness of students to accept the device use also stands out (Ally, 2009), (Kennedy, Judd, Churchward, Gray, Lee- Krause, 2008), (Abas, Peng, Mansor, 2009).

The idea behind m-learning as a way of improving the traditional way of learning by use of AR technology has been gaining more significance, most of all because of the fact that it offers a unique visual and interactive experience.

2. M-LEARNING – THE BASIS FOR AUGMENTED REALITY

The main advantage of m-learning is the possibility of continual access to educational materials through a mobile device at any given time from any location. For the last few years, mobile applications have been improving by means of integrating new possibilities, service operators have been competing in application offers, all with the goal to create a new experience for users. Higher education has been keeping up with the trend of increase use of mobile devices through situational learning.

The current concept of higher education has the potential to utilize the space out of the classroom by improving e-learning and m-learning. M-learning has a potential advantage over e-learning (figure 1) (Pachler, Bachmair, Cook, 2009) keeping in mind that, aside from the main advantage of mobility, the following three m-learning characteristics also exist:

- The use of mobile devices by students who are applying and using specific tools adjusted to mobile technologies;
- Out-of-classroom learning, while providing the students with the support in different learning situations;
- The students' need for mobility, which provides the students with the ability to learn any time (Zapata-Ros, 2012).

With the increasing use of smart devices, the demand for AR applications has also been on the rise. Contemporary smart devices combine fast processors with graphics hardware, gradually larger touch-sensitive screens, sensors (camera, GPS, compass, accelerator), which makes them ideal for AR experience in and outside of the classroom. Researchers and commercial programmers have the opportunity to use these platforms for developing educational programs and enabling new learning experiences.

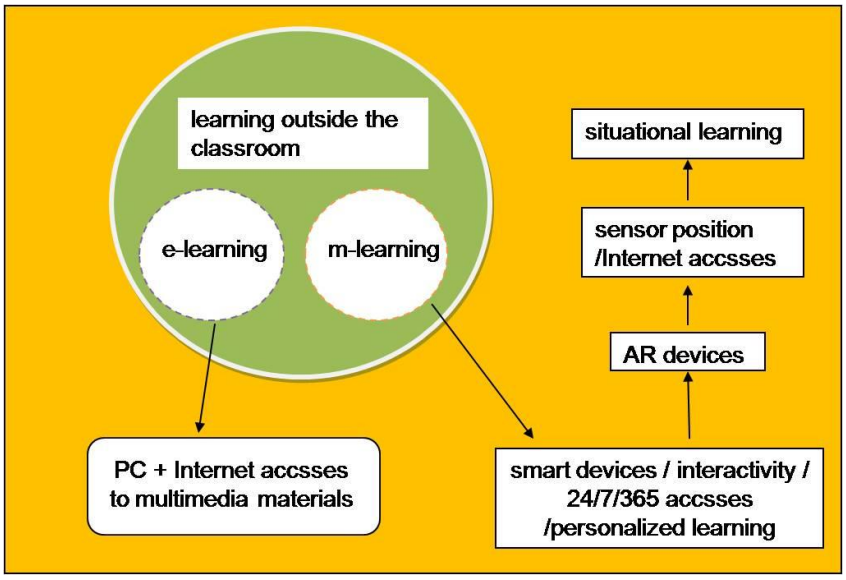

Figure 1: E-learning and m-learning in educational surroundings

The research on this topic has shown that offering AR experiences through mobile devices can have a unique advantage over materials which do not offer this experience.

3. AUGMENTED REALITY AND EDUCATIONAL MATERIALS

Augmented reality can be viewed as an extension of reality. It ensures displaying surroundings-related virtual information, while also enabling the digital information differs depending on the device on which it is viewed. If we view the human body as an interface which experiences its surroundings through visual, auditory, somatosensory, olfactory, and gustatory senses, augmented reality is a form of extension which amplifies the perception of an outer interface.

Using AR technology on mobile devices in adaptive surroundings puts the emphasis on the level of personalization. A student advances independently, by his or her own pace, according to his or her own interests and capacities. The advancement in learning is presented to students through interactivity with their own surroundings, which enables them to move on to new materials and new tasks. Technology provides access to resources which improve learning by means of a more efficient, better reality. The main idea is to use additional educational information to make an impact on the perspective, understanding and meaning of decision-making in reality.

3.1. AR System Functioning

AR system components can be put into three categories: displaying, following, and interacting.

The displaying components enable users to display an optical or video version of materials, depending on whether they are trying to view individual images or video recordings. The device construction plays a crucial role in determining where the display will be placed relative to the user (on their heads, in their hands, or spatial).

The following components serve to integrate virtual information (text, images, 3D) into real surroundings. These components depend on the viewer's position and the device position. The accuracy of orientation does not only depend on the device position, but on the rotation, direction of moving, and slope as well. The following component is defined by six points (coordinates X, Y, and Z, rotation, slope, and yaw). Overall, the following components can be put into three groups: sensory, visual, and hybrid.

Interaction is a category which requires the most attention, since it is necessary to establish a connection between the user and the virtual materials. The basis of interaction are activities such as: managing, copying, commenting, erasing virtual objects and materials, or information. The access interface, during the interaction between the user and the AR materials, depends on the GUI version, and the keyboard, mouse or screen are most commonly touch-sensitive. Interaction styles can be divided into: direct management, menu selection, entry form, programming and natural language (Gesa, 2012). It is also essential to follow the so-called eight golden rules when designing the interface: consistency, including shortcuts for experienced users, feedback option, specially designed problem-solving dialogue, simple handling in case of errors, simple undo option, user support control, and the release of short-term memory.

3.2. Possibilities in AR application in education

Using AR application, the existing educational materials are enriched with virtual materials, which remain invisible to others. In this way, students are offered a new layer of knowledge, new level of information, or a visual guide through the materials and tasks.

When it comes to the materials which can be offered through AR technology in educational purposes, the methodology of clearly forming such materials does not yet exist (Mesarošova, Ferrer Hernandez, Mesaroš, 2014).

Expanding educational space to mobile devices can increase students' attention. In order to make students feel a part of the technological space and participate in activities, it is necessary to design the surroundings. The surroundings created with mobile devices increases the communication span in everyday life, and could thus be used to increase students' attention in classroom and when learning (Pachler, Bachmair, Cook, 2009).

Some studies have researched the implementation of AR technology into education. One of these studies, a study from the University of Nottingham, which researched the expansion of viewers experience in Lake District, where geography students can access additional information about their surroundings through a helmet-like display (Shneiderman, 1997). Another study from the same university was done with history students, who gained access to additional information on places of historical events through smart phones,

based on their GPS positions (Priestnall, Brown, Sharples, Polmear, 2010). AR can also be used as a supplement to traditionally written books, as a way of teaching storytelling skills, or to satisfy the desire to read the (non-)obligatory bibliography (FitzGerald, 2012).

3.3. Challenges in AR application in education

As any new technology which is widely applied, AR technology faces challenges in its implementation into education. Some of those challenges are:

- Overcoming innovation factors, since every innovation must show improvement compared to the existing sustainable teaching methods;
- Problems with the use of equipment in real-life situations, such as display size, device behavior in outdoor conditions (display reflection, etc.);
- Stepping out of informal into the formal education by introducing innovations into official lecture plans, which requires accreditation;
- Changing the existing practices;
- The question of appropriateness of the media to reality (the notion of misappropriation).

In order to overcome some of the aforementioned challenges, a short study was conducted at the ICT College of Vocational Studies involving first-year students, researching their will and opportunity to use smart mobile devices for learning.

Out of 53 respondents, 96 per cent of them already own a smart mobile device (image 2), but only 58 per cent use it for purposes of learning (figure 2). It is obvious that there is a potential for the use of smart mobile devices for purposes of m-learning.

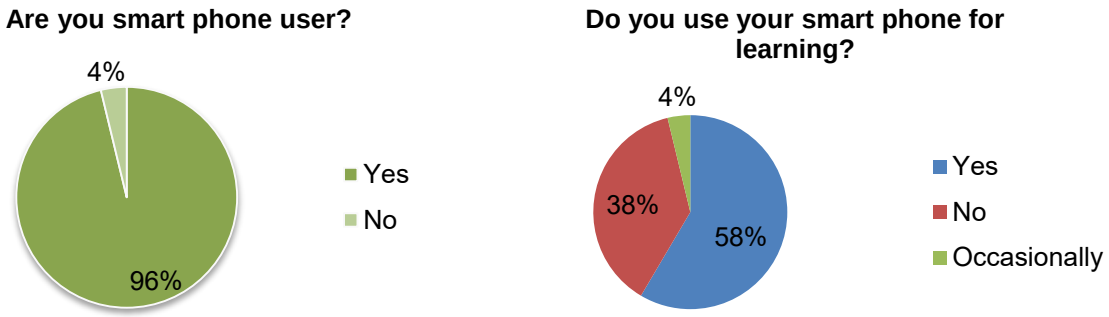

Figure 2: The number of smart phone users and the number of those who use smart phones for learning

This is also supported by the fact that a large number of participants (79 per cent) would install additional m-learning applications (figure 3), as well as the fact that 69 per cent of the students prefer lectures which involve combined multimedia (text, pictures, video material) (figure 4).

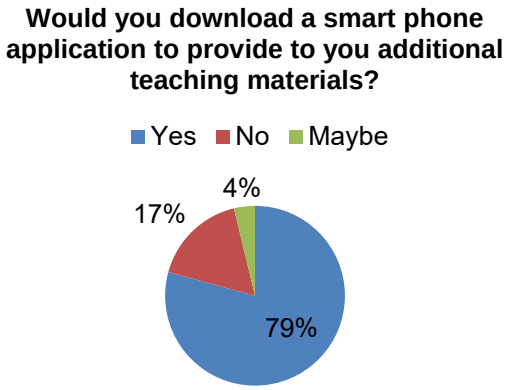

Figure 3: Number of students who would download an additional application for m-learning

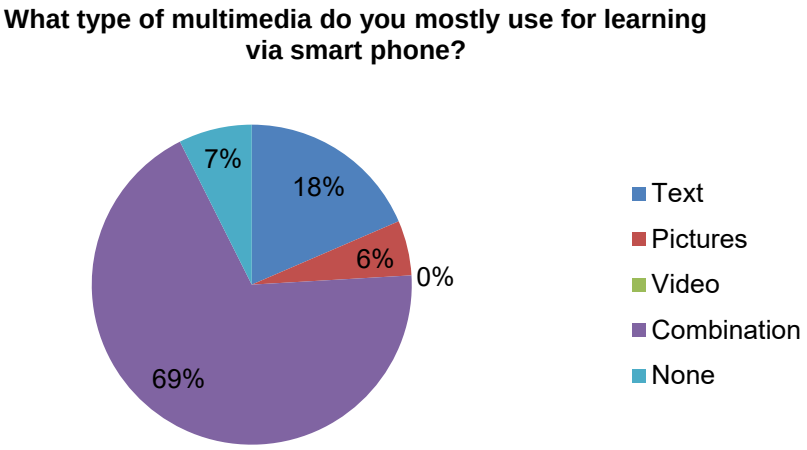

Figure 4: Multimedia materials used on smart mobile devices

Since this group of students largely prefers the Android platform – about 90 per cent of them (image 5), the potential m-learning application should be made for this platform.

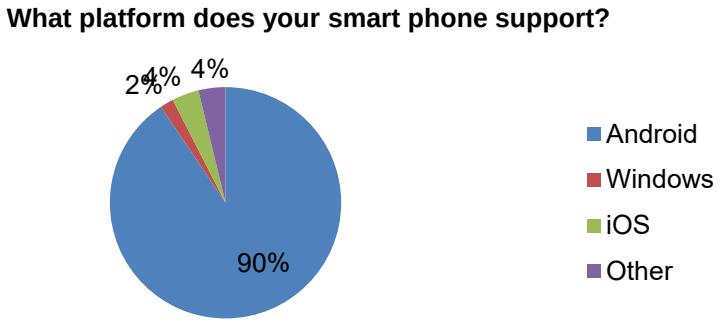

Figure 5: Frequency of mobile OS

4. CREATING AUGMENTED REALITY FOR EDUCATIONAL PURPOSES

Over previous years, m-learning has mostly been analyzed in elementary and high-school contexts, and thus the future of m-learning lies in higher education and education of adults (Alioon, Delialioglu, 2015).

Providing AR experience does not necessarily result in more effective learning. As with any technology, the most important lessons to be learned are those concerning the optimal use of AR in educational contexts. Whether or not the effectiveness will be greater if the traditional teaching materials are only enhanced with AR experiences, or with completely new materials with integrated AR elements, remains to be seen.

Creating teaching materials enriched with AR elements is becoming increasingly simpler. Namely, there is a large number of tools which do not require programming knowledge for creating such materials (buildar, artofillusion, wikitude, yalp, etc.). This offers students not only the possibility to observe the prepared materials, but to actively take part in creating them. The process of creating AR scenes carries in itself certain educational value, since students have to think of ways to use technology in order to introduce complex concepts. In addition to this, working on producing and using materials includes processing and solving problems using team work. This combination could affect motivation, involvement and commitment of students. When they create materials using AR creating tools, students create their own AR experiences and ensure further learning.

Support with displaying educational materials through multimedia, digital materials, such as 2D and 3D images, sounds, and video materials, enables students to notice, memorize, and understand information better. This implies especially to students who have difficulties understanding the traditionally written materials (McKenzie, Darnell, 2004). According to a study where participants read books with and without AR elements, the group which used AR elements noticed things better and reproduced information more

effectively later (Billinghurst, Duenser, 2012). It is interesting that application of AR in education gives the best results in high-school education (Moreno, Mayer, 2005).

The interactive element which AR brings is the key element to success. Namely, when using interactive materials, students see learning as a game, which can prove to be very important when creating materials and overcoming the usual learning limitations.

4.1. The potential benefits of the application of AR in education

Most AR systems are created as a prototype for a certain project or purpose, and it is difficult to compare any results gained that way.

In general, books with AR elements have the potential for high-quality and very employable educational material, in laboratory conditions, as well as in traditional classrooms. In addition to this, intuitive interactions and spatial 3D material visualizations can increase the value of educational materials. Another important value of AR is the possibility to gain skills and experiences which students should overcome with real jobs, which they will get after graduation, as their goals.

A special value of AR is related to the aforementioned interactivity dimension. Some researches claim that interactivity can result in learning and activating certain cognitive processes (Dünser, 2008). A high level of interactivity enables better learning, especially in students who learn through kinetic, visual, and other methods which are not based on a text. In this way, the learned materials are stored as long-term memory. Students who interact with materials can remember more than students who passively receive data. Aside from that, they are better at applying what they have learned.

5. CONCLUSION

Using AR in classroom is still a relatively new notion, but the impact of new technologies has been on the rise ever since AR system platforms became widely accessible. At the moment, experiences are directed only towards the visual expansion of the real world, but several key ideas have been established when it comes to using AR in class:

- AR technology is strong enough to support experiences, especially in the form of extended books and mobile AR learning applications;
- AR experiences should be used as a complement, and not as a substitution to traditional teaching materials;
- AR offers real benefits when reading, through understanding spatial data, especially for students who have difficulties with understanding traditional learning materials.

As the use of AR technology is expanding, the educational model is most likely to be completely different for students who have mobile devices with AR applications.

Based on the insight into the way and frequency of use of smart mobile devices in college students, it can be concluded that there is a great potential for using mobile devices for m-learning purposes. Future m-learning applications, especially when it comes to AR, should be designed for operating systems most frequently used.

Future educational AR experiences will be offered through video channels supplemented with audio and kinetic channels, with a wide variety of interactions. For example, while walking around and using a mobile AR application, a student should be able to hear audio data related to a certain place, as well as see visual signs. This multimodality can be a part of materials which enrich learning experiences and transfer ideas in different forms. These materials can be delivered to students with different preferences when it comes to learning and different learning styles, through active involvement in new, individual ways of learning.

Introducing hardware devices of new capacities, flexible and collapsible displays, 3D cameras, pico projectors, etc. will bring new ways for displaying and interacting with AR materials.

Future AR technology will enable a wider spectrum of educational experiences. Research in new areas open up possibilities for applying abstract concepts to practical lectures. The technology itself enables creation of materials, so that a way is made for students to create materials themselves, who, in this way, experience real-life situations which they can encounter in real-life surroundings.

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SEMANTIC MODEL FOR ADAPTIVE E-LEARNING SYSTEMS

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Abstract: *This paper describes a model for creating semantic elements* for *the current learning management systems (LMS). Propsed model is based on ontology and semantic web technologies. The goal of this paper is to enable dynamic mechanisms for real time mapping, semantic annotation, learning resources enrichment, student profile creation and personalization according to the adaptation criteria. Selected criteria for adaptative systems is the Felder-Silverman learning style model (FSLSM). Also, this work describes real time monitoring of students activities on Facebook social network and learning resources enrichment from external academic open repositories by tags and criteria of adaptation. Several modules (plug-ins) have been implemented.*

Keywords*: semantic web, ontologies, learning objects, adaptive learning, personalization, learning styles.*

1. INTRODUCTION

The main characteristic of e-learning systems is their ability to recognize students needs, their educational behavior and also, their capabilities. In an educational environment, learners with diverse learning capacities and background information require different learning paths (Brusilovsky, 2012). Each student has his own characteristics (profile, learning style, prior background and learning objectives). These individual attributes are very useful to provide each student the most adequate learning path to accomplish his learning outcomes.

LMSs (Learning Management Systems) are platforms for administrating, documenting and delivering e-learning content. They offer the enrolled students a vast number of courses with highly customizable capabilities. A way to automatically plan student-oriented learning content in Moodle was built in (Caputi & Garrido, 2015). For personalized e-learning, several different strategies and characteristics can be used and considered by teachers and course authors/designers (Dorça, Lima, Fernandes, & Lopes, 2013).

Adaptation is a key element in web based learning systems. Most of the existing learning management systems focus on adaptivity in general, whereas others focus more specifically on adaptivity based on learning style (Popescu, 2009). There are many different learning style models that adaptive e-learning systems are generally based on. An automatic, dynamic and probabilistic approach for modeling students learning styles based on reinforcement learning was presented in (Dorça et al., 2013). Another method based on adaptive content presentation, communication methods, and organization of online activities to students' learning styles and preferences was described in (Despotović-Zrakić, Marković, Bogdanović, Barać, & Krčo, 2012). Trends and approaches within this area are covered in (Somyürek, 2015).

Learning styles can be defined as strategies, or regular learning manners usually applied by an individual, which are built on student's fundamental potentials (Kurilovas, Kubilinskiene, & Dagiene, 2014). Learning styles are one of the criteria that adaptation of online courses can be made. In this paper, Felder-Silverman model (FSLSM) is selected because there are the questionnaire and the comprehensive guide on how to use it provided (Felder & Silverman, 1988). In addition, this model has been turned out to be powerful in numerous adaptive learning systems and it has often been used in technology-enhanced learning in order to deliver personalised content adapted to student's learning styles.

Learning objects (LO) have become a fundamental element to develop educational content for e-learning environments. In the modern educational systems number and complexity of learning objects is large. Therefore, there is a problem in the creation, maintenance and retrieval of semantic academic libraries and repositories. Also, many of them are not open. Thus, there is a limited number of semantic repositories or many of them which in different ways describe the same concept. These problems can be solved by developing a personalized, dynamic, semantically-oriented model for annotation and enrichment of learning object. This mechanism involves mapping procedures, adaptations and visualization of certain educational resources in accordance with the rules defined in ontologies. One possible solution for adaptation is an

approach for recommending personalization strategies based on the learning objects included in the course presented in (Essalmi, Ayed, Jemni, & Graf, 2015). In this work it was also evaluated how well these strategies support particular combinations of learner's characteristics.

Semantic web, ontologies and rule-based reasoning play a major part in the development of knowledge and personalized student's profile (Nafea, Maglaras, Siewe, Smith, & Janicke, 2016). Semantic web technologies can be applyed for e-learning systems (Begam & Ganapathy, 2013; Qwaider, 2012; Sheeba, Begum, & Bernard, 2012) and can be used for intelligent discovery of learning objects (Hsu, 2012). They significantly affects the annotation of learning objects, their transformation and semantic enrichment. The advantage of using an ontology is made possible by overcoming interoperability problems between different e-learning systems, as well as the re-use of knowledge in the field to which it relates. Of particular importance to the subject of this paper is to describe the ontologies and rule-base reasoning field of adaptive and personalized e-learning.

Ontologies are open vocabularies, models that describe the world common types, attributes, and relations. Any form of relationship between two concepts can be expressed using strongly typed relations. A short, concise definition of ontologies states that they are a "formal, explicit specification of a shared conceptualization" (Gruber, 1993). Ontologies are powerful and extendable and can be used to personalized knowledge search and recommendation (Chen, Chu, Chen, & Chao, 2013) and extending moodle functionalities (Rezgui, Mhiri, & Ghédira, 2014; Yunianta, Yusof, Jayadianti, Othman, & Suhaimi, 2014). In our study we used Protégé for ontology development because it is the most popular and widely used ontology and knowledge based editor. Also, it has flexible knowledge model and extensible plug-in architecture (Malviya, Mishra, & Sahu, 2011).

There is an increasing demand for sharing learning resources between existing learning systems to support reusability, exchangeability, and adaptability. One approach reccomends a domain-independent, automatic and unsupervised method to detect relevant features from heterogeneous textual resources, associating them to concepts modelled in a background ontology (Vicient, Sánchez, & Moreno, 2013). Generally, the learning resources need to be annotated with ontologies into learning objects that use different metadata standards. These ontologies have introduced the problems of semantic and structural heterogeneity. There are many ways to overcome these problems and one of them is a semantic ontology mapping for interoperability of learning resource systems presented in (Arch-Int & Arch-Int, 2013).

2. LITERATURE REVIEW

Adaptivity in e-learning can be based on the learning flow, where learning and sequence of activities dynamically adapt to each student, or can be based on content, where educational resources and activities available to students dynamically change. In both cases, it is necessary to introduce educational activities and used them as learning objects. Quality of personalized e-learning systems depends on appropriately selected learning objects, their relationships and criteria of adaptation.

In the case of e-learning, learning materials and sources are primarily digital in nature. This allows them to be easily modified in order to adapt to users' needs and learning context. Student-created and professionally-created learning materials can be found on the internet in various formats. The amount and diversity of available resources are becoming an issue for both the learners and the information systems that facilitate learning. Using a descriptive and a standardized set of attributes (metadata), the aforementioned problems can be solved. IEEE Learning Object Metadata (IEEE Learning Technology Standards Committee, 2002) is a prominent metamodel for description of learning objects. Another popular set of standards, based on the IEEE LOM, is Sharable Content Object Reference Model (SCORM). SCORM learning objects are packed into content packages of specific structure, and are based around the use of web-centric technologies, HTML pages and interactivity with the system. Many resources like research papers, student-created materials, links to web pages, etc. do not naturally fit into this concept. In order to facilitate easier and automated searching and indexing of diverse learning resources, a simplier, implementation-agnostic set of metadata is likely a better match.

The evolution of learning processes is almost always linked to social changes and/or technological changes. One of those processes is e-learning, which is involved in the changes brought by web 2.0 trends. This new tendencies consider the user, socialization and collaboration as the main important elements and this must be considered also in e-Learning contexts. Web Services can be applied to define open learning environments (Conde, García, Casany, & Alier, 2010). Social networks, for example Facebook, can be used as e-learning tool for higher education institutes (Ainin, Naqshbandi, Moghavvemi, & Jaafar, 2015; Manasijević, Živković, Arsić, & Milošević, 2016; Qureshi, Raza, & Whitty, 2014).

The transition from the traditional web to Semantic web (relational databases (RDB) to semantic graphs) requires new structuring of data. In this context, we propose D2RQ server which allows automatic extraction of data from RDB and their restructuring in the form of RDF graphs using the Jena API to make them available for the Semantic Web (Bakkas & Bahaj, 2013; Bäumer, Gim, Jeong, Geierhos, & Jung, 2014). On D2RQ server it is possible to execute SPARQL queries over semantic base and also get a semantic data (Calvanese, Cogrel, Komla-ebri, Kontchakov, & Lanti, 2015). These data are later transformed into the semantic subset - OWL model. The goal of our stady is to create an ontology model, and to enrich it with the components of the RDB schema using different classes provided by the Jena API. Jena Semantic Framework also enables implementation of the semantic web recommendations (Carroll et al., 2004).

Pellet is the first sound and complete OWL-DL reasoner with extensive support for reasoning with individuals, user-defined datatypes, and debugging support for ontologies (Sirin, Parsia, Grau, Kalyanpur, & Katz, 2007). The OWL API (Application Programming Interface) represents Java API for OWL ontologies. The OWL API supports parsing and rendering of the syntaxes defined in the W3C specification, manipulation of ontological structures, and the use of reasoning engines. The reference implementation of the OWL API, written in Java, includes validators for the various OWL 2 profiles. The OWL API has widespread usage in a variety of tools and applications (Horridge & Bechhofer, 2011).

Rule sets in SWRL (Semantic Web Rule Language) have the fundamental role of being the inference engine to create new knowledge inside the Semantic Web. SWRL allows the combination of rules and ontology terms defined using the Web Ontology Language (OWL), increasing the expressiveness of both of them (Hassanpour, O'Connor, & Das, 2010).

3. SEMANTIC MODEL FOR ADAPTIVE E-LEARNING SYSTEMS

Our research differs from previous works in relation to several aspects. We provided personalized student profile based on the learner's behavior pattern using FSLSM model. Educational resources from external academic semantic repositories were enriched using the mechanisms of visualization. Also, adaptive learning was supported using different types of techniques such as ontologies and inference rules. The proposed model is not only intended to ensure the learner's ability to learn, but it is also expected to be useful in providing a learning path and guidance based on individual differences (learning style). Personalized guidance is achieved by collecting a student's initial capability and preferences and by using semantic rules and rule-based reasoning in order to detect learner behavioral changes.

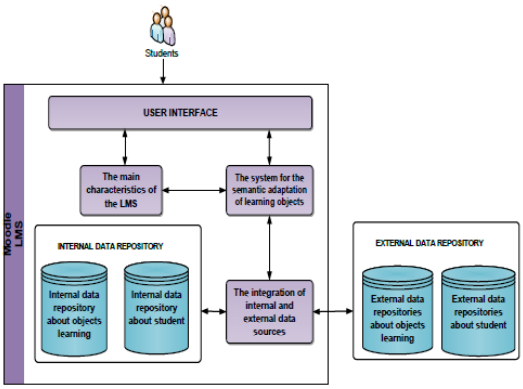

Figure 1: The model architecture

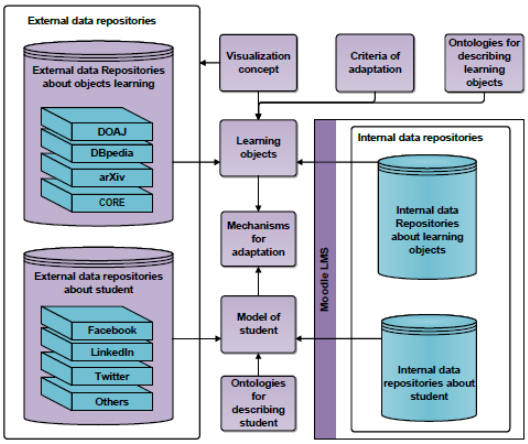

Figure 2: The main model elements

The architecture of the proposed model is shown in Fig. 1. It includes the following components: learning objects (metadata, annotation and semantic content enrichment), the student's model (static and dynamic data on the student), ontology (ontology for describing learning objects and ontologies to describe students) and criteria of adaptation (Felder – Silverman learning styles model). The figure 2. shows the main model elements.

The proposed model is based on the next procedure: The initial step in the procedure is student Interface. It is the communication component that controls the interaction between the student and the system. It deals with the user account data (such as registration and login). After this step, student will answer learning style questionnaire related to FSLSM model. If student logs into the Moodle for the first time, he will need to fill Felder Silverman Questonary, if not, his learning style will be already available in the system. Real time monitoring of the activities of students in the system and the use of learning objects will be executed by Moodle, and forwarded to Jena. D2RQ server is responsible for transforming Moodle MySQL relational database into a semantic database that is organized in tables. The next stage is creating ontology in Protégé 5.0.0.beta version. In this stage, the system compares the outcomes from questionnaire to these from the reference ontology using inference rules (association rules). Subsequently, it starts to recommend adaptive content based on the personalization. The result is transfered to Jena Semantic Framework. Jena enables implementation of the semantic web recommendations (Carroll et al., 2004). Dynamically reasoning over the semantic data is done by Pellet. Base SWRL rules defined in the ontology and rules defined in the Pellet receive the recommendations in which way learning objects should be personalized. Through this, aaccording to student's learning style, appropriate contet will be displayed to him. The inference engine is the crucial component for constructing adaptive learning. It includes comparing recommendation agent and updating agent that provide personalized student profile dynamically. Whenever new information is available, it will be sent to the inference engine, which functionality is based on rule-based reasoning. Jena returns results of the semantic reasoning to Moodle by connecting with OWL and PHP API. This procedure requires several web services for implementation.

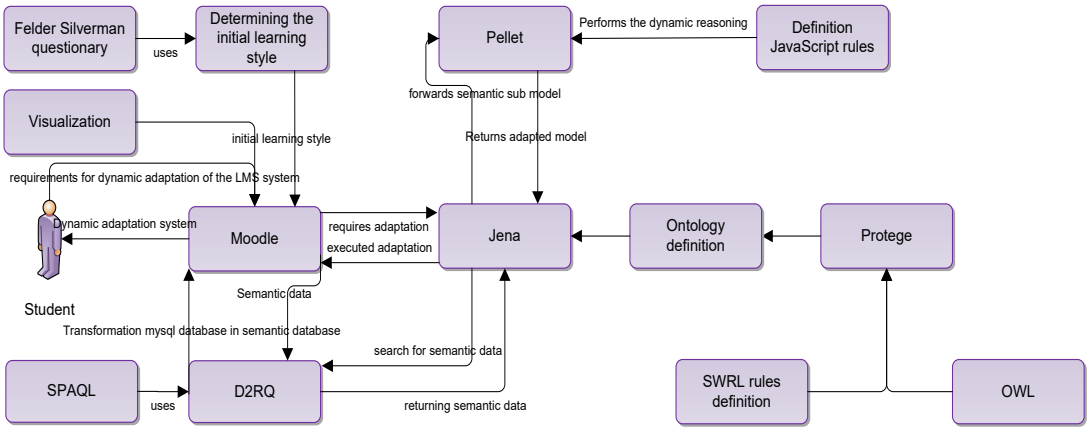

Figure 3: The proposed procedure for adaptive e-learning systems

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3.1. Creating semantic elements in moodle

Three plug-in blocks and two web services were implemented in the Moodle platform for the purpose of this research (figure 4):

- MAU (Moodle Adaptive Learning) block where for each student initial learning style according to the Felder Silverman questionnaire is defined. During the time, the student's learning style can be changed.
- MAU resource block for resource classification based on learning style.
- MAU visualization block (Recommended resources button available for each week) for visual representation of semantic enriched resources. It contains an internal educational resource from Moodle and resources are recommended to students according to their learning style from three semantic academic repositories: DBPedia, Directory of open access Journal (DOAJ), arXiv I COnnecting REpositories (CORE).
- Web service that monitors the behavior of students in Moodle in real time. The task of this web service is to monitor how much and how often student performs some actions and activities with educational resources.
  - Web service FB app that monitors the students' activities on Facebook. The reason for this is to follow with greater precision if he belongs to a particular learning style. This web service is done by connecting Facebook and Moodle API. Jena combines all of the API calls.

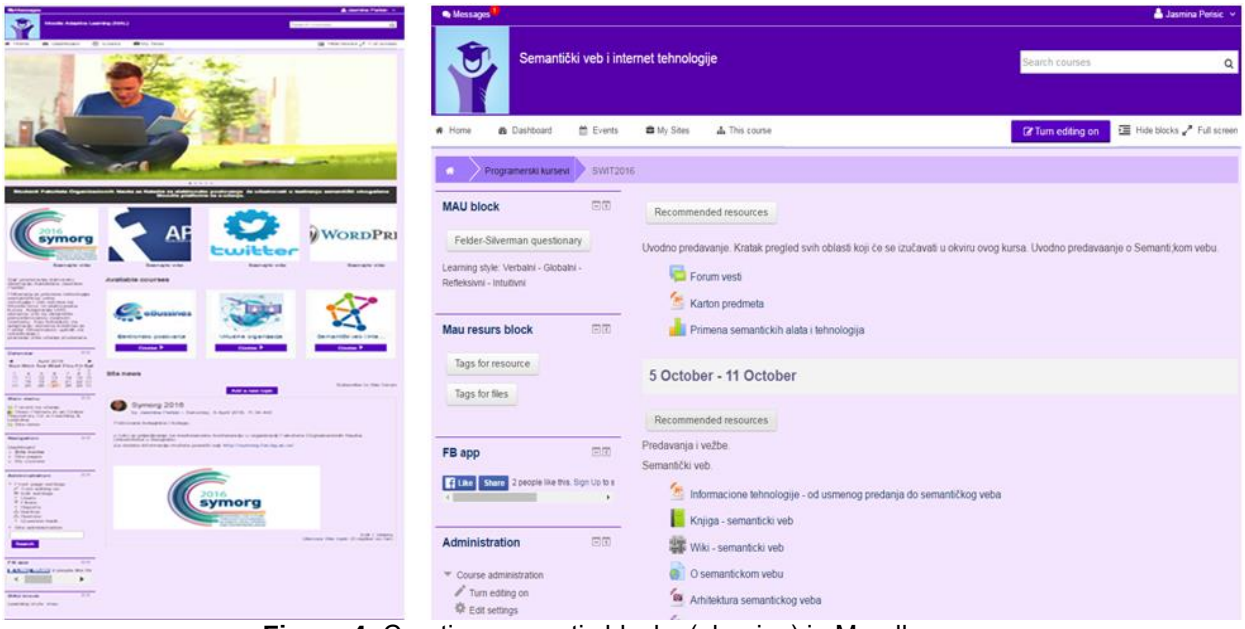

Figure 4: Creating semantic blocks (plug-ins) in Moodle

3.2. Moodle data semantic mapping

The process of translating relational database into semantic can be made using D2RQ platform (figure 5). The D2RQ Platform consists of:

- The D2RQ Mapping Language - a declarative mapping language for describing the relation between an ontology and a relational data model. Mapping of one table from Moodle represents one class in D2RQ Mapping Language.
- The D2RQ Engine - a plug-in for the Jena Semantic Web toolkit that uses the mappings to rewrite Jena API calls to SQL queries over the database and passes query results up to the higher layers of the frameworks.
- D2R Server - an HTTP server that provides a Linked Data view, an HTML view for debugging and a SPARQL Protocol endpoint over the database.

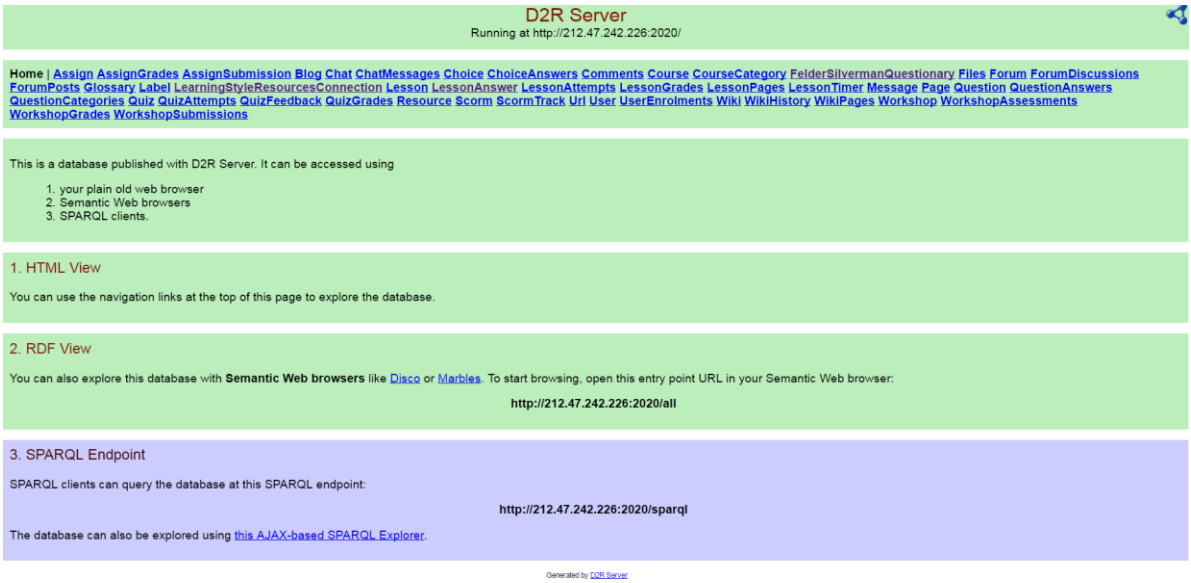

Figure 5: Moodle mapping classes (dataset)

The figure 6. shows D2RQ Engine Moodle classes. Actually, it represents a SPARQL endpoint for our Moodle dataset mapping. So, we can execute some SPARQL queries for mapping classes and properties. The result of the SPARQL queries can be used by Jena in JSON or XML syntax.

Figure 6: D2RQ Engine Moodle classes

The figure 7. shows the source code from Moodle relational database server D2RQ that is mapped using the semantic database with the default prefix *vocab* replaced with the prefix of our ontology *mau*. The D2RQ generic code has Tirttle syntax.

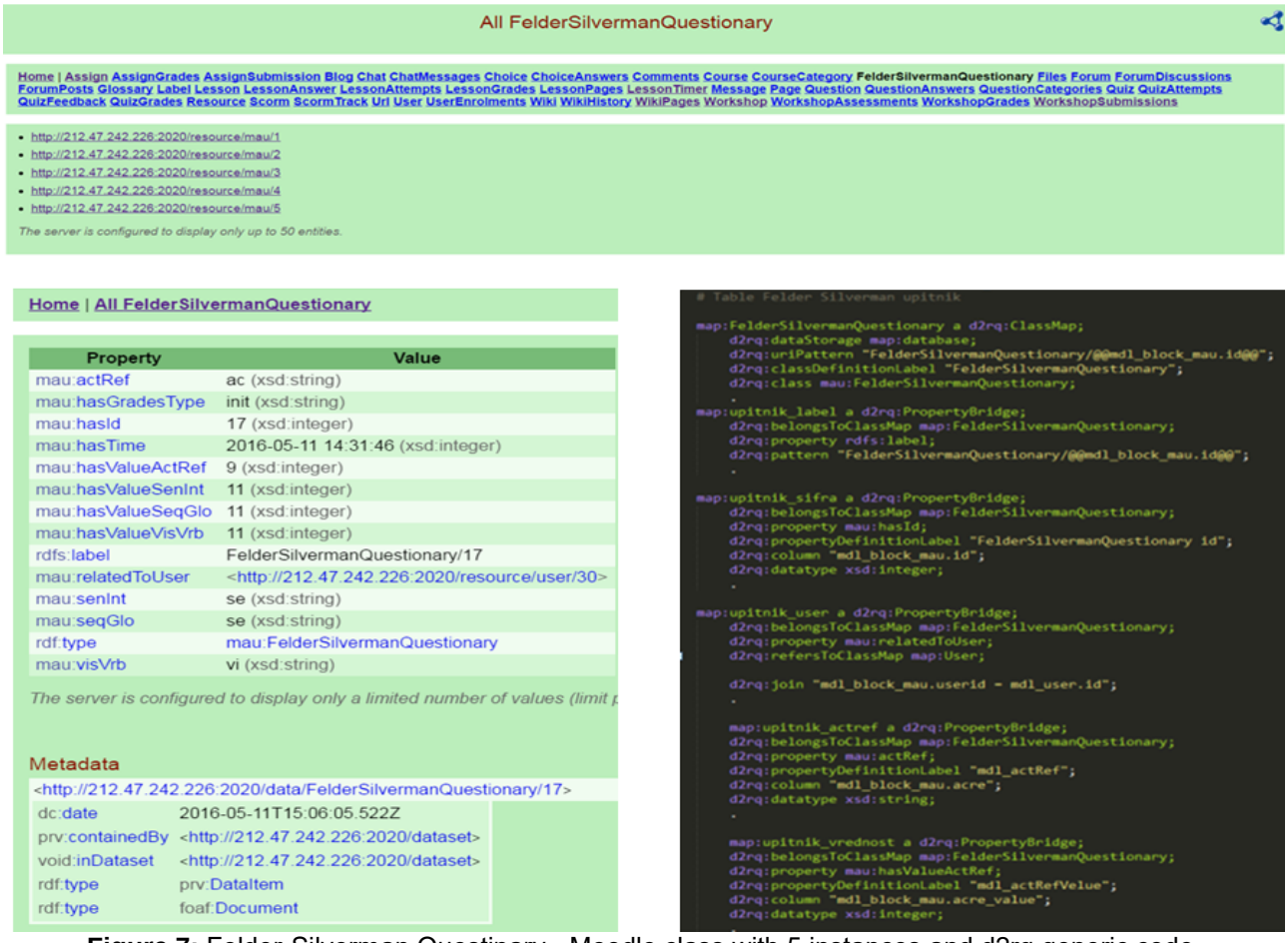

Figure 7: Felder-Silverman Questinary - Moodle class with 5 instances and d2rq generic code

3.3. Creating a domain ontology in Protégé and SWRL rules

Properly designed ontologies can accurately describe any domain, but caution needs to be exercised with balancing their expressiveness and complexity. For the purposes of this paper, it was necessary to partially take advantage of existing standards (vocabularies, ontologies) and use their classes and properties in the D2RQ mapping file (Fig. 8). For creating a student model, we used the basic FOAF ontology. For the modeling of learning objects, we used the basic Dublin Core and IEEE LOM ontologies. Those mapped Moodle data represent a good base for enriching of domain ontology and making more precise rules for personalized dynamic adaptive e-learning systems.

```
@prefix owl: <http://www.w3.org/2002/07/owl#> .
@prefix dc: <http://purl.org/dc/terms/#> .
@prefix mau: <http://mau.rs/Ver1.owl#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix foaf: <http://xmlns.com/foaf/0.1/#> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
@prefix d2rq: <http://www.wiwiss.fu-berlin.de/suhl/bizer/D2RQ/0.1#> .
@prefix jdbc: <http://d2rq.org/terms/jdbc/> .
@prefix lom: <http://mau.rs/LOM.owl#> .
```

Figure 8: Using existing ontologies for creating the domain ontology

Ontology and learning bases can be adjusted intuitively inside Protégé, being accessed with a graphical client interface and Java API. Protégé can be extended using pluggable components to include new functionalities and administration (Calvanese et al., 2015; Lohmann, Negru, Haag, & Ertl, 2014). We used this editor for ontology development because it enables the construction of domain ontologies and customized data entry forms. In addition, it allows the definition of classes, class hierarchies, variables, variable-value restrictions, and the relationships between classes as well as the properties of these relationships. The figure 9. shows list of clasees, data, object properties and instances in the created ontology.

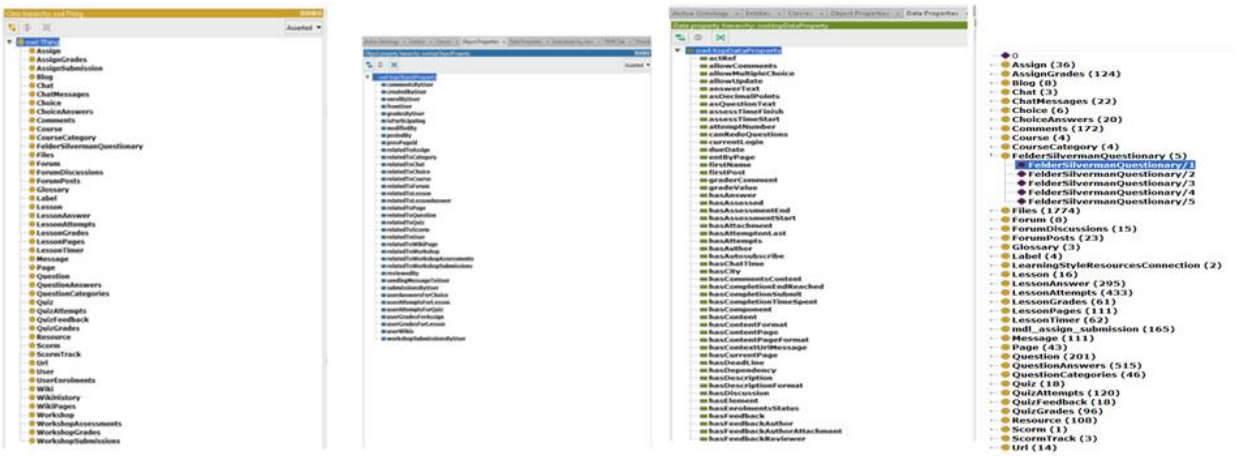

Figure 9: List of Classess, Object Properties, Data Properties and instances in MAU ontology

The first phase of the ontology building process is to identify the ontology, goal and scope, in order to specify the domain ontology and required resources. Figure 10. shows creation of simple adaptation rules which are defined with SWRL syntax. For instance, the Felder Silverman questionnaire class has an initial value of 0. Then we define SWRL rules for student's learning style classification after the questionnaire is completed. The student must belong to one learning style in one dimension. If the learning style changes over time, the student can move only his counterparts within the same dimension.

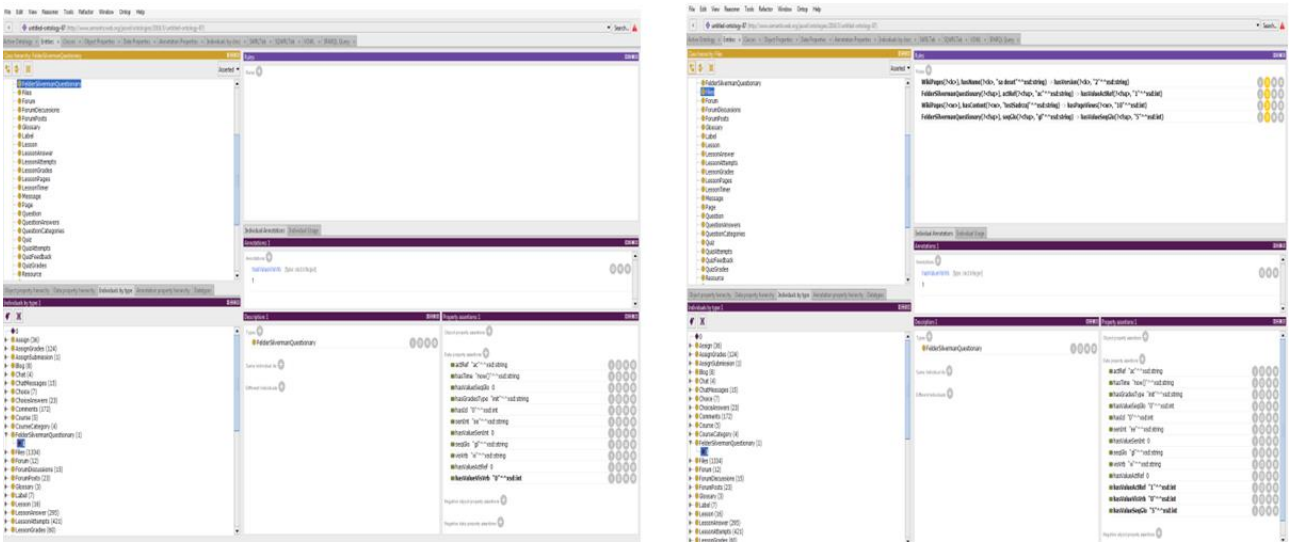

Figure 10: Felder Silverman class before and after applying simple SWRL rules

Rule 1: FelderSilvermanQuestionary (?fsq) ^ seqGlo(?fsq, "gl"^^xsd:string) → hasValueSeqGlo(?fsq, 5)
Rule 2: FelderSilvermanQuestionary (?fsq) ^ actRef(?fsq, "ac"^^xsd:string) → hasValueActRef(?fsq, 1)
Rule 3: WikiPages(?k) ^ hasName(?k, "sa deset") → hasVersion(?k, "2"^^xsd:string)
Rule 4: WikiPages(?w) ^ hasContent(?w, "testSadrzaj"^^xsd:string) → hasPageViews(?w, 10)

The first two rules are related to the Felder-Silverman questionnaire and the other two to WikiPages. Rules execute sequentially. Values that belong to the class of individuals and values returned to the set of SWRL rules are shown in the Individual Description and Individual Property fields. Creation and execution of SWRL rules are executed in Protege SWRL Tab.

4. CONCLUSION

Learning Management Systems have demonstrated to be a useful tool in learning processes, especially for online students, and they are implemented in most universities worldwide. In this paper, we propose a new semantic model for creating dataset and ontology model for adaptation in e-learning systems. It is based on real behavior patterns of students during interaction with the Moodle LMS and social networks. Those patterns involve the use of ontologies, semantic technologies and adaptation rules according to the personalization with a FSLSM model in real time. An advantage of this proposed model is that if the metadata model changes in the dataset and ontology, then, all semantic plug-ins in LMS that use this ontology as a reference model will change their behavior without changing its code.Future work will focus on extending our ontology to other metadata standards and external vocabularies. Also, in the future we will try to extend the criteria of adaptation to some other student preferences.

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SUCCESS FACTORS FOR LUXURY BRANDS IN E-BUSINESS: BURBERRY CASE STUDY

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***Abstract**: The most of brands in luxury fashion industry are resistant to adopting e-business due to certain characteristics of Internet that are threatening to diminish luxury brand exclusivity. However, many researches showed that e-commerce could bring new opportunities of increasing markets for luxury goods. Thus, the question is no longer whether luxury brands should go online, but what is the best strategy to do it. Hence, the aim of this paper is to identify best practices and define conceptual model that provide guidance to the companies entering digital world. Based on analysis of Burberry's digital strategy, as the company with the highest digital IG, recognized, this study presents some of critical success factors on luxury fashion e-business.*

***Keywords:** e-commerce, digitalisation, luxury, brands, burberry, online, strategy*

1. INTRODUCTION

E-commerce is an inevitable trend as consumers purchase more products and services through online channels (Kotler & Keller, 2009). Chaffey (2015) reports that more than 40% of the World population is using the Internet and Forte (2014) predicts that online market will reach $ 1.4 billion, which is 14% more than in 2012. Yet, there are still companies, mainly from luxury fashion industry, that are wittingly avoiding the implementation of e-business into their strategy. The underlying reason for it is belief that Internet characteristics will diminish exclusivity and value of the luxury brand. However, statistical data and other researches showed that Internet has major influence on luxury shoppers as well that carefully designed e-strategy can help luxury companies to benefit from online presence and involvement (Mau, 2015). Moreover, Bain & Company (2014, p.17) said in their report that online luxury market multiplied 12 times in the past 11 years composing now 5% of total sales.

Concepts of luxury and Internet, at first site, are carrying opposite ideas. While luxury is related to the ideas of originality, creativity, precision, focus on details, emotions, exclusivity, prestige, high prices, high quality and very narrow target group, Internet is related to mass accessibility and availability as well as low price (Okonkwo, 2010). There is 35% of luxury brands, among which are Chanel, Dior, Celine, Hermes, that used these contrasts as the excuse for not integrating the online business into their strategy (Bain & Company, 2014, p.17; Mau, 2015). Even though this excuse may seem reasonable, statistical reports and other researches showed digital technology is part of everyday life of luxury consumers, as well that there are many examples of the luxury fashion companies (such as Burberry, Gucci or Ralph Lauren) that successfully implemented online strategy and benefited from it (Choi et al., 2014; Galloway, 2013).

Digital technology is important when it comes to two-way communication between company and customers. Companies are using digital technology to interact with their customers in order to gain insightful feedback, while customers are using it to create communities and share experiences (Euromonitor, 2013). Moreover, McKinsey&Company (2015) reports that three out of four luxury shopping are influenced by online experience, even though they are done offline. Moreover, digital interaction between consumers and luxury brands is directly increasing the offline sale for 13% and overall sale for 20% (McKinsey&Company, 2013). Not only online experience influences the offline shopping but demand for online luxury products is on constant growth (Okonkwo, 2010). Furthermore, unlike the offline sale growing only 7% a year, online sale grows 27% a year. Despite the fact that Internet cannot offer the prestigious locations, atmosphere, smell and touch that luxury products put forward, Okonkwo (2010) states that modern technology has made it possible to develop, adapt and apply e-business strategies that will enable luxury to thrive on the Internet without compromising its innate qualities and unique philosophy. Burberry was named the company with the highest digital IQ when it comes to Luxury Industry (Galloway, 2013), hence this paper aims to determine patterns and define common conceptual benchmark model that could help other luxury brands to implement their e-strategy.

Companies in luxury fashion industry are lagged behind adopting e-commerce due to some difficulties of maintaining brand image while being present online. However, e-commerce could bring new opportunities of increasing the size of luxury goods market. Thus, the issue of 'why' luxury should be online is no longer relevant but the current challenge is 'how' luxury should position itself online, particularly as consumers take charge of their online experiences. Based on in-depth analysis of Burberry, recognized as a digital innovation leader in luxury industry, this study presents some of critical success factors on luxury fashion e-commerce.

2. ELECTRONIC BUSINESS

Electronic business (e-business) is often thought to refer to buying and selling using the Internet, however, it involves much more than online financial transactions between two parties. Adoption of e-business is driven by benefits it brings to various parts of the organization, depending on the orientation of e-business (Chaffey, 2009; Okonkwo, 2010).

E-business represents "all electronically mediated information exchanges, both within an organization and with external stakeholders supporting the range of business processes" (Chaffey, 2009, p.13). Thus, e-business includes "online communications, client relationship management, consumer monitoring, Internet marketing, experiential marketing, branding, retail, logistics and their connected dimensions like merchandizing and after-sales support" (Okonkwo, 2010, p.20).

When evaluating the strategic impact of e-business on an organization, it is useful to identify the orientation of e-commerce, whether it is sell-side or buy-side, as well as the benefits in terms of increased revenue and/or reduced costs (Chaffey, 2009). Electronic commerce, defined as "all electronically mediated information exchanges between an organization and its external stakeholders", on one hand has its buy-side whereby transactions are done between a purchasing organization and its suppliers and on the other, sell-side where transactions occur between a supplier organization and its customers (Chaffey, 2009, p.10). The focus of this study is the sell-side e-commerce, which has for a purpose to sell the products and/or services, provide necessary information, stimulate the purchase, and to build stronger brand image. Benefits arising out of these activities are reflected in decreased costs and/or increased revenues. While potential revenue growth is a result of larger customer base and encouraged loyalty, cost reduction is achieved by delivering services electronically whereby staff costs, transport costs, costs of materials and others are cut (Chaffey, 2009).

Electronic Business should be understood as an integrated approach to every aspect of online business with a purpose to continuously optimise a company's value proposition through adopting digital technology and the Internet as channels of multiple business activities.

2.1. Online Value Proposition Model

Online value proposition of a specific brand refers to the set of dimensions, which provide benefits for the customers and distinguish it from its competitors (Kotler and Armstrong, 2006; Sheth, Newman and Gross, 1991; Schultz and Zelezny, 1999). In order to conceptualise this topic, some scholars were focused on defining frameworks with key dimensions that would determine essential attributes for their business value proposition (Chaffey, 2009; Rayport and Jaworski, 2001; Rayport and Jaworski, 2003).

Schultz and Zelezny (1999) define values as beliefs that lead and evaluate the choices, outcomes and desirable behaviours. Considering the consumption when it comes to purchase, different types of values are what is directly driving customer choices (Sheth, Newman, and Gross, 1991). Accordingly, a value proposition was defined as "the set of benefits or values it promises to deliver to consumers to satisfy their needs" (Kotler and Armstrong, 2006, p. 9). It implies to customers how it will satisfy their needs better or differently from competitors ((Tsun-Yin) Tung, (Catherine) Jai and Davis Burns, 2014).

In order to provide a clear understanding of benefits for the customers, some academics proposed application of online value proposition models as a part of online strategy. Chaffey (2009, p.37) introduced the "6 Cs" model that consists of six different elements: content, customization, community, convenience, choice and cost reduction. Similarly, Rayport and Jaworski (2001, p.116) proposed "7 Cs" model that includes slightly different dimensions: context, content, customisation, community, communication, connection and commerce. Given the fact that this paper is focused on luxury industry where high prices of the products/services are one of the main characteristics, Chaffey's model of "6 Cs" is found to be less suitable for the specific scope of this study, thus the focus will be on "7 Cs" model:

- *Context* captures the aesthetic nature and functionality of the site, which have significant impact on consumer perception (Tsun-Yin) Tung, (Catherine) Jai and Davis Burns, 2014). Rayport and Jaworski (2001) defined Context as "the look-and-feel of a screen-to-face customer interface" (p. 11). In order to create a positive experience and influence on the customer, it is important to have highly organised linking structure between pages and important information easily visible (Chaffey, 2009; Lee and Benbasat, 2003).
- *Content* should be focused on what site delivers, comprising the mix of product and service (Lee and Benbasat, 2003). Rayport and Jaworski (2001) defined it as "all digital subject matter on the site" (p. 115). Content could be presented through combination of product and service information, interaction with the customers and multimedia support (Tsun-Yin) Tung, (Catherine) Jai and Davis Burns, 2014).
- *Community* deals with the interaction between the users including a sense of involvement and membership through which they share their opinions and experiences (Chaffey, 2009; Lee and Benbasat, 2003).
- *Customisation* refers to the site's ability to offer customised content and personalised interface based on the customer preferences (Chaffey, 2009; Lee and Benbasat, 2003). Rayport and Jaworski (2001) defined it as "the site's ability to tailor itself or to be tailored by each user" (p. 115). Customisation has two main concepts depending which side is the initiator of the customisation- tailoring is initiated by the firm and personalisation by the user. This feature is important part of online value proposition model as it is able to encourage consumer's shopping activities (Tsun-Yin) Tung, (Catherine) Jai and Davis Burns, 2014).
- *Communication* concerns "the dialogue that unfolds between the site and its user" (Rayport and Jaworski, 2001, p. 116), which can be both one-way information exchange, or interactive whereby communication flow would be two-sided (Lee and Benbasat, 2003; (Tsun-Yin) Tung, (Catherine) Jai and Davis Burns, 2014).

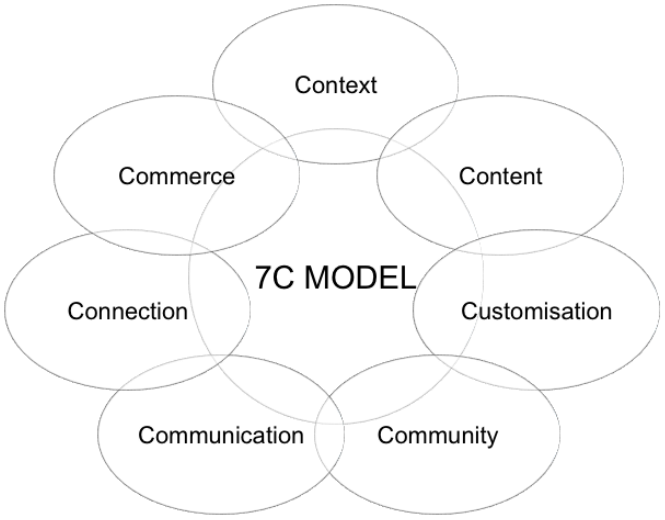

Figure 1: Seven Cs Model (Rayport i Jaworski, 2003)

- *Connection* is defined as "the extent of the formal linkages between the site and other sites" (Rayport and Jaworski, 2001, p. 116), which can create additional value for the customers (Lee and Benbasat, 2003; (Tsun-Yin) Tung, (Catherine) Jai and Davis Burns, 2014).
- *Commerce* involves various aspects of business transactions ssuch as "the sale of goods, products, or service on the site" (Rayport and Jaworski, 2001, p. 116), pre-sale and after-sale support, security, order tracking, delivery options, etc. (Lee and Benbasat, 2003; (Tsun-Yin) Tung, (Catherine) Jai and Davis Burns, 2014).

The purpose of the 7Cs framework is to show the importance of the seven dimensions when it comes to influencing consumer perception, creating value for them and meeting their needs in order to grow the business.

3. LUXURY INDUSTRY

Among the businesses currently present in the market, luxury business is, by far, one with most complexity and wide-range (Hoffmann and Coste-Manière, 2011). Fast- moving environment is bringing new challenges but as well opportunities for the companies.

Most people are able to recognise luxury products but cannot define the characteristics that contribute to the concept of luxury. Some define luxury by price, others by a list of attributes, and some by exclusivity of distribution (Hoffmann and Coste-Manière, 2013). Karoline Huber, cited in Boyden (n.d., p.8), explains, "Luxury is based on an emotion and it is people who create emotional differences. Competing on product provides less advantage – but using people as a competitive differentiator creates the emotional benefits that drive loyalty, protect brand value and build brand equity". What justifies the premium pricing of luxury goods is the value of a brand in the consumer minds. Brand value is created through stories, traditions, innovation, scarcity, differentiation and exclusivity (Dubois, Czellar and Laurent, 2005). Luxury goods are not used for their intrinsic value but for their symbolic value that for each individual can be different. Hence, it can be said that luxury product has two facets, tangible and intangible. Tangible aspect involves at first place product quality that is assured on all stages of supply chain. Furthermore, visible aspects include exceptional and scarce materials (components), expertise in manufacturing, craftsmanship heritage, original design and outstanding performance (Brun and Castelli, 2013). According to Herzberg's Motivation Theory (1959) tangible characteristic of luxury product would be dissatisfier, meaning that luxury consumers will naturally expect excellence in the product performance and quality. Luxury product must satisfy three criteria: it must have a strong artistic element, it must be the result of craftsmanship and it must have a global brand reputation (Hoffmann and Coste-Manière, 2011). Yet, what motivate the consumers to opt for luxury product are intangible facets of it, which include emotional appeal of specific luxury brand. Emotional appeal is driven by many intangible factors, such as global reputation of the brand, innovation, shopping experience, a lifestyle brand is proposing, exclusivity of product achieved by marketing approaches and premium prices (Brun and Castelli, 2013; de Azevedo Rosa, 2012).

The global luxury market is composed of nine different, yet complementary, segments presented in the Figure 2, whereby the focus of this study is Personal luxury goods. In 2014 the global luxury market

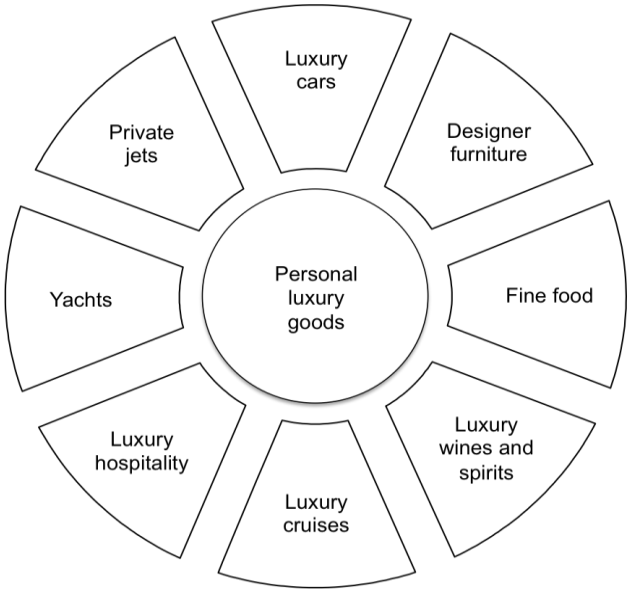

Figure 2: The nine segments of global luxury market (Adapted from: Bain & Company, 2014, p. 8)

exceeded €850 billion from which the personal luxury goods market generated more than €223 billion, which is for 3% higher than in the previous year (Bain & Company, 2014, p.8). Moreover, Bain & Company (2014, p.7) stated that the market of personal luxury goods tripled over the past 20 years and represents the "core of the core" of luxury.

All definitions and associations of luxury contain concepts of power, distinction, excellence, beauty, sophistication, superiority, class, privilege, rarity and exclusivity (de Azevedo Rosa, 2012). Luxury brand industry comprises exclusive group of brands across different product segments, whereby luxury brands differ from non-luxury brands according to functional and symbolic dimensions of the product as well as consumer perceptions of luxuriousness (Seo and Buchanan-Oliver, 2015).

3.1. Luxury Value Proposition Model (Offline)

Following the comprehensive understanding of all factors that build a luxury brand, Wiedmann, Hennigs and Siebels (2009, p.4) proposed a single model that includes "all relevant present and potential value sources of

the consumer‘s luxury perception”. Drawing on existing luxury research theory, Wiedmann, Hennigs and Siebels (2009) defined the model with the four different dimensions and its variables (Figure 3) through which customers perceive the value of luxury product and/or service.

Financial Value represents the necessary element when it comes to luxury goods and it refers to the monetary aspects of the product or service in terms of price, discount, investment, etc. However, it is important to emphasise that in case of luxury goods qualitative characteristic are more important than quantitative. Accompanying the Financial Value, Price Value is positively correlated with high quality suggesting the sense of prestige and social status, which makes a product more desirable (Hennigs, Wiedmann and Klarmann, 2012; Wiedmann, Hennigs and Siebels, 2009).

Functional Value refers the essence of the luxury good, its purpose and core benefit. This dimension refers to the visible elements of a luxury good such as rare resources and materials, tradition, unique craftsmanship, original design and excellence in performance. Functional value is driven by usability, quality and uniqueness. Usability Value refers to both the product functionality and customer needs that will be satisfied with the product functionality. Thus, customers expect the item they purchase to perform and look as expected. Quality Value is related to the superior quality as the reason why customers opt for luxury

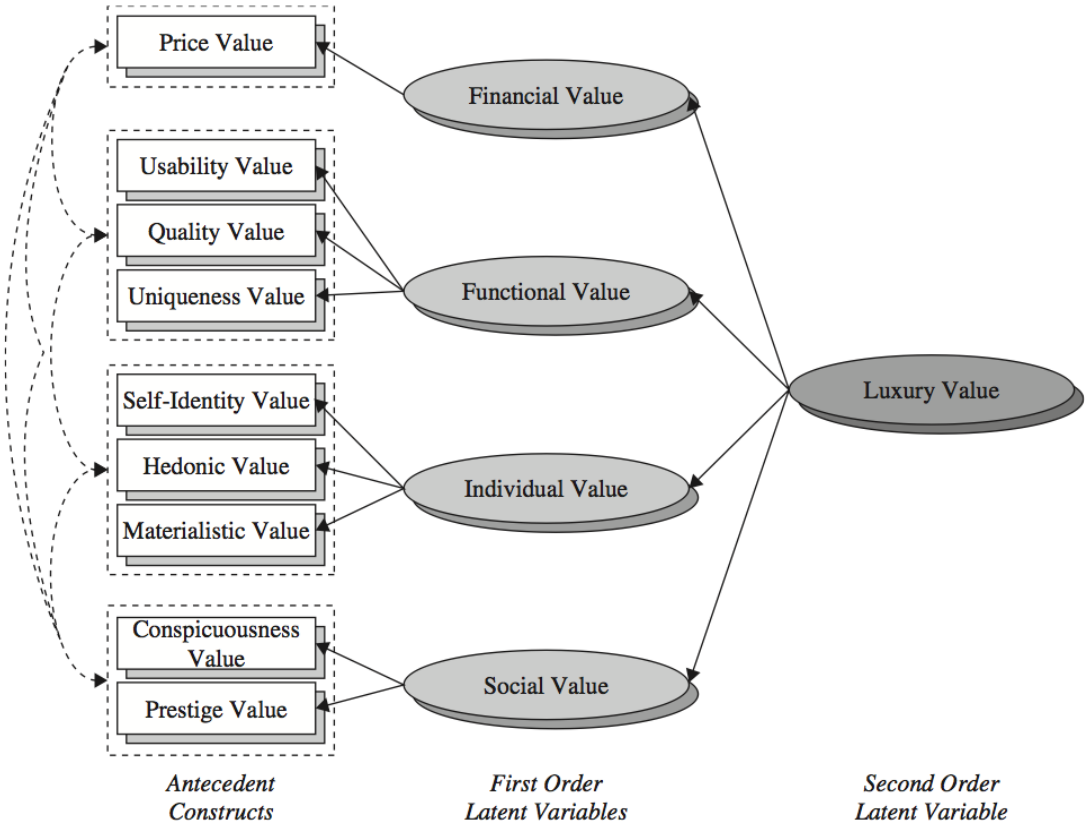

Figure 3: Conceptual Model: Determinants of Consumers’ Luxury Value Perceptions (Adapted from: Wiedmann, Hennigs and Siebels, 2009, p.629, fig. 1)

goods as well to the assumption that luxury brand offers “greater product quality and performance than non-luxury brands” (Wiedmann, Hennigs and Siebels, 2009, p.630).

Individual Value of Luxury Value Perception has to do with consumer's personal preferences when it comes to luxury consumption. It addresses personal matters such as Self-Identity Value, Hedonic Value and Materialistic Value. Self-Identity Value is related to the research that showed some people opt for luxury brands in order to identify themselves with the symbols of luxury, such as exclusivity, authenticity, high quality, uniqueness, etc. Hedonic Value explains the intangible benefits of luxury goods that are creating emotional value, pleasure and excitement for the consumers. Materialistic Value represents the consumers’ need to posses and acquire luxury goods in order to impress the social environment and position themselves highly in the society (Hennigs, Wiedmann and Klarmann, 2012; Wiedmann, Hennigs and Siebels, 2009).

Social Value is refers to the strong social function the consumption of luxury goods has for individuals. It represents the perceived utility in terms of conspicuousness and prestige value that luxury goods

consumption brings to the individuals within the their social groups. Conspicuousness Value is important to individuals who seek the social status and representation. Bearden and Etzel, cited in Wiedmann, Hennigs and Siebels (2009, p.632) concluded that "luxury goods consumed in public were more likely to be conspicuous goods than privately consumed luxury goods and that conspicuous consumption still plays a significant part in shaping preferences for many products that are purchased or consumed in public contexts". Prestige Value serves as the symbolic sign of elite group affiliation that will distinguish them from the no affluent lifestyles (Hennigs, Wiedmann and Klarmann, 2012; Wiedmann, Hennigs and Siebels, 2009). The key to creating successful strategy, including taking up online space, understands all relevant facts of consumer perception of luxury. The four proposed values and their antecedent constructs encompass consumer values that justify luxury purchase and represent prerequisite for successfully deployed online strategy.

3.2. Online Luxury Value Proposition Model

The Internet has played important role in the global market by enabling consumers not only to have an insight in the latest trends worldwide but also to shop worldwide (Deloitte, 2014a). Due to current trends in the market, the four-dimension model of luxury value proposition is extended through additional components related to e-business (Hennings, Wiedmann and Klarmann, 2012).

The latest trends like the market globalisation, digital technology, the Internet, democratisation of luxury and an increase in number of wealthy individuals are requiring from companies not only to adjust their strategies to the newest trends but also to change their perception of luxury as phenomenon (Radisavljević, n.d., p.10). Globalisation, as very popular trend lately, represents the integration of global market through social, economical, cultural, technological exchanges. Additionally, the Internet enabled a comprehensive availability, which led to assimilation of luxury preferences regardless cultural differences. One more consequence of these trends is the "democratisation of luxury" which refers to the fact that exclusivity got replaced by mass accessibility (Deloitte, 2014a, p.10). Furthermore, Okonkwo (2010) stated that online demand for luxury goods is on constant increase and influencing the growth of offline sales for 13% (McKinsey&Company, 2013, p.1). In addition, Bain & Company (2014, p.17) reported that in the last 11 years online luxury market multiplied 12 times and now accounts for 5% of total sales.

The refusal to accept the Internet as a complement to offline retailing and the inability to innovate is one of the biggest threats for luxury brands today. Luxury brands are finding justification in the adversarial relationship between the luxury and the Internet. While luxury nourishes tradition and exclusivity, Internet is quite an opposite. Even though many luxury brands are still hesitating to going online, this paper examines the power of the Internet as an instrument to reach a global audience while still maintaining a sense of exclusivity and sensory experience (Hennings, Wiedmann and Klarmann, 2012; Okonkwo, 2010).

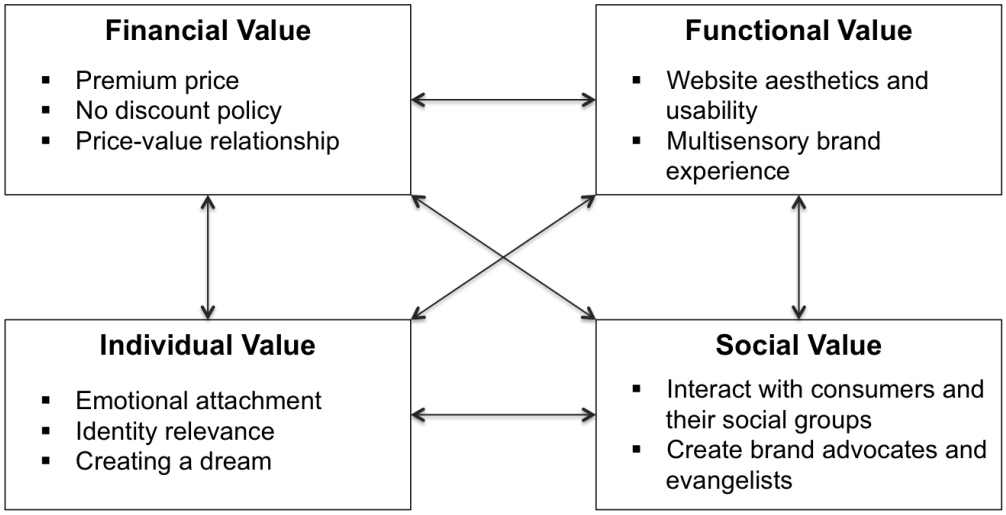

Figure 4: Online Luxury Value Proposition Model (Adapted from: Hennings, Wiedmann and Klarmann, 2012, p.34, fig.2)

With reference to the above-mentioned value dimensions, leaders in online luxury also incorporate the aspects that have to be addressed in luxury online business as illustrated in the Figure 4 and described in the following paragraphs.

Financial value. Despite the fact that a high price is widely accepted as a key component of luxury goods, it is important to point out that nature of luxury is qualitative and not quantitative. Hence, the price–value relationship is crucial, especially because the consumption of luxury products should provide social and psychological enhancements (Okonkwo 2010). In order to prevent potential diminishment of luxury goods in the virtual environment, the price premium associated with uniqueness, exclusivity, superb quality, hand-made craftsmanship, and impeccable service needs to be ensured in the virtual environment via limited distribution (Hennings, Wiedmann and Klarmann, 2012).

Functional value. Besides product-related characteristics that create value for luxury customers, the functional value of luxury in the virtual environment refers to the usability, quality and uniqueness of the online appearance when using the website and other applications. Even though the senses of touch and smell are missing, the digital technologies can leverage movement, music, texture, space and community to successfully regenerate a brand‘s philosophy online. Luxury brand managers should go beyond aesthetics and create marketing products that add value for the customer in terms of entertainment, education and engagement with the brand (Hennings, Wiedmann and Klarmann, 2012).

Individual value. Individuals use the luxury goods to support their identity projects and satisfy emotional needs, which represents the key elements in defining the concept of luxury. Customers experience luxuries as symbolic resources to transfer the brand’s social symbolism, such as exclusivity, authenticity, quality, uniqueness and culture, into their own aspired identities. Therefore, with regard to the individual value of luxury, luxury brands should transfer the offline image into the online appearance and involve customers with the brand at a deeper level using the opportunity to gain feedback and make adjustments accordingly (Hennings, Wiedmann and Klarmann, 2012).

Social value. The social dimension of luxury addresses the social groups and focuses on online social networks. A lot of wealthy Internet users are regularly using social media becoming potential brand advocates. Customers broadcast their association with luxury brands within their social circles in order to relate brand’s characteristics with their individual profiles, whereby they simultaneously promote the brand. Thus, by using the appropriate strategy, brands can become a part of the customer’s online identity and vice versa.

The luxury companies can apply these four value dimensions with differing priorities, depending on their strategy for communicating their luxury message online. Researches have shown the opposite of what majority of luxury brands have thought (Hennigs, Wiedmann and Klarmann, 2012; Okonkwo, 2010; Radisavljevic, n.d.). The well-defined online strategy is crucial for luxury brands as it is not weakening, but strengthening the brand. The digital environment offers the opportunity to reach billions of people internationally, thus brands have to integrate their philosophy into online world in order to stay relevant and desirable for current and future customers (Hennings, Wiedmann and Klarmann, 2012).

Best practices give evidence that the key value dimensions of a luxury brand’s offline strategy are a useful basis for the development of complementary online strategy that can create a true luxury experience. Further, this paper will examine the Burberry’s best practice.

4. FINDINGS- A HOLISTIC LUXURY VALUE PROPOSITION MODEL

Given the above mentioned it could be concluded that in luxury industry online values cannot be created without the successful offline strategy. Likewise, researches showed that due to latest trends, it is not enough for luxury brands to propose only offline values but they need to adopt online strategy and reach their target group in virtual environment (Okonkwo, 2010). Thus, this study is proposing a holistic approach to creating a value for luxury customers.

The model presented in the Figure 5 integrates the both online and offline Luxury Value Proposition models with the 7Cs model. The integration of these three models is reflected in the correlation and overlapping between 7Cs’ element Commerce with Financial Value, elements Communication, Content, Context with Functional Value, element Customisation with Individual value and elements Connection and Community with Social Value.

This model and the relationship of its elements can be explained the best through Herzberg’s motivation theory (Herzberg, 1959). In order to succeed in digital environment, firstly it is necessary to have the values successfully implemented so that luxury brand will have well-established philosophy, story and tradition. If these elements are not well designed, they will diminish the luxuriousness of the goods. However, they are not enough to succeed digitally. In order for customer to buy a luxury product online the next step will be

implementation of online luxury values that are aligned with 7Cs model as presented in the Figure 5. Similarly, Abrams Research (n.d., p.6) are suggesting the five steps for business digitalisation: translate unique brand elements to social platforms, adapt business practices to the online business model, identify and expand audiences, empower customers and manage customer relations. Challenges that arise here are

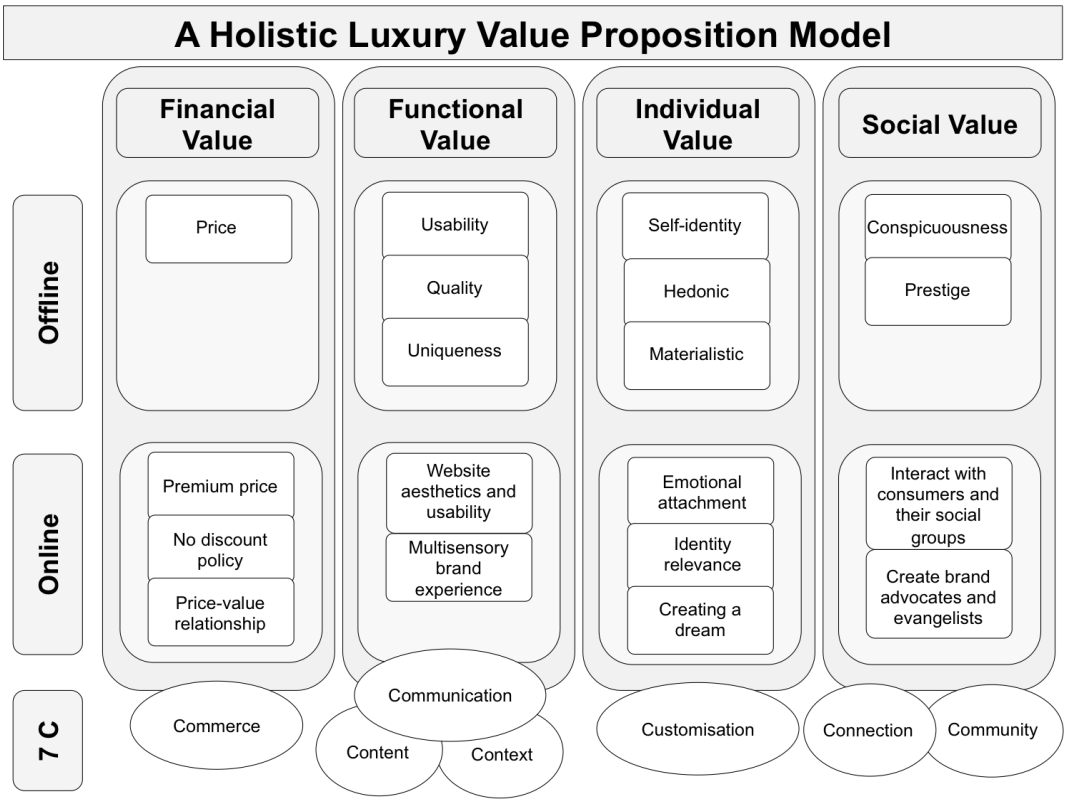

Figure 5: A Holistic Luxury Value Proposition Model (Source: The Authors)

to meet or exceed customer's expectations, to assure sophisticated social media presence and to participate in two-way communication on social media (Abrams Research, n.d.).
The e-business brought many challenges and opportunities for growth in luxury industry. Luxury brands should translate their brand message in the digital environment taking care not to diminish existing values and brand philosophy. However, in order to translate those opportunities into growth and success it is necessary to apply strategic and organised approach to online business in terms of holistic approach presented in the figure above.

4.1. Burberry Case Study

Burberry, the main representative of British fashion scene, was founded almost two centuries ago, in 1856 (Burberry, 2014). Burberry's strategy proved to be successful over the decades as Burberry always finds its place in the top of the lists of the world's best brands (Deloitte, 2014a). Moreover, according to Galloway (2013, p.5) Burberry is the most successful luxury brand when it comes to e-business. It started implementing its online strategy as of 2011 (Choi et al., 2014; Galloway, 2013). Moreover, when it comes to financial performance it is one of the most profitable luxury companies in European market (Choi et al., 2014; Deloitte, 2014). Given the fact that Burberry proved its quality and strong brand image over the years, its offline strategy will not be considered in this study. The focus of this study is to examine Burberry's online strategy and tactics in the light of the holistic concept presented in the Figure 5.

Burberry's vision to become the first company to be fully digitalised is supported by £30million investment that aims to connect Burberry with its customers, employees, partners and suppliers (Burberry, 2014; Choi et al., 2014). This investment also supports the value creation for new market through digital innovation, mainly through implementation of e-commerce. The value created in this way is supposed to provide the exactly same Burberry experience regardless of where, when and how customers are accessing the brand. Using this strategy, Burberry is not only targeting existing customers but also young people, potential customers,

who do not have money yet to invest in Burberry goods, however emotional connection that is built later can turn them into real consumers of Burberry luxury goods (Choi et al., 2014).
With the reference of Figure 5 presented in the previous section, tactics that Burberry applied in order to use opportunities of digital environment and consequently increase profits and strengthen the brand identity are presented in the Figure 6 below, in the "Online" section.

When it comes to Financial Value, Burberry keeps the same prices in online and offline stores, offering online discount only when in offline stores as well. Moreover, Burberry gives the benefit of international return policy whereby customers can return goods they are not satisfied with (Burberry, 2014; Choi et al., 2014; Rayport and Jaworski, 2001).

Functional Value in Burberry case offers profuse and high quality contents and benefits. Not only are Burberry goods presented in high-quality photos on their online platform but also in 360° view, which facilitates the experience of "see and feel" (Choi et al., 2014, p.6). Likewise, besides the real-time streaming of Burberry fashion shows (Runway to Reality), its customers can order looks straight from the catwalk as of 2012. Moreover, Burberry's customer support centre is available 24/7 in 14 different languages (Burberry,

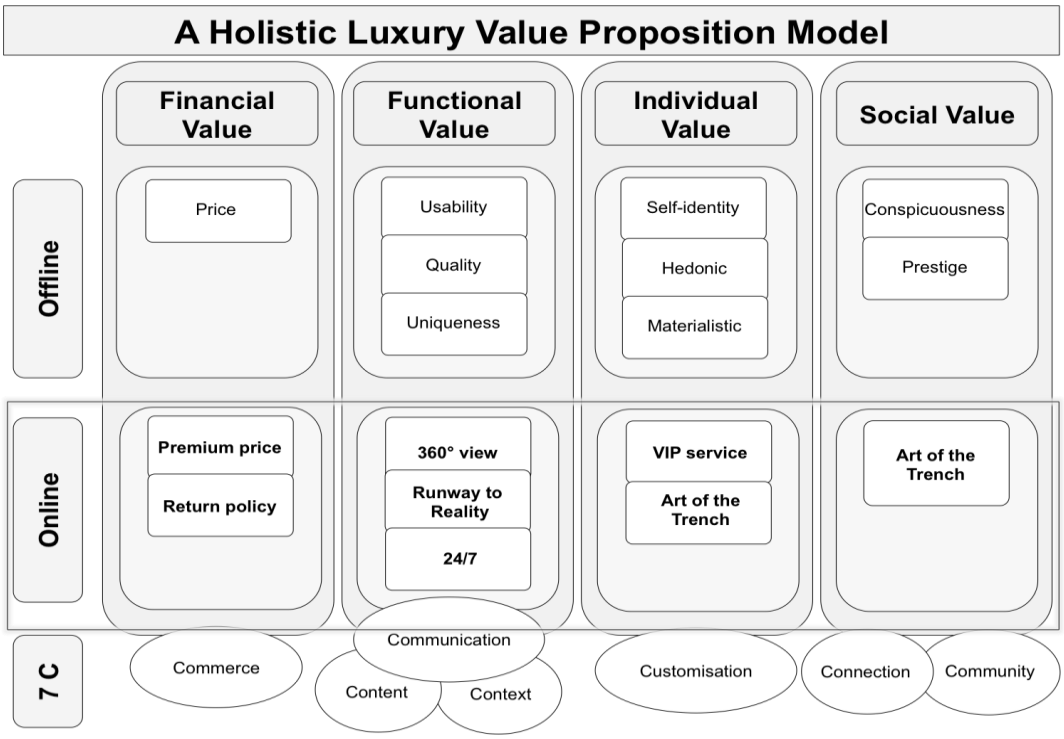

Figure 6: A Holistic Luxury Value Proposition Model- Burberry case (Source: The Authors)

2014; Choi et al., 2014, p.7; Rayport and Jaworski, 2001).

Burberry's strategy in case of Individual Value is to provide support to very important customers (VIP) in order to preserve exclusive treatment that customers expect and also their loyalty. Besides that, both Individual and Social Value are supported with the feature "Art of Trench". This feature is actually Burberry's very own social network designed to allow customers to upload a photo of themselves in the famous and iconic Burberry's trench coat. In this way, customers of luxury goods can satisfy their need of conspicuousness. During the first year of launching, the Art of Trench network reached more than 11 million views (Choi et al., 2014). Moreover, this project created the community of its customers promoting Burberry's brand in the same time (Burberry, 2014; Choi et al., 2014, p.7; Rayport and Jaworski, 2001).

Burberry is the luxury brand with the highest digital IQ. The benefits of being involved in digital environment, even for luxury brands, are reflected in Burberry's financial performance. In 2012, Burberry had both revenue and operating profit growth of 24%. In addition, it increased brand awareness among young population (Choi et al., 2014). It can be concluded that all tactics Burberry uses to provide financial, functional, individual and social values for its customers not only remained faithful to original brand philosophy and tradition but also improved Burberry's business as a whole.

5. CONCLUSION

This paper examined how luxury brands could benefit by digitalising their business. Luxury brands perceive the Internet as a threat to attenuate the brand value. However, we argue that the question is no more whether luxury brands should adopt online business but how they should do it. Thus, the challenge is to deliver the unique experiences for their luxury products to their customers as they do in offline store.

The luxury customers worldwide have accepted the internet as a resource, communication vehicle and e-commerce platform. As the customers continue to spend more time online, a strategic approach to e-business will prove critical. Luxury brands would be negligent not to do the same. Although the primary purpose of luxury businesses has not changed, the most effective and efficient ways for reaching it have. According to the latest studies, luxury brands should invest in their online presence and translate their original philosophy into digital environment that should be understood as the extension of the existing business and not a new concept. Consequently, the progress of a luxury brand's digital presence translates to measurable gains in terms of financial performance and the number of people who interact with that brand.

This research used the case of the British luxury brand, Burberry, to show how this company adopted e-commerce and which tactics it used in the light of a holistic value proposition model developed in this study. As a result of all efforts when it comes to digitalisation, Burberry has become the most successful brand among the luxury fashion companies. As this paper argued, Burberry suitably translated and adapted its offline values, exclusivity and philosophy into online platform, which resulted in financial growth and brand awareness increment.

To succeed online, luxury brands must convey their quintessence to the digital environment and leverage the unique capabilities of the digital space to reach customers in modern and stirring way. Customers will only identify with a luxury brand that ads value to their own personality. Luxury brands that have adopted this are experiencing benefits across the various aspects from customer communities, to the raise of brand ambassadors, to enlarged brand awareness, to online sales growth and to increased market share.

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DIGITAL MARKETING AND SOCIAL MEDIA IN HIGHER EDUCATION

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Abstract: *This paper presents opportunities of implementation digital marketing and social media marketing in higher education. The world of digital media is changing and progressing, and the way people are using technologies is constantly evolving. The goal of this paper is to analyze the potential of implementation digital marketing in higher education in Serbia. The paper shows that technical habits of students in Serbia are eligible for implementation of digital marketing and higher education synergy. Also, the paper presents the global digital marketing trends in higher education. The second part of the paper gives an example and first steps for implementation of this synergy. The institutions of higher education in Serbia have chance to use digital marketing and social media and introduce higher education into next technical level.*

Keywords*: Digital Marketing, Social Media Marketing, Social Networks, Higher Education, Search Engine Marketing (SEM), Search Engine Optimization (SEO)*

1. INTRODUCTION

The digital media world is changing constantly. Beside the technology progress, the way of using internet is evolving and changing. These changes are transforming not just how people access to information, but how they communicate and interact. Also, the way people choose and buy products and services is changing. Ryan and Jones point out that "People are embracing digital technology to communicate in ways that would have been inconceivable just a few short years ago. Digital technologies are no longer the preserve of tech-savvy early adopters, and today ordinary people are integrating them seamlessly into their everyday lives" (p.8). According to Parker “The explosion of new digital technologies and practices is also revolutionizing teaching and learning and there is probably no academic discipline more affected by the emergence of Internet technology than the field of marketing” (p.173). Today’s students often referred to as the “digital generation,” use an impressive assortment of technological tools in a wide variety of ways.

In 2011, Constantinides and Zinck noted that “the importance of the internet as commercial platform is by now universally recognized and increasingly businesses adopt online marketing channels at the cost of traditional ones. The social media, being second generation (Web 2.0) internet applications, allow interaction, one-to-one communication, customer engagement, and user generated content” (p.1).

All of this made a space for digital marketing and social media in education. This is primarily an opportunity for institutions of higher education in Serbia.

This paper presents the preconditions, the advantages and disadvantages for implementation digital marketing in higher education in Serbia and why is it so important for higher level educational system to implement digital trends.

2. DIGITAL MARKETING IN HIGHER EDUCATION

Integration of technology into the marketing classroom is not a new phenomenon. Nuldén noted that by the late 1990s, technology had become a routine component of the classroom pedagogy and of education in general (p.363). However, the technology and its integration in the marketing classroom have changer past ten years. According to Grewal and Levy “The changes and advances in social, mobile, and online technologies have created a perfect storm, forcing firms to change how they communicate with their customers” (p.84).

Hensen, Shneiderman and Smith pointed that digital and social media have changed the nature of interactions between customers and companies, engendering radically new ways of interacting and, essentially, revolutionizing marketing. As such, an integration of digital and social media into business marketing strategies is necessary to promote increased engagement and interaction (Coulter & Roggeveen,

2012). Engagement is the name of the game in marketing practice (Rohm & Weiss, 2014), and the marketing professoriate needs to be ahead of this technological storm instead of behind it (Crittenden, V. & Crittenden, W., 2015).

2.2. Digital marketing trends in higher education

Continuous monitoring of trends is necessary in every activity, including education. When big universities started using Social Media in education, most students immediately accepted the idea and actively involved, which shows that this channel of communication is close and familiar to them. Based on this, the conclusion is that this synergy can only bring positive results.

According to Hanover Research institutions of higher education are focusing on branding and marketing far more than previous years. Many have hired marketing professionals from the corporate world and invested significant time and money to create strong institutional brands (p.5).

Based on digital marketing trends defined by Hanover Research, the aditional trends that higher education institutions must follow if they want to implement digital marketing, are:

- Responsive website design: Institutions are placing more emphasis on responsive web design to create intuitive and easy to navigate websites that can be viewed on multiple devices and platforms.
- Search Engine Optimization and Search Engine Marketing (SEO and SEM) - the importance of this trend is reflected in the fact that educational institutions rank first places in search engines (Google). Also, Google Search Engine is constantly changing, so that more and more top results are paid ads. This makes institutions of higher education to invest resources in SEM.
- Uses of web analytics – Institutions of higher education are relying on data-driven analytics to determine who, how, and where they are reaching their audiences. The use of analytics software is increasing as the higher education web ecosystem is becoming increasingly complex, and the amount of online material institutions is expanding (domains, sub domains, etc.). Better analysis of this data is a new area of concentration for institutions of higher education.
- Strategic Social Media Management – like in many business areas, Social Media Management have a major impact on education. Most institutions of higher education in Serbia have accounts on at least one Social Network.
- Mobile development - Because of the rise of mobile technology and connected devices, colleges and universities are making greater investments in having a mobile presence. This includes not only mobile versions of websites and other content, but also making of mobile applications and BYOD (Bring Your Own Device) access to mobile devices.
- Content Management System and Customer Relationship Management (CMS and CRM) – Alongside the use of web analytics and other methods of harnessing “big data” in higher education, institutions of higher education are relying more heavily on content management and customer relations systems. CRM systems are especially important tools for admissions professionals engaged in outreach to prospective students, and also to make communication better and more efficient.
- Blogging and vlogging - Institutions of higher education should have a blog and a vlog. This will help students to solve everyday problems and answer to their most frequent questions.
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2.3. Technology preconditions for the implementation of digital marketing in higher education

For making use of digital marketing in higher education successful, it is necessary to examine if our target group (students, 17-28) have daily access to the Internet. According to data from website Consumer Barometer with Google, on the chart Figure 1, we can see that the number of people who have access to the Internet from year to year is constantly growing, so in 2015, 97% of respondents said that they have access to the Internet. Also, the number of people who access the Internet every day is increasing, so we can say that these two categories are going to equalize, with the prediction that in a few years all people who will have access to the Internet, access the Internet every day.

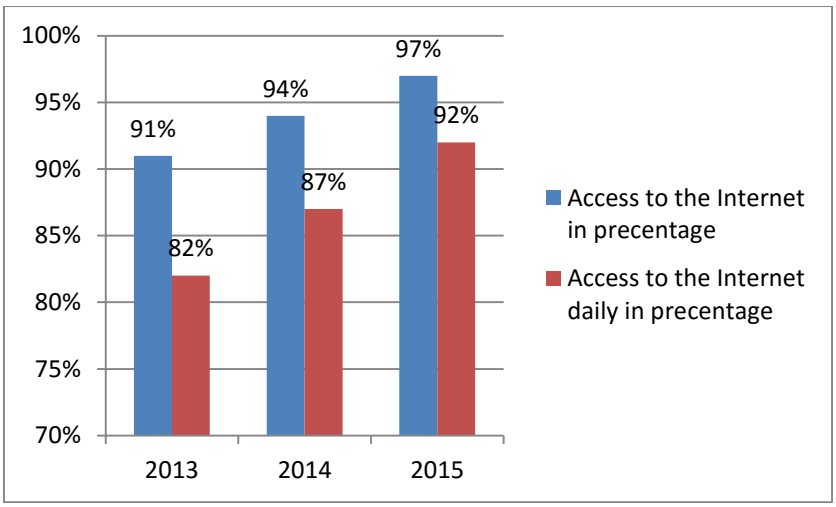

Figure 1: The ratio of people who have access to the Internet (%) and people who access the Internet daily
www.consumerbarometer.com

For implementation of digital marketing in higher education it is important that students can get information anywhere, anytime, and that the only requirement is the Internet access. This is enabled by the portable devices such as mobile phones and tablets. Of course, the use of computers is irreplaceable when we talk about writing papers, access online exams etc. On the chart, Figure 2 we can see the percentage of people (under 25) who use smartphones, computers and/or tablets. We can notice that the number of people who use computers since 2013. is in stagnation, while usage of smartphones recorded rapid growth.

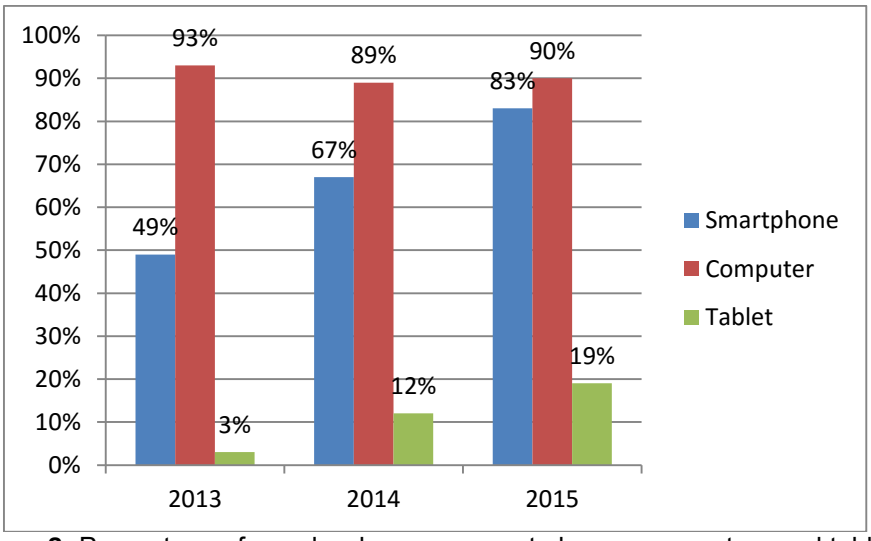

Figure 2: Percentage of people who use a smart phones, computers and tablets
www.consumerbarometer.com

Based on previous facts, we can conclude that Serbia fulfilled basic technology preconditions for the development of the synergy of digital marketing and higher education.

3. SOCIAL MEDIA IN HIGHER EDUCATION

The social media is a relatively new but fast-growing category of online interactive applications. These applications are based on user-generated content rather than supplier-generated allowing peer-to-peer communication and user-participation (Nambisan & Nambisan, 2008; Shankar & Malthouse, 2009).

Internet technology development in last years enabled that users can use Social Networks daily, in any place and at any time. Social Networks development caused that organizations and companies started to use them on the way that places them as an important part of marketing concept. That made some space for using Social Networks in educational purposes, which can be good chance for institutions of higher education.

Also, digital marketing and social network development changed the way that organizations/companies/institutions interact with users. With social networks, interaction became more simple and efficient.

One of the advantages of using social networks in higher education is that universities now can share different content, from sharing content directly from official website, to sharing various information which can be interesting for students, but can't be found on website. This is how institutions of higher education can come closer to their existing and potential students, because they show themselves as an institution which takes care of their students.

When we talk about students (existing and potential) as a target group (17-28 y/o), almost everybody from that target group owns smart phone or some other portable device. Social networks became important thing in student's life. They are something like personal information card, where you can find many details about user's life, from statuses where they write about their daily routine, photos and videos, to their relationship status and their likes. Social networks users are used to get important information in real time from those communication channels. The main indicator of good online interaction between institution of higher education and students are Facebook groups where information about exams, results of exams, important dates and other experiences are exchanged. Based on this indicator, we can conclude that there is definitely a place on social networks which is reserved for institutions of higher education.

The most used social networks in Serbia are Facebook (3,2 million users), Twitter (350.000 users), Instagram (360.000 users), LinkedIn, Google+ (as special groups which are created and used for special purposes) and YouTube (reach 47%, with TA music) (McCann Ericson, Wave5, 2010).

Based on this indicators, we can conclude that population in Serbia is following global social network trends.

According to research by website Top Universities from 2014. year, the most students are using social network Facebook, but also, other social networks should not be ignored,

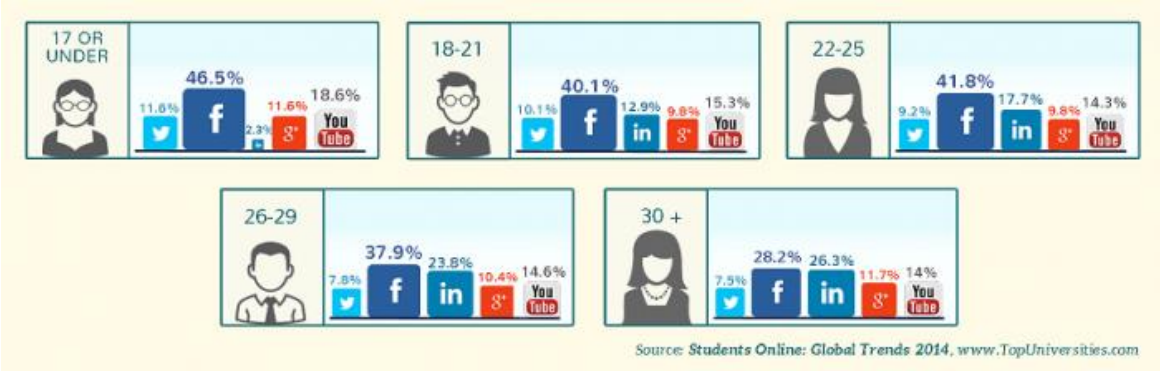

Figure 3: Students Online, Global Trends 2014
www.TopUniversities.com

As students mature, they are changing the way of using social networks. By the time, students are starting to use LinkedIn, because of their need for employment is increasing. (Tucker, L., 2014).

According to researches about the presence of the institutions of higher education on social networks, we can notice that the full potential is not used, and that there is a lot space for advance in presentation, engagement and interaction on social networks.

From the research conducted by the website emarketer.com from May 2015., (Table 1), we can see that the students (17-25 y/o) spend much of their free time online.

Table 1: Daily Time Spent on Social Networks (eMarketer, 2015)

Social Networks	Google+	LinkedIn	Twitter	Instagram	Facebook
0-1 hours	92.6%	89.5%	73.4%	57.6%	39.3%
2-3 hours	4.9%	7.8%	18.1%	24.1%	34.1%
4-5 hours	1.4%	0.6%	5.3%	10.3%	15.6%
6-7 hours	0.4%	1.2%	2.0%	3.9%	5.8%
8-9 hours	0.4%	0.6%	0.4%	2.5%	2.7%
10+ hours	0.4%	0.4%	1.0%	1.6%	2.5%

As we can see from the Table 1, the most respondents spend 0-1 hours daily on social networks, but also the number of people who are spending 2-5 hours is not low. Of course, there are extreme groups who spend online 6+ hours and if we consider only Facebook than this percentage is not negligible.

Because of the student's behavior the potential of the active presence of institutions of higher education on social networks is huge and definitely should be used. Institution of higher education should take advantage of social networks to encourage students by offering useful information.

3.1. Advantages and disadvantages of using social networks in education

As an educational tool, social media enriches the learning experience by allowing students and teachers to connect and interact in new, exciting ways (Lederer, K., 2012). There is an ongoing debate regarding the integration of social media in education. Guy point out "Advocates of social media usage point to the benefits of using social media for academic practice while critics are calling for regulations and/or the removal of such online technologies in the classroom. Finding middle ground has become a challenge" (p.12).

Advantages:

- Better open access to education
- Better integration and communication with students
- Better integration with students from distant locations
- Better integration between students and professors
- Real-time efficient and fast communication
- Enabling and presentation tools that help students in solving problems
- There are no age limits for the level of difficulty, students can learn at their own pace
- Reducing the cost of travel for students (in combination with an LMS system)
- Presentation of institution of higher education in the best possible way
- Presentation of study programs to high target group from any location
- Increase student motivation
- The participation of the masses. Scientific material may be accessible to the general mass
- A combination of formal and informal learning
- Availability on portable devices (smart phones, tablets)

Disadvantages:

- Social networks can disrupt student in learnigng.
- Cyberbulling - Open side of comunication have that disadvantage, i.e. proffesor can be disturbed by the students, or students can be disturbed beetwen themselves.
- Face-To-Face communication absence - We are still living in time in which is FTF comunication considered as the most relevant and efficient. This can be changed by the change of generations.
- Students maybe still don't get the seriousness of this way of learning, because they are still thinking of social networks as a way of fun

4. AN EXAMPLE OF IMPLEMENTATION OF DIGITAL MARKETING AND SOCIAL NETWORKS IN HIGHER EDUCATION

The Institution of Higher Education in Serbia wants to implement digital marketing and social media marketing in the education system. It is necessary to have a website with generated content which will be the final destination of using any digital marketing tools.

Website of The Institution of Higher Education can provide a basis for an engaging user environment (Weiss, 2008) and the social media is an ideal extension for the relational marketing activities due to their collaborative and interactive nature (Zinck Stagno, M., 2011). Website must follow the technology trends, be innovative and to give students all needed information. Having a mobile-responsive website is also important with the growth of smart phone and tablet use, particularly amongst young adults which are our target group.

Looking at the experiences from the business practices (Constantinides, 2010), one could argue that such strategies can provide higher university institutions with new communication possibilities allowing direct engagement with potential students. Such engagement can involve interaction with institutions of higher education recruiters or interactions with other students during the process of searching for a suitable study

and university. Engaging potential students in the social media domain is in principle an inexpensive way for universities to attract and persuade potential students. Social networks or online communities created by schools as part of their online presence can bring together potential student with students who already enrolled, or with peers looking for similar information and help (Zinck Stagno, M., 2011).

First, The Institution of Higher Education must work on SEO optimization and invest in SEM campaigns. Students are using search engines as their first source of information for higher education institutions and 9 of 10 are not knowing which institutions of higher education they wish to attend during initial research stages,. It's more important than ever to make sure that the website of The Institution of Higher Education looks and operates to a high standard to show up within the top search results. Unlike other industries, users who are looking for higher education information don't just stop at the homepage, but navigate through sites to find admission and course information, student associations and even details on what student life is like on faculty. This is why an SEO optimization is very important and could bring only benefits to the institution of higher education. Also, when potential student Google institution of higher education, on Google Search will first appear paid results. Because of that, The Institution of Higher Education has to invest resources for SEM campaign.

With the right strategy, Social Media can make studying more collaborative and efficient, and bring benefits to the both side, The Institution of Higher Education and students. The Institution of Higher Education should open accounts on the most popular Social Networks in Serbia, and those are Facebook, Twitter, YouTube, LinkedIn, Instagram and Google+ (just for special needs). Social Media Networks are an ideal way for institution of higher education in Serbia to engage with students. Social Media enables talking with students in real time, answering their questions and directing them to the website. This will not only increase the traffic to the website, but it will also enhance the user experience, allowing students to view institution of higher education as helpful and student-focused. Social Media also gives the opportunity to connect with other educational associations. Also, The institution of higher education can share important and interesting information, student's life quotes, courses, exam results, etc. This all will help students, but it also can help The institution of higher education in future development and growth.

Those are the first steps for implementation of digital marketing, and when this sets properly, next steps are following and implementation of digital marketing global trends.

5. CONCLUSION

There are many advantages that can bring synergy of digital marketing and higher education, like better open access to education, more efficient and real-time communication and interaction, making students more satisfied, branding and attracting new students, etc. The institutions of higher education in Serbia have fulfilled basic technology preconditions for the development of the implementation of digital marketing and higher education. Also, because of student's behavior the potential of the active presence of institutions of higher education on social networks and implementation of digital marketing is huge and definitely should be used.

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ANALYSIS AND VALIDATION OF SUCCESS FACTORS OF MOBILE APPLICATIONS AS E-MARKETING TACTIC

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Abstract: *With fast penetration and adoption of smart phones, mobile marketing and mobile applications as one of the possible mobile marketing tactics are increasingly gaining relevance. Previous theory and research dealing with mobile applications and mobile marketing typically covered one (or few) aspects: technology, process or user experience, defining success factors and good practices. Using the example of Tastly application in Serbia, this paper attempts to integrate all of the mentioned aspects and validate success factors. Main theoretical guidelines have been validated with additional useful implications for marketing practitioners.*

Keywords*: mobile marketing, mobile application, native type, agile methodology, user experience*

1. INTRODUCTION

Mobile communications accelerate with fast adoption of smart phones and that also drives significant growth of mobile applications market. Mobile phone's ubiquitous nature and the fact that the user almost never separates from it make this device an attractive channel for direct, two-way, real time communication with the consumer. Most of the scientific papers so far covered one (or few) functionality and success aspects and factors of mobile apps. Using the example of Tastly application in Serbia this paper analyses complete approach for development, launch and maintenance of a mobile app as a marketing communication tactic, covering the aspects of process, technology and content. The objective is to validate theoretical assumptions of successful use of mobile application as a tool for consumer communication.

2. SMART PHONE AND MOBILE APPLICATIONS RELATED TRENDS AND IMPLEMENTATION IN MARKETING

Fast adoption of smart phones drives dramatic growth of mobile applications market. This segment is one of the fastest growing industries (Datta, Kajanan, 2014). IDC forecasted 182.7 billion mobile apps downloads in 2015 (Păvăloaia, 2013). With more than 2.6 billion smart phone users in the world, mobile communications industry alone contributed to 4.2% GDP growth globally last year, with mobile apps and services segment ranking second in size (GSMA, 2016). Internet via mobile phone accounts for 25% of total internet traffic in 2014 (Yan et al., 2014). Forrester forecasted that 42% of world population would own a smart phone in 2015 (Forrester, 2014), while GSMA recorded 60% smart phone penetration in Europe (GSMA, 2016).

With no physical location limitations, mobile technologies allow advertisers and retailers to contact their consumers always and everywhere (Fong et al., 2015). Possibility of contact anytime and anywhere are significant advantages of mobile devices (Persaud, 2012). Even though 90% of purchases are still made in brick-and-mortar stores, 70% of consumers use a mobile phone prior to purchase, more than 50% of purchase decisions are influenced by mobile phone and this technology increases conversion by about 40% (RetailmenotInc, 2015). Smart devices allow marketers to develop a wider range of pull-based services and employ a larger set of marketing techniques (Persaud, 2012). In 2015 in USA more than half of total digital communications investments have been allocated to mobile devices (eMarketer, 2015).

Association for Mobile Marketing defines it as set of practices that enable organizations to communicate and engage with their target audience in an interactive and relevant manner and with any mobile device or network (MMA; Ström et al., 2013). Mobility can be related to mobile medium, device, channel or technology (Shankar et al., 2010). Some of mobile marketing tactics are SMS, MMS, mobile banner, QR codes, mobile applications, mobile web design (Hadadi and Almsafir, 2014) etc. Presence of various sensors and services within a smart phone enable geo-targeting, motion triggers, beacon activations and so on.

3. SUCCESS FACTORS OF USING MOBILE DEVICES AND APPLICATIONS IN MARKETING

Mobile phone is almost always on its user which allows for communication everywhere and always and implementation in marketing (Persaud, 2012; Bauer et al., 2005; Banerjee and Yancey, 2010). One of important questions covered in numerous scientific papers was the question of utility and value. Perceived utility impacts acceptance and use of mobile technology and acceptance of marketing services (Ström et al., 2013). Bauer (Bauer et al., 2005) finds that entertainment and information value are most important factors of perceived utility. Value or benefits can be defined as utilitarian, emotional, social and monetary (Ström et al., 2013). Issues in mobile marketing are the result of variety of platforms, data security and privacy, obtaining permission for communication, ease of navigation, user experience, battery power, processing and memory power of the device etc. (Hadadi and Almsafir, 2014; Watson et al., 2013; Mahmud et al., 2014; Rupnik, 2009).

3.1. Mobile applications for smart phones

Mobile applications on smart phones are a specific tool for target group communication and activation. Mobile application is a software that operates on mobile devices using the operating system of the device (iOS, Android…) (Datta, Kajanan, 2014), i.e. it is a program that runs on mobile devices and presenting value to the mobile user (Rupnik, 2009).

"Mobile first" approach in today's practice (TCCC, 2015) helps avoid poor user experience resulting from browsing web pages which are not tailored for mobile devices (Guirguis, Hassan, 2010). Older web applications face challenges from variety of browsers and their compatibility, screen size and resolution, security, operating systems, touch-screen interface, usage of camera, location service, screen rotation and other device features.

3.2. Technology aspects of mobile applications

Mobile application development is a set of processes of writing software for small and wireless computing devices (Mahmud et al., 2014). Technical aspects include application type, operating system, web service and architecture.

There are three types of applications: web, hybrid and native. Figure 1 provides comparison of different application types (Mahmud et al., 2014):

Criteria	Type of mobile application		
	Web	Hybrid	Native
Development cost	Reasonable	Reasonable	High
Speed	Fast	Native speed	Very fast
Device access	Partial	Full	Full
Approval process	None	Low overhead	Mandatory
Application store	Not available	Available	Available
Multi cross platform support	Full support	Full support	Limited support
Native look and feel	Limited support	Some support	Full support
Access to peripheral SDK	Limited support	Some support	Full support

Figure 1: Differences between web, hybrid and native applications

Hybrid type is recommended to optimize budget, development and maintenance of application, while native application offers best user experience and fully leverages device features and possibilities.

Application architecture defines user-server architecture and usually has multi-layered structure: user, presentation, services, cloud service, data (Păvăloaia, 2013; TCCC, 2015). This defines, for example, how application can operate without server connection, storing data on local database until server connection is restored and data transferred (Mahmud et al., 2014).

3.3. Mobile application development process

General software development cycle assumes four phases: analysis, design, implementation and testing (Rahimian and Ramsin, 2008) and this can also be applied for mobile applications development. Somewhat

detailed process according to (Maharmeh and Unhelkar, 2009) includes: project initiation, project plan, analysis, design, coding, testing, deployment, post implementation (closure).

There are many process types that can be applied for applications development (Waterfall, iterative, V model, spiral, prototype model, agile) (Păvăloaia, 2013; Maharmeh and Unhelkar, 2009), and each has certain advantages regarding level of detail in planning, risk reduction or user collaboration during development.

Agile methodology has been accepted as the best practice for mobile applications development – design and implementation are key activities of development process (Păvăloaia, 2013; Mahmud et al., 2014; Rahimian and Ramsin, 2008). This process is incremental, cooperative, simple and adaptable (Abrahamsson, 2002).

3.4. Mobile application content and user experience

Marketers see mobile marketing as a vehicle for direct, personalized contact with consumers without temporal or spatial barriers, while perceived utility and relevance are among most important factors of mobile applications acceptance and usage by the end user (Watson et al., 2013). Assuming basic requirements of data security and privacy are fulfilled, users are ready to exchange their personal data for useful services (Persaud, 2012; Ström et al., 2013). According to Xu (Xu et al. 2014) convenience and simplicity are main reasons for using mobile services. Personal data can be obtained actively (provided by user) or passively (generated by technology) (Pousttchi and Hufenbach, 2013; Xu et al. 2014), and they are the basis for building and applying CRM (Hadadi and Almsafir, 2014; Xu et al. 2014).

Smart phones and tablets are mainly used for social networking, content sharing and personal productivity (Bancora et al., 2015). Therefore, integrating applications with device functionalities (camera, geo-positioning, calendar, planner…) helps fulfil these needs (Hadadi and Almsafir, 2014).

Keeping same approach in digital communication development for web and mobile phones is inefficient and provides poor experience for the user (Guirguis, Hassan, 2010). “Mobile first” approach becomes a standard that marketers are adopting more and more, but certain potential problems still remain: different screen sizes, content optimization to screen, ease of navigation, connection quality, battery life, memory capacity, processor speed, security (eMarketer, 2015; Rupnik, 2009).

Users recognize added value for tailored content, adapted to context, individual preferences, location, time, activity and interactivity (Fong et al., 2015; Persaud, 2012; Ström et al., 2013; Unhelkar and Murugesan, 2010).

4. TASTLY MOBILE APPLICATION EXAMPLE

As part of the small baskets project, The Coca-Cola Company identified the opportunity to use mobile devices for customer communication during pre-shop phase.

Based on extensive shopper behaviour research (Company’s standard global methodology) in a few markets of Central and South Europe (CSE), one of key behavioural models of shoppers when on small basket missions is the “mental shopping list” (shopper knows what is needed to be purchased on this routine shopping mission, but does not have that list written down) – preparing for this shopping trip the shopper (in this case a mum) thinks about what to prepare for the main meal of the day, which food items she may still have at home, where would be most convenient to do the shopping, how much money she has available… In addition to checking household stocks, internet becomes important source of information and inspiration when preparing for the shopping trip i.e. preparing the main family meal.

One of key marketing activation platforms for brand Coca-Cola is “Coke & Meals”. Main activation tactics until 2015 were focused on traditional media and retail outlets, with limited use of digital media and social networks. Data from different markets indicated that a lot of mums (main target group for this platform) currently and increasingly more use internet and especially mobile phone during shopping preparation – searching for information, recipes for inspiration, recommendations, checking prices and looking for offers. Central shopper marketing team for Coca-Cola in CSE identified the opportunity to implement mobile marketing as tactic that could respond to shoppers’ needs.

4.1. Application development process validation

Application development process will be validated according to Maharmeh (Maharmeh and Unhelkar, 2009): project initiation, plan, analysis, design, coding, testing, deployment and post implementation.

Based on insights from above mentioned shopper studies, shopper team briefed the agency to propose relevant solutions for defined target group activation objectives. Agency proposal included development of a mobile application which would contain following features: recipes for inspiration, shopping list creation, current promotions and leaflets across retailers, retail outlets maps and various entertainment content (music, fashion).

Idea was interesting and decision to initiate the project was made. Key objective of this phase was success and sustainability assessment of such an initiative. With people, financial and technical resources limitations, project team was tasked to develop a sustainable plan.

First step was the extensive analysis of existing market offering. Application development is not the core competency of The Coca-Cola Company – challenge was to develop something new that would be differentiated and useful to users. Reviewing more than 30000 existing application related to cooking and shopping, following key functionalities were identified: step-by-step recipes, useful tips, local cuisine relevance, shopping list creation, sharing. None of the existing apps provided all of them.

Next stage was defining way of working – internal vs external development and maintenance team, inclusion into existing Company IT systems or using market available IT solutions, development model options, possibility to maintain and keep relevance across all CSE markets and beyond (globally), reviewing locally relevant resources needed to maintain local app version, ways of sourcing content for the app (relevance and reliability or sources, legal requirements and limitations, intellectual property solutions, sufficient content quantity) and estimation of financial resources needed for launch, expansion and maintenance.

Satisfactory solutions from the analysis stage were given the approval for project launch, i.e. approval of the plan with all technical, organizational, financial and timing details. Serbian market was selected as pilot market for this project.

Application design was initiated – architecture, graphic design, coding. Beta versions were tested on limited number of users, mainly Coca-Cola system and partner agencies employees. Beta testing took five months, until final version was ready for full launch.

Prior to launch, success criteria were defined – those would be used to validate the pilot and decide on expansion in Serbia and other countries. Main KBIs were: 25% user base of target group of mums smartphone users (69000) within 4 months, daily users (5000), application rating (>4).

In September 2015 Tastly application became available on Google Play and App Store for Android and iOS smart phones. The app is free for the user, in accordance with validated practice of launching apps free of charge as an effective way to build awareness, affinity, creating usage habits and word of mouth expansion (Datta, Kajanan, 2014; Liu et al., 2012; Kim and Morris, 2007). Distribution and discovery are very important phases of the process, as per internal Company process – in addition to app stores availability, launch media plan for advertising in digital media was put together, containing banners with link to app store as well as PR texts on target audience and topic relevant sites and pages (recipes, cooking, family, shopping etc.). Results have shown significantly higher efficiency of PR texts (Figure 2 and Figure 3).

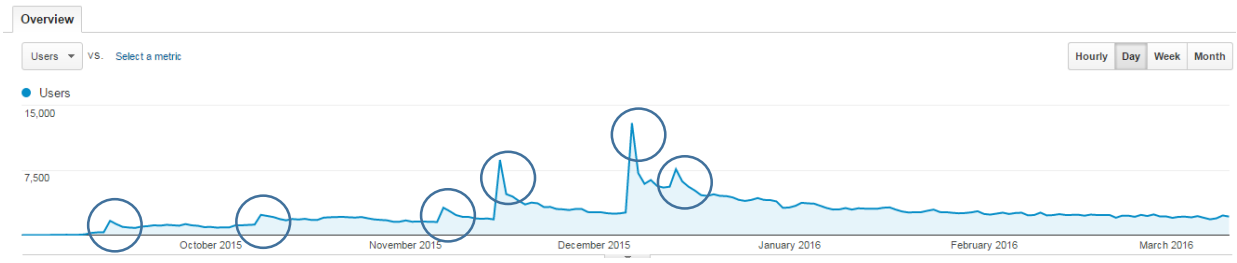

Figure 2: Daily overview of new users for Android version of Tastly app for Sep 2015 – Mar 2016

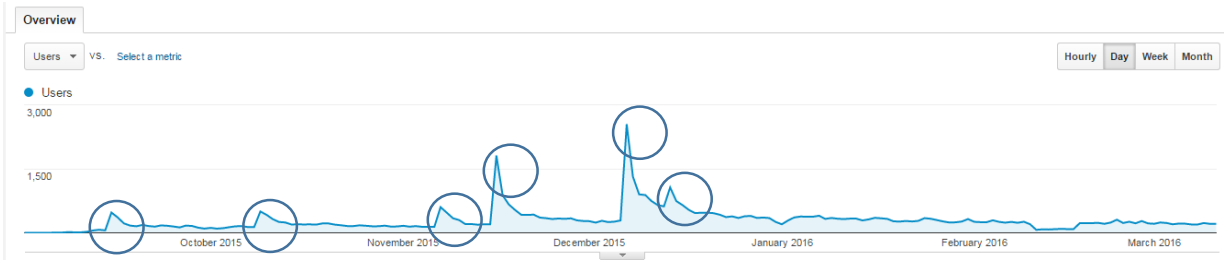

Figure 3: Daily overview of new users for iOS version of Tastly app for Sep 2015 – Mar 2016

Number of users surpassed the set target (reaching more than 85000), as well as the application rating (4.6), while daily users were below set target (reached 2500) (Figure 4 and Figure 5). Since the number of regular users is extremely high (89% for Android and 81% for iOS version), as well as the number on weekly users, pilot was evaluated as positive.

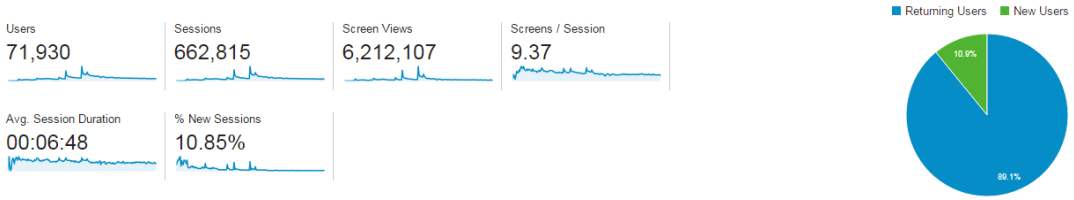

Figure 4: Activity overview for Android version of Tastly app Sep 2015 – Mar 2016

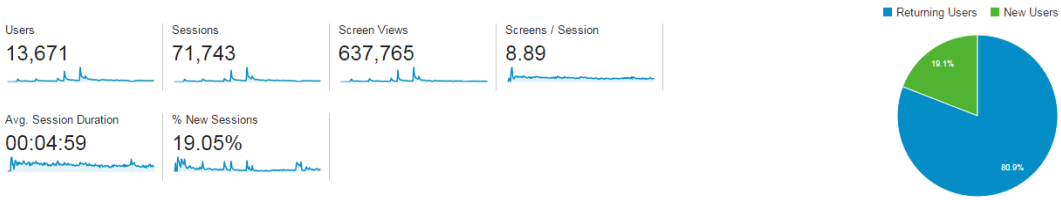

Figure 5: Activity overview for iOS version of Tastly app Sep 2015 – Mar 2016

Tastly app will continue to be used as a marketing tactic in Serbian market and will be further developed and it will be launched in other markets of CSE. Based on experience in Serbia, team has defined precise process with mandatory steps and guidelines for other markets how to proceed in preparation, launch and activation. In line with brand objectives and consumer behaviour and needs analytics new functionalities will be added, and that is another factor of success for an application according to Datta (Datta, Kajanan, 2014).

Whole process can be illustrated as in Figure 6, showing which functions were involved, in which way, at each of the project phases. For clarification, following is the meaning of abbreviations: CIC – Consumer Interaction Centre (locally responsible person for consumer interaction in digital media), CCH – Coca-Cola Hellenic, local bottler.

Function / Project phase	Shopper Marketing	CIC	IT	Digital	Marketing	CCH	Developer	Media Agency
Project initiation	R/A	C		C	C			
Plan	R/A	R/A	C	C	C	I	C	
Analysis	R	A		C	I		A	C
Design	R	A	C	C	A	C	A	
Coding	R	C	C	C			A	
Testing	R	A	C	I	A	I	A	I
Deployment	C	R	C	I	A	C	A	A
Post implementation	R/A	A	C	I	A	C	C	I

RACI: Responsible, Accountable, Consulted, Informed

Figure 6: Internal process of Tastly application development

To conclude, more detailed process as per (Datta, Kajanan, 2014) in this case was more useful than the simpler general version as per (Rahimian and Ramsin, 2008) for the following reasons: it allows for more detailed steps during preparation and planning, it provides for steps after testing and deployment and it assumes testing prior to deployment which prevents launch of suboptimal application version.

4.2. Application development model validation

As mentioned in 3.3 agile application development methodology has been accepted as best practice (Păvăloaia, 2013; Mahmud et al., 2014; Rahimian and Ramsin, 2008). The process is incremental, cooperative, simple and adaptable (Datta, Kajanan, 2014; Abrahamsson et al., 2002), which was relevant in case of Tastly.

Team that worked on application preparation and launch was small and flexible, with following members: central shopper team, local digital team (Company and agency), central IT team, developers, local marketing team, local bottler representative, local media agency. Communication between team members was frequent and direct, on needs be basis, not only as per protocol. Each team members used his own network of friends to include users to test the app and collect feedback to improve functionalities.

Architecture is multi-layered, as per best practice defined by (Păvăloaia, 2013; TCCC, 2015). It is cloud hosted, which helps overcome device limitations of processing power and memory capacity, and it allows for contextual user engagement and geo-targeting (Gupta and Agarwal, 2015). User data are also stored in cloud, currently using external analytics and CRM services, while user engagement tactics are being evaluated and tested for scalability.

This approach enabled entire development and beta testing to be completed within 8 months and pilot validated within a year since project initiation, keeping costs at acceptable level.

4.3. Application content validation

Tastly has been developed as native application for Android and iOS because quality user experience and connection with device functionalities have been defined as main objectives (Mahmud et al., 2014; TCCC, 2015).

Based on available consumer insights, application functionalities fit users' needs when preparing for shopping, meal planning, managing household budget, and simplifying shopping. Tastly has following features: recipes search and browsing, shopping list creation, current retailer leaflets and promotions review, store location relative to user's location, possibility to share comments, ask questions, share content, connecting with social networks profiles.

Knowing that privacy and data protection is very important to users (Jiang et al., 2015; Hadadi and Almsafir, 2014; Pousttchi and Hufenbach, 2013; Persaud 2012; Bauer et al., 2005), Tastly does not require identification or registration, but allows for optional link to Facebook and Google+ account. Passive data resulting from using the application enable anonymous application analytics (Xu et al., 2014): recipes search and browsing, shopping list content and geolocation will be used to develop algorithms for user engagement in the coming months, in collaboration with retailers (via notifications and beacons in stores).

This application is also an example of content creation solution, which is becoming frequent practice by advertisers (Jutkowitz, 2014). Tastly is an integral part of total marketing plan for "Coke & Meals" platform – source of recipes are mum food bloggers, it features current retail promotions, retail outlets are mapped and described, it links with social networks and relevant media.

There are multiple indications that right solutions regarding content have been implemented: high application rating, high percent of regular users, positive comments about the app and within the app, interactivity between users and their recommendations. It has all been based on understanding consumers' needs and creating solutions to their needs, coupled with visual graphic design and technical solutions. According to Datta (Datta, Kajanan, 2014), regular application updates and development of new features and content drive success, which would be validated in the coming months when new features will be added to Tastly.

Analysing in-app behaviour flow (Figure 7) indicates opportunity to improve visits and usage of shopping list. This feature is important to the Company for the purpose of measuring efficiency (during pilot period, presence of Coca-Cola brand in the shopping list (as the best approximation of purchase) has been three times higher than incidence in purchases measured by household panel).

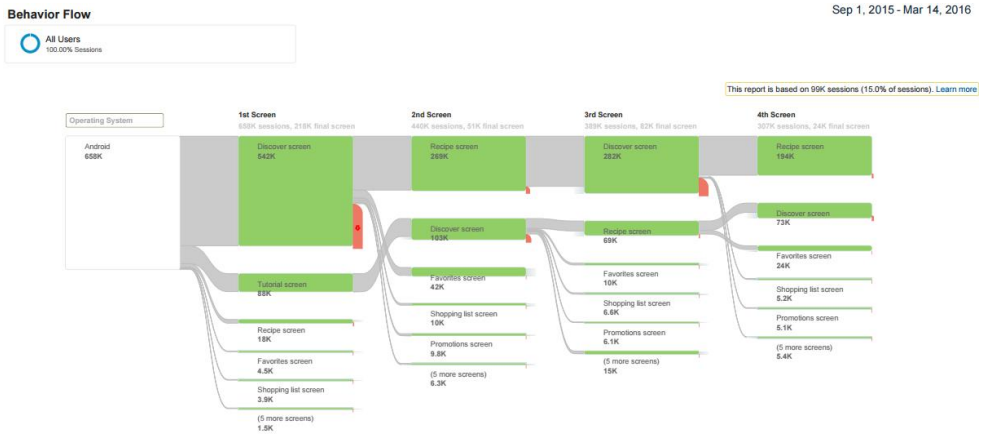

Figure 7: Overview of behavior flow for Android version of Tastly application for Sep 2015 – Mar 2016

Statistics show that it is very hard to succeed in mobile applications market: out of more than a million available apps, average user actively uses about 24 apps per month, spending more than 80% of time on only 5 (Forrester, 2014). During pilot, Tastly was among top five downloaded apps in Serbia, with excellent statistics on regular users.

For The Coca-Cola Company important utility test for Tastly will be when personalized communication and offers will be activated, as well as geo-targeting and beacons activation within retail outlets. All of these are validated success factors for mobile applications and mobile marketing in general (Fong et al., 2015; Gupta and Agarwal, 2015; RetailmenotInc., 2015; Xu et al., 2014; Banerjee and Yancey, 2010; Rupnik, 2009; Bauer et al., 2005), providing platform for collaboration with retailers and direct tracking of efficacy via sales results.

5. CONCLUSION

With fast penetration of smart mobile phones, use of mobile devices for consumer communication becomes increasingly important. Theory on processes and methodologies about mobile applications development is abundant, with established recommended best practices. There are also many academic papers that analyze success factors of mobile marketing and mobile applications. This paper attempts to validate good practices and success factors using the example of Tastly mobile application, developed by The Coca-Cola Company.

Selected exampled demonstrates high level of success a mobile application as a mobile marketing tactic can reach by respecting and deploying efficient processes, technologies and management. In this case, agile methodology and extensive process were significant for success – from clear objectives, flexible, small and dedicated team with frequent interactions, thorough testing, results tracking and tactics adjustment during implementation, to clear directions for future application evolution and management.

Regarding content, most critical for success was understanding potential users' needs and creating the application as response to those needs. Regular updates and information accuracy help maintain user satisfaction. Also, timely reactions to users' comments and questions, as well a regular tracking and analytics are important to succeed and require dedicated human resources.

Possible future research in terms of further understanding success factors can be in domain of dynamics and scope of improvements in new application releases and what is the most efficient way to inform existing and potential users about those changes, as they could be important to attract new users and drive frequency with existing occasional users. In addition, possibilities for partnering with retailers (and other partners) in real or digital world and measuring direct impact on brand perception, attributes and sales would be relevant to marketers to define the role and investment level into such tool as part of broader marketing plan.

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E-SERVICES IN THE REGULATION OF MEDICINES AND MEDICAL DEVICES

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Abstract: *This paper presents the development of e-services and e-submission request of clients in the pharmaceutical industry as a subsystem of e-government of the Republic of Serbia. The main goal of this paper is to introduces the relationship of e-business in the regulation of medicines with other segments of e-government, e-health and e-pharmacy. The methodology for the development of e-services, methods for modeling and analysis of business processes, the reference model of e-business in the regulation of medicines are the main scientific contributions of this work. E-services development in the regulation of medicines, as one subsystem of the e-government implemented in Medicines and Medical Devices of Agency of Serbia, is a major professional contribution of this work.*

Keywords*: internet, e-government, medicines, e-services, e-submission*

1. INTRODUCTION

Electronic business (E-business) is the exchange of standardized electronic messages between natural and legal persons in negotiating, contracting, purchasing, sales, payments, communication with the administration and the courts, and in all other business transactions for which the law allowed its application (Ivkovic, Radenkovic, 1998).
E-business can be defined as "buying and selling of information, products and services through computer networks and support for any type of business transactions via the digital infrastructure." On the other hand, e-business can be seen as a process of conversion of digital inputs and outputs through a set of intermediaries. E-business is based on more modern work organization adapted to the use of ICT, internet usage in the performance of most business transactions, organization and implementation of information systems (IS), implementation of electronic signature and using cryptographic protection mechanisms. In the context of business operations relationships are established between companies and enterprises, enterprises and customers, buyers and customers and the rest, so that we can distinguish between the following business models: B2B (Business to Bussiness), B2C (Business to Customer), C2C (Customer to Customer)…
E-Government uses the application of information technology to improve: efficiency, productivity, transparency and accountability of the Government in dealing with: citizens, businesses and institutions, other government units and private officials. E-government can be seen from the "online access to services" to "tools for the construction and reconstruction of democracy"(Pedro, Gonnet, 2001). The objectives of e-government are: providing better services to citizens and businesses, clearer rules and procedures and less opportunity for corruption, and better control of costs and claims. In recent years, e-business and e-government there has been progress thanks to, on one hand, technological advances in the field of hardware, and on the other hand, the emergence of new methodologies in e-business and e-government. E-government is a Web-based technology that uses the local government as a communication channel, which is offered to visitors, citizens, business partners, other local governments and employees. Business models, which are used in the development of e-government are G2C (Government to Customer), G2B (Government to Business), G2G (Government to Government)...

2. E-BUSINESS IN THE REGULATION OF MEDICINES AND MEDICAL DEVICES

E-business has changed the traditional way of doing business. For regulation of medicines and medical devices, e-business is used for collecting, recording, storing and securing data, and information about medicines is a source of necessary information for the daily work of doctors, pharmacists and other health workers. The development of e-business in regulation of medicines, as one segment of e-government of Serbia provides interactive e-services tailored to the needs of citizens, public authorities, regulatory and educational institutions and industry (producers, representations, importers, representations of medicines and medical devices, health care and pharmaceutical institutions). The goal of this approach is the integration of e-government and the segment relating to the regulation of medicines, ensuring the efficiency of how the process of modeling and model implementation, which should result in models that must be

explicit, understandable, modular and can be effectively amended and supplemented, distrubuted and placed on a variety of computing platforms and operating systems in e-government.
E-business in regulation of medicines is one of the segments of the development of e-government in Serbia. Without e-business in regulation of medicines it is unthinkable to develop e-health and e-pharmacy. Providing information on medicines is one of the e-services in the regulation of medicines. Information about medicines is coming from routine sources, specific non-routine, library sources and research sources. Information on medicines, which must be precise and authoritative data are necessary for the daily work of doctors, pharmacists and other health workers in general and special branches of medicine, pharmacists in the production, medicines and pharmacies, as well as other professionals involved in health care, regulatory bodies. At this level, the information collected is detailed, often imprecise and poorly structured, while face to face contact provides sufficient information for the collection and processing. This information is then filtered, grouped and standardized. In a further move of information, less detailed information is required , but the number of people is getting bigger. Because of this, there is a need for standardization of terms and reports of how data can be easily grouped, analyzed and compared, and with a limit on the collection and analysis of just what is really needed.
Integration of eBusiness in the regulation of medicines and medical devices, eGovernment, eHealth and ePharmacy in Serbia (Figure 1) uses e-business models to better communication, better management of documents and records in public administration, the pharmaceutical industry and the health system, as well as the achievement of measures directly connected to savings in dealing with several aspects (time - efficiency, money - economy). Networking of institutions in the field of information on medicines and medical devices affects how efficiently the business of the Medicine and Medical Device Agency of Serbia (ALIMS) and health institutions, patients or the pharmaceutical industry is, which leads to a significant reduction in total costs and time saving. ALIMS was ready from the start to participate in the initiative to open data and thus enable that information on medicines and medical devices, and integration with other data, to get more value and become useful to other state bodies and institutions.

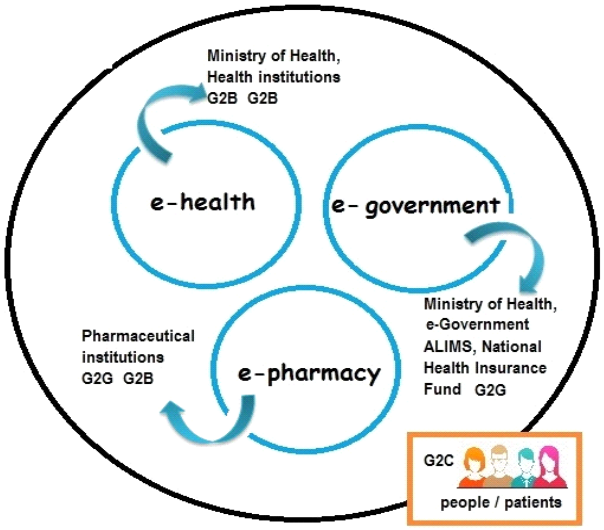

Figure 1: Models of e-business between eHealth, eGovernment and ePharmacy

3. METHODS OF DEVELOPING SOFTWARE IN E-GOVERNMENT

Methods of software design are specific strategies that propose and provide a set of notations which are used with the method (as a description of the process that should be used when monitoring methods , and a set of guidelines for the use of the method) (Budgen, 2004).
Some of the methods of design software are: object- oriented design, functionally - oriented design , design - oriented data structures and design based on components. This section will describe the methods, methodologies and software development models, which are used in e-government. Particular attention will be devoted to the life cycle of software and business intelligence, and SOA (Service Oriented Architecture) and BPM (Business Process Modeling). The methods of the life cycle of the attention will be devoted to a single method of software development process. The integrated framework, which will be displayed and used in this paper is based on the use of RUP methodology and agile methodologies, business intelligence with the principles of data mining and data warehousing, BMPL (Business Process Modeling Language) and UML (Unified Modeling Language) - notation and reengineering business processes. The main principles are incremental and iterative development, active participation of users, based on the development of models, testing and cooperation. The paper consolidated methods, techniques, standards and process models in the field of e-business and access to quality analysis, modeling and design of the portal system of the Serbian authorities. The life cycle of software can be considered through its processes, ie. activities that make this

process as well as through its models, methods and strategies. Software Life Cycle Processes are defined by a number of reasons, including increasing product quality, facilitating human understanding and communication, support process improvement, and support management processes. It also enables the automatic routing process and provide support for automatic execution. Various elements of the process can be defined by means of activities, products and resources. Software process is a set of activities, methods, practices, and transformations that are used to develop and maintain software and related products.Methods for software life cycle can be said to describe the process of software development through its individual operations or processes. Model describes the software life cycle phases that occur during software development. Software development process includes 5 stages: requirements specification, analysis, design, implementation and testing. Different methods of software life cycle models use different software life cycle.
The purpose of Business Intelligence (BI) is not just a collection, but also processing, analysis, visualization and use of information for business purposes, mainly in order to support business decisions. By definition, the term BI combines methodologies, technologies and platforms for data warehousing, OLAP (Online Analytical Processing) and data mining allow companies to create useful management information from the data on the operations, which are at different transactional systems and come from a variety of internal and external sources. BI is a set of tools and applications that enable the creation of a system for the collection, analysis and dissemination of business information, with the aim of making better business decisions (Kevin, 2007).

3.1. SOA and BPM

This subchapter focuses on SOA, where programming is based on the process approach and represents a higher step in the development of software engineering. Process oriented programming does not need to replace, but to complement existing approaches to programming, such as structural, component and object-oriented programming. SOA describes the concepts, architecture and procedural framework to ensure cost effective development, integration and maintenance of IS, through the reduction of complexity and stimulation of their integration and re-use. SOA does not represent a radically new architecture, but rather the evolution of the well-known distributed architecture and integration methods. SOA improves and expands the flexibility of previous integration methods and distributed architecture and focuses on the re-use of existing applications and systems, effective interoperability and integration of applications, as well as the composition of business processes through service secured applications. An important feature of SOA is the ability to implement the changes that will occur in the future, in a relatively simple and easy way. SOA is more than a set of technologies. It is not directly related to any technology, although they are often implemented using Web Services (WS). WS are the most appropriate technology for the realization of SOA. The most important concepts of SOA are (Emig, Weisser, Abeck, 2006):

- Services that provide business functionality and business value, that hide implementation details and are autonomous.
- Interfaces, through which users access the service. The interface defines a set of public service operation signatures and represents a contract between service providers and service users. The interface is separated from its implementation, the self-descriptive, and independent of the platform.
- Messages that specify the data to be exchanged, describe them in a manner independent of platform and language use patterns.
- Synchronous and asynchronous communication to call the service operations.
- Poor connectivity includes services that only show the necessary dependencies and reduce all kinds of artificial dependencies.
- Registers, where service providers publish services, while service users search registers to find the needed service.
- Quality of service marks attributes such as - security, reliable messaging, transactions, correlation, addressing.
- Composition of services into a business process (the most important SOA concept), providing support for business processes in a flexible and relatively easy way, as well as rapid changes of business processes with less effort.

BPM refers to the design, management and execution of the business process, and its strength lies in the unification and expansion of existing process oriented techniques and technologies. For business analysts, BPM means the perception of the organization as a set of processes that can be defined, which can be controlled, and which can be optimized. Instead of the traditional orientation, according to which parts of the operations of organizational units, BPM is oriented towards business, regardless of the organizational unit that are executed. For technical staff, BPM technology represents a group focused on defining, executing and monitoring process logic. Regardless of the different perspectives of both groups, and business analysts and technical staff, aim to improve business processes. BPM should be used only for applications that are process-oriented, respectively, which are: long-term, state kept in databases, most of the time waiting for the action to start the next activity and processes which are responsible for the management and coordination of

communication between different role of systems and people. Process applications need to meet at least part of the above characteristics. The reasons for the use of BPM are: formalization of existing processes, better understanding and incorporation of improvements in the business processes, more efficient execution of business processes from the use of BPM software, increasing productivity and reducing people's participation in the execution process, enabling people to solve.

4. DEVELOPMENT OF E-SERVICES AND E-SUBMISSION IN ALIMS

ALIMS is a public agency of the Republic of Serbia, whose work provides the services of issuance, renewal and amendment of licenses for medicines for human and veterinary medicine, as well as the registration of marketing authorizations for medical devices, quality control of medicines and medical devices that meet the requirements for efficiency, quality and safety. The vision of being a modern, efficient and socially responsible institution is conducted everyday by a teamwork of employees, which is based on four basic principles: social responsibility, leadership, trust and quality. Transparency of the work is reflected through the portal of ALIMS where they meet all the criteria of functionality, defining the guidelines for making Web presentations of the state administration.

ALIMS participates in the development of eGovernment portal RS. The functional area of e-services is enabled on the primary web page of the ALIMS site and contains a list of all names of e-services published on the portal of e-government.

The latest e-services "Downloading registry of medicines and medical devices" is set in 2015. State agencies and legal entities can retrieve the registry of medicines for use in human and veterinary medicine, as well as a registry of registered medical devices for which the ALIMS issued a marketing authorization, and the registration of medical devices in the Register of medical devices, with the use of a qualified digital certificate. The aim of this service is to download data on medicines and medical devices in digital, machine-readable formats that can be used for further work and use in other state bodies and legal entities, especially in the context of the development of the e-Health of the Republic of Serbia. Register of medicines and medical devices in the form of e-Service enable downloading of the codebook data on medicines and medical devices from the ALIMS database that are updated on a daily basis. E-service "Downloading registry of medicines and medical devices" enables downloading on a daily basis from the updated medicines register for use in human and veterinary medicine and medical devices registered in the register of MS, in digital, machine-readable, and open formats: .csv and .xls. Data on medicines and medical devices that ALIMS handed over to the state institution and legal entities on the eGovernment portal, are available for those with qualified electronic certificate, which allows authentication in order to ensure data protection using existing protection mechanisms. This way of downloading data is also conducting and updating records on persons who retrieve data, as well as the institutions that are interested in this information. The download process data is very simple. E-Government portal, onced logged in on by using a digital certificate, displays information about the owner of the digital certificate who has to state a reason for downloading data. This way ALIMS achieves more benefits for almost all sectors of society: new business and economic opportunities - turning data into economic systems at all levels and new innovative solutions - combining data from multiple sources, which then creates new values.

At the end of last year ALIMS has started a new project that will enable the integration of ALIMS and pharmaceutical industry, and includes e-submission request of clients in the pharmaceutical industry on the easiest way by selecting the appropriate eServices and completing the application form, which was given the opportunity to submit the attached documentation in electronic form with certain requirements. The basic idea of this project is to enable clients wishing to apply electronically. The vision of the project is to develop application forms for eGovernment portal where customers will be able to electronically fill patterns ie. customer requirements and deliver them electronically with all the accompanying documentation. The project titled "eSubmission" began in the middle of last year, with the plan to be completed by the end of August 2016. The project includes the development of 60 eServices ALIMS and allows the pharmaceutical industry to operate without physical arrival at the location ALIMS by applying for the appropriate electronic service ALIMS. This is reached by using a digital certificate, which provides training and leads to the pharmaceutical industry when it comes to the development and application of informational technologies and provides additional support for the development of the same in the Republic of Serbia. For the future of e-government and e-business in regulation of medicines in Serbia it is important to use the experience of other countries, with consideration of their successes and failures, as well as adapting this knowledge characteristics of socio-economic environment in Serbia. Equally important is the cooperation with the Ministry of Health and the Government of Serbia, because in this way there is a solution that information subsystem of e-business in regulation of medicines integrates into the overall IS of e-government of Serbia leading into single architecture, which can be reached by working together and forming an agreement of all stakeholders, starting from the government, through the non-governmental sector, academic institutions, to the citizens themselves.

This chapter shows model and life cycle of the process (Figure 2).

SOA is implemented using WS as follows:
- WS that enables the transfer of all customer requirements with the appropriate electronic services from eGovernment portal to the internal ALIMS network (external eGovernment portal to DMZ at ALIMS),
- WS that enables the transmission of the same client requests and integration with electronic document management system of ALIMS (DMZ at ALIMS to internal, production EDMS at ALIMS).

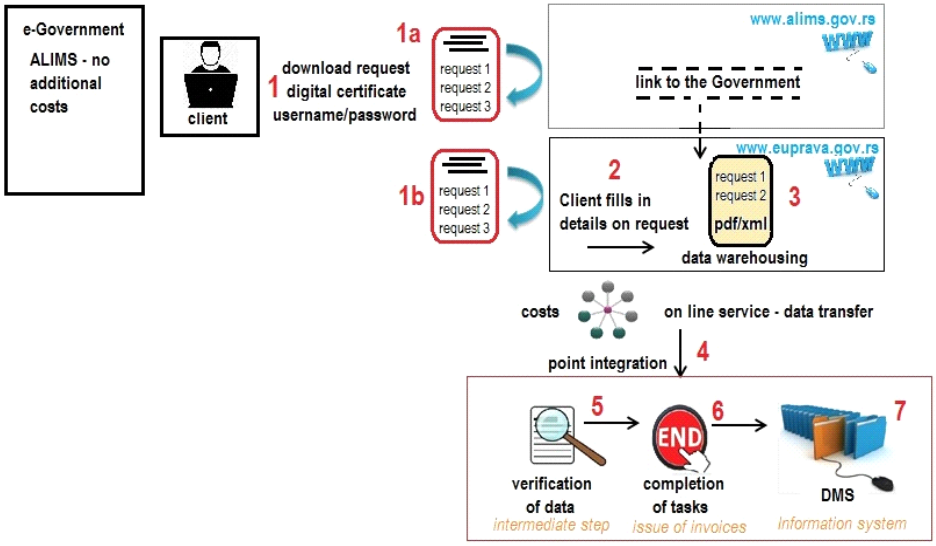

Figure 2: Model and life cycle process

The life cycle process is:
1. Requests for clients are located on the ALIMS site linked with the eGovernment portal. Link on each request is transferred to the appropriate eGovernment services portal (1a) .The client only with a valid digital certificate has the ability to fill the requests (on the eGovernment portal).
2. Client selects appropriate eService and fills request directly using the application, which is located on the eGovernment portal.
3. Data is stored with the request in the database on the eGovernment portal, which can be accessed by the authorized person. The document, which is formed as a client request must contain the e-signature, and is in pdf and xml format.
4. Online WS on the eGovernment portal then transfers the request to the defined system integration point, which is server located in the DMZ at AliMS. Server in the DMZ at AliMS automaticly passes the requests to the internal EDMS (Electronic Document Management System).
5. In the system EDMS data verification is done by the colleagues that work on Acceptance of client requests.
6. After verification, acceptance and ending task, there shall be issued a pro-forma invoice to the client and confirmation of receipt, which are sent by e-mail or otherwise electronically or physically considering the fact that the client has to come and bring the documentation also.
7.Flow in the process takes place in the information system of the ALIMS-EDMS
List of e-services is divided into three segments: human medicines, veterinary medicines and medical devices,in the following way with total of 62 forms used:
• Human Medicines (23 Forms): Application for marketing authorization (6), Application for the import of unregistered medicines (2), Application for the approval of clinical trials (4), Application for the SPC, PIL and Labeling (3), Application for approval of promotional materials for the medicines or medical devices (1), Application for issuing the technical opinion (1), Application for the issue of categorization of medicines (1), Application for reporting doubts about the quality of the medicine (1), Application for the quality control (1), Application for supplementary documentation (1), Application for the suspension of request (1) and Application For partial suspension of the request or changes the marketing authorization grouped variation request (1).
• Veterinary medication (25 Forms): Application for marketing authorization (6), Application for the import of unregistered medicines (4), Application for the approval of clinical trials (4), Application for veterinary SPC, PIL and Labeling (3), Application for approval of promotional materials for the veterinary medicines and medical devices (1), Application for issuing the technical opinion (1), Application for the issue of categorization of veterinary medicines (1), Application for reporting doubts about the quality (1), Application for quality control (1), Application For supplementary documentation (1), Application For the suspension of request (1) and Application For partial suspension of the request or changes the marketing authorization grouped variation request (1).

• Medical devices (14 Forms): Application for for registering the medical device in the Register of medical devices (1), Application for import of unregistered medical devices that are not registered in the Register of medical devices (2), Application for authorization or notification of clinical testing of medical devices (1), Application for promotional material for medical devices (1), Application for issuing an expert opinion (1), Application for the categorization of medical devices (1), Application for reporting adverse reactions to a medical device usage (5), Application for reporting doubts about the quality or deviations from the standard quality of the medical devices (1) and Application for quality control (1).

5. ANALYSIS

The survey relating to the testing of e-readiness of the pharmaceutical industry for the project of e-submission was implemented in August 2015. The questionnaire was sent to all pharmaceutical institutions with a term of one month for an answer. Of the total number of participants, the survey was completed by 32% of participants. Most of the participants are familiar with the concept of electronic storage of data / documents and with the guidelines on the subject of filing documents. The Agency's intention to move to an electronic system of communication was supported the most. The proposal to organize workshops and conferences on this subject in order to inform and educate the clients on time, in order to better and more successful transition to the new system of application was also well supported. Figure 3. shows some of the results of that survey.

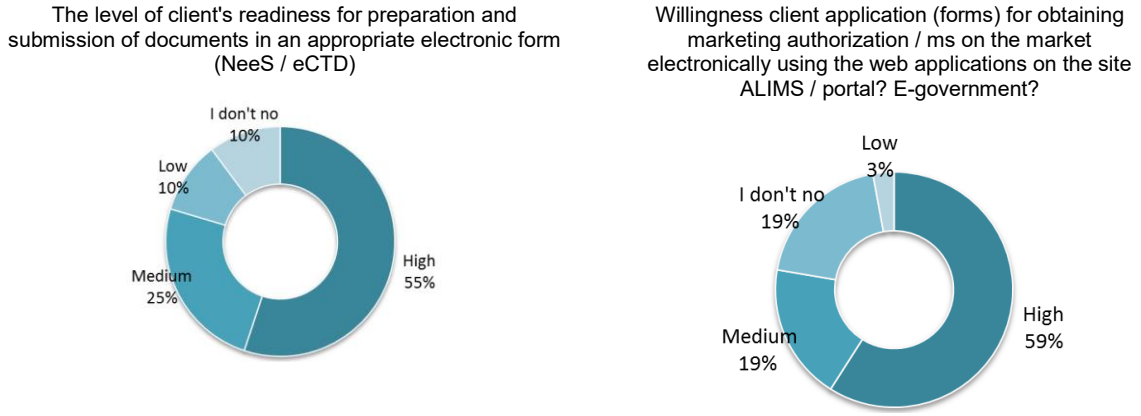

Figure 3: The testing of e-readiness of the pharmaceutical industry in Republic of Serbia

6. CONCLUSION

The methodology for the development of e-services, methods for modeling and analysis of business processes and reference model of e-business in regulation of medicines as one of the subsystems of e-government process metamodel in the context of e-government, life cycle business system design on the e-government network web portal and e-business in regulation of medicines, are the main scientific contributions of this work. Developing web software for e-business development in regulation of medicines, as one subsystem of the e-government implemented in Serbian Agency are the main professional contributions to this work. Improving e-business in regulation of medicines, as a subsystem of e-government would have to aim: the development of interfaces and support for model specification systems through interaction with citizens, the economy, healthcare, pharmaceuticals and other public authorities, support the adopted modeling standards, integration of e-business in regulation of medicines, the e-government, e-health and e-pharmacy in Republic of Serbia, application of methods and techniques of life cycle business model which are presented in the thesis, agile methods and application of SOA, BI, and BMP. The "e-filling clients' requests ALIMS" will enable the integration of ALIMS with pharmaceutical industry and provide electronic submission of customer requirements, thus achieving significant savings for ALIMS as for the pharmaceutical industry in the RS. In this way ALIMS fulfills its mission - to promote and improve the health of people and animals, as well as to contribute to the realization of the fundamental human right to access to quality, safe and effective medicines and medical devices. The development of e-business in regulation of medicines, as a subsystem of e-government of the Republic of Serbia, provides a unique environment for communication, better information about medicines, education via Internet for health workers, as well as the more efficient operations in the healthcare and pharmaceutical industries and the realization of the concept of e-government in segment which regulates medicines and medical devices areas.

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INTERNET OF THINGS IN E-HEALTH: APPLICATION OF WEARABLES FOR STRESS MANAGEMENT

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Abstract: *In this paper, we investigate the potential of the Internet of Things in health and well-being. One of the most popular component of well-being is stress management and many research attentions have been focused on relationship that exists between stress and different contexts. In this paper, the model of mobile health for well-being based on wearable computing has been introduced. It allows monitoring of vital parameters and environment parameters that are of importance for the identification of stress or its predictors. As a support to the wearable system, a mobile health application for well-being was developed, featuring relaxation content. Mobile health application for well-being with relaxation content should minimize the excitement and impact on reducing stress. The main goal of research in this paper was measurement of vital parameters during students' term papers defense. Results shows differences between measured vital parameters through wearable system before and during students' defense of term papers.*

Keywords*: e-health, mobile health, Internet of Things, wearable computing, mobile technologies, well-being, stress management*

1. INTRODUCTION

The use of Internet of Things in health in different contexts is not a novelty, and the idea of constant monitoring of well-being is becaming more and more popular. Wearable sensors in health care allow continuous monitoring of relevant vital parameters during every day human activities.
Collected data can be distributed to health gateways or remote systems where they can be processed and analyzed based on algorithms or expert knowledge. Such expertise may indicate the occurrence or symptoms of certain illnesses or stress.

Many life situations can lead to stress-induced excitement today. Heart starts beating fast, face changes and sweating starts. Most obvious example are public speeches (Kusserow, Amft, & Tröster, 2013). Student who defending term paper, taking exam orally or defending thesis also has public onset.
Stress that occurs on those occasions can significantly reduce the quality of speech and increase the possibility of making mistakes. If repeated several times over a longer period can affect the changes in student's behavior or his attitude towards learning and future career (Sohail, 2013).

By measuring certain vital parameters in students, such as heart rate, skin conductivity etc. one can observe their variations in different contexts (waiting for the exam, while defense term paper, taking exams, etc.).
The source of stress for students can be reached through cross-referencing, comparison and analysis of measured data over a longer period.
Testing the influence of mobile health application for well-being in the reduction of stress can serve to build model-pattern of behaviour that can be used to predict the same or similar reactions of the same population in the future (Dragon, et al., 2008), (Shen, Wang, & Shen, 2009).

The research aims of this paper are the concepts of the Internet of Things in the area of electronic health, wearable computing in different areas of well-being, as well as technical and technological setups necessary for the realization of Internet of Things solutions.
Mobile health system based on wearable computing for stress management has been developed. System will measure presence of stress in students during defense of term papers. Mobile application for well-being with relaxation content should increase stress in students.

2. INTERNET OF THINGS IN E-HEALTH

With the expansion of the Internet and the introduction of modern ICTs, a modernization of almost all aspects of business in society took place. Electronic health or e-health originated as the crossroads between health

informatics, public health, and processes related to providing healthcare and to the information generated and transferred through the Internet and related technologies (Eysenbach, 2001).
According to the definition of the World Health Organization, electronic health (eHealth) denotes the use of information and communication technology in healthcare (World Health Organization, 2015).
According to the definition of the European Commission (European Commission, 2015), electronic health is defined as the application of information and communication technologies for fulfilling the needs of citizens, patients, healthcare professionals, healthcare providers and health policy creators.

The term mobile health (mHealth or m-health) is an area of eHealth. Mobile health is a term that is used in providing health and medical care as well as in public health, with the support of mobile devices (World Health Organization, 2011). This term also covers healthy lifestyle applications that, in a direct or indirect way, improve the health and quality of life of individuals. Such applications are often connected to medical devices or sensors (watches, bracelets, jewellery, etc.).

Market and performance of mobile phones has seen such advances that tens of millions of people who previously had no access to a phone or a computer, use cell phones nowadays, which provide them communication and data transfer.
Smartphones allows smooth transfer of data such as multimedia content, high-resolution images, voice, etc.
In Serbia 91.4% of population, own mobile phone and more than 60% Internet connection (Statistical Office of the Republic of Serbia, 2016).
Mobile devices have a wireless Internet connection that allows them to connect anywhere and continuous access to data. Today's smartphones have a number of sensors such as gyroscope, accelerometer, GPS that measures specific user activities. In addition, they are unavoidable in the development and deployment of mobile applications for well-being.
The Internet of Things represents a network of physical objects connected using wireless or wired Internet networks, which contain built-in sensor technology, allowing for interaction with the interior state of the smart device itself or with the external environment. Devices collect and exchange information directly between themselves, with other devices or through a cloud, where it is possible to collect, store and analyse data (Chouffani, 2015).

Wearables are one of the Internet of Things technologies. Wearables are small electronic devices, which are often composed of one or more sensors and have computing capabilities (Salah, MacIntosh, & Rajakulendran, 2014). Wearables are objects which are worn on the body, e.g. on the head, foot, hands, wrists or waist, they can be built into clothes, or they can also be clothes themselves (Mann, 2014). They can take the shape of watches, sunglasses, clothes, contact lenses or even a very modern jewellery. Wearable devices are portable, which allows for the comfort and mobility of those wearing them.
Measurement of vital parameters are possible during users' normal daily activities, regardless the location of the user, and the data can be transferred to a remote server, health gateway or mobile device, where its further analysis and distribution will be performed.

2.1. Wearable computing in eHealth

The promotion of healthy lifestyles and well-being, and their impact on health, has encouraged people to take part in managing their health.
This led to the fact that in recent years, there is increased interest in wearable medical devices, in research area, as well as in health activities (fitness, wellness, equipment for people with disabilities, dermatology, etc.) (Ranck, 2012).
As many technologies are available nowadays (micro technologies, telecommunications, energy efficient devices that consume minimal amounts of energy, new fabrics and flexible sensors), it is possible to design new and modern devices. That devices are usually very comfortable, modern and safety for users and users easily accept them and wear them in different occasions.

Stress is main and leading challenge in modern society. Stress activates the sympathetic nervous system, and its activation causes different reactions in the human body as:

- Heart rate increased. Heart rate is the number of heartbeats per unit of time, usually measured at the wrist. Heart rate shows the health condition of a person and can give early indication of heart diseases.
- Sweeting. When a person is under tension or influenced of certain emotions, sweat glands become more active and secrete more fluid through skin.
- Muscle tension. Muscle tension, facial expressions and eye blink rate increase while person is under tension or influenced of certain emotions.

Long-term repetitions of such manifestations in any population are a frequent predictor of other health conditions and disorders, and even of mental illnesses.
Among students, there is a frequent onset of stress whose sources lie in a separation from home, change in habits, short deadlines, social environment, long waiting in lines etc., all of which can significantly contribute to a reduction in academic performance (Sohail, 2013).
The presence of stress can be identified by measuring various vital parameters of the user, as well as measuring the parameters of the environment that may have an impact on the change in the values of the vital parameters.
Many studies are dealing with stress identification with different type of sensors or their combination.

Galvanic skin response (GSR), also known as electrodermal response (EDR), psychogalvanic reflex (PGR), or skin conductance response (SCR), is a method of measuring the resistance of the skin.
Skin conductivity is one of the signal often used in lie detectors.
Fear, anger, startle response, orienting response and sexual feelings are all among the emotions that may produce similar GSR responses (Mohankumar, 2010).
When person is in its calm state, skin has high resistance and low conductivity. If the blood flow to the skin, when stress is present, blood vessels becomes leaky and water leaks out to form the sweat. This mechanism is important because it cools the body skin through the evaporation of sweat. When this happens, the resistance of the skin decreases to be capable to remove water from itself. At the same time, as the skin's resistance and conductivity are directly proportional, the moist skin increases electrical conductivity.

The sensor for conductivity is involved in many studies that deal with the identification of stress. In the study (Picard & Scheirer, 2001), a skin conductivity sensor was applied as a wearable device for the identification of a person's excitement while listening the seminar speakers. LED light simulated a change in values of GSR.
Following study (Zubair, Yoon, Kim, Kim, & Kim, 2015) also performed detection of mental stress during everyday activities with wearable sensor for GSR. In a case of changed values user, get alert through mobile phone in order to manage the stressful situation.
In study (Sano & Picard, 2013) a skin conductivity sensor and existing mobile phone features (calls, SMS, location services) were used for stress detection. The results were compared with traditional research techniques for stress detection.

Heart rate is one of more certain indicators of the presence of a change in mood or stress, and it is useful to monitor it in actions of health prevention.
A heart rate measurement system is often implemented in devices related to sports (Suunto, 2015), fitness (BASIS Science, 2015), and in stress management (Millings, et al., 2015).

Heart rate sensor is one of the most common sensor in stress management. In (Kusserow, Amft, & Tröster, 2013) a heart rate sensor was implemented together with a skin conductivity sensor, accelerometer and temperature sensor in a familiar natural context – public appearance of PhD students in front of an audience, where significant variations in the values of measured vital parameters were observed.

SpO2 stands for peripheral capillary oxygen saturation. Pulse oximetry is a method used to measure the concentration of oxygen in the blood. SpO2 can be measured by pulse oximetry by emitting and then absorbing a light wave passing through blood vessels (or capillaries) in the fingertip. Normal SpO2 values vary between 95 and 100% (Withings, 2015).

Certain parameters of the environment can affect the individual feels like or a change in his behaviour. Therefore, it is important to monitor them in certain contexts with appropriate sensors. Some of the parameters that may have an impact on well-being during exams or defences of term paper or thesis are noise levels, room temperature, air humidity, the amount of oxygen and others.

2.2. Model of mobile health for well-being based on wearable computing

Model of mobile health for well-being based on wearable computing consist of wearable system for monitoring of vital parameters, system for environment parameters measurement and Android application for well-being with relaxing content, and services for connecting components, hosts and users.

Implemented wearable system and system for measurement of environment parameters consists of heart rate sensor and pulse oximetry (Pulse Oximeter Contec CMS 50D+), GSR sensor (Grove - Galvanic Skin Response – GSR), noise level sensor, CO and temperature sensor.

The system was implemented using the Arduino microprocessor and the Raspberry Pi microcomputer. The implementation on these devices was carried out using the *Python* programming language and the *php* script language.
The Android well-being application was created in the Android Studio 1.2.1 programming environment, using the Java programming language. Contents that students-assistants found to be relaxing were implemented in the app: funny sport scenes, beautiful nature photos, relax music (SPA, relax music, Zen, Chill out etc.). The content was taken from YouTube channel.

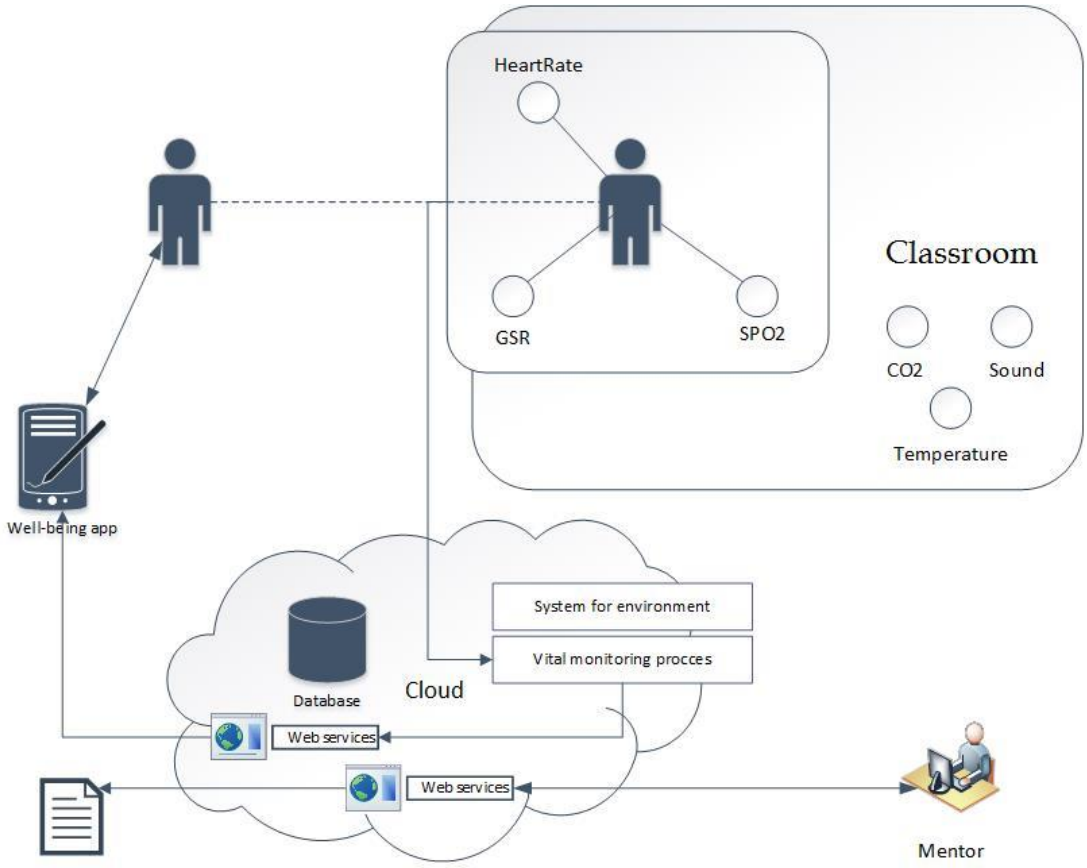

Figure 1: Model of mobile health for well-being based on wearable computing

Since a high level of noise or temperature can cause concentration issues, the values are measured using a noise and temperature sensor and the obtained information is analyzed.

3. METHODOLOGY

The aim of research is measurement of vital parameters during students' defense of term papers, as well as determining the differences between measured GSR values, oxygen saturation and heart rate through implemented wearable system before and during defense of term papers.

The students were supposed to defend term papers in e-business, i.e. Internet of Things in e-health, and they were familiar with the concept of the wearable computing. Research took place in April 2016 at the E-business Laboratory of the Faculty of Organizational Sciences, University of Belgrade. The measurements were conducted over one day.

3.1. Experimental protocol

After arrival, respondent was situated in a pleasant room, connected to sensors (heart rate, SPO2 and GSR). Heart rate sensor was attached on forefinger, GSR sensor on middle and ring finger on the palm side of the left hand. After that, the respondent was given a general questionnaire.
After completing the tests, respondent was given a tablet with a pre-installed Android application for well-being with relaxation content and short instructions on how to use it. The respondent had 15 minutes to relax and use the application content. During the use of the mobile application, the duration of the use of the application and the content browsed by the user were tracked. The obtained values of vital parameters for the respondent were recorded.

The test began after the 15-minute of relaxation. Three examiners entered the room. The test consisted in three parts: first part – preparatory notes, second part – presentation and third part – questions and math.
The test began when one of the examiners read the following text to the respondent: “You are expected to prepare notes for the presentation of your term paper within five minutes, and then to orally present your paper within exactly five minutes. Your presentation will be recorded. The time starts now!”
During the entire test, vital parameters (heart rate, SPO2 and GSR) were measured as well as environment parameters. After the time of five minutes was up, an examiner took the paper with preparatory notes from the respondent and asked him/her to start with second part - defense of term paper within five minutes.
If respondent paused for about 15 seconds, he/she was told to continue as well as remaining time until the end of that part of the test. After the 5-minutes defense of term papers an examiner asked the respondent five questions related to the paper (approximately 2.5 minutes), and then the mathematical part of the exam started, lasting for approximately 2.5 minutes. The respondent was asked to count backwards, subtracting 13 from 1022. If the respondent made a mistake, they were asked to start from the beginning. They were informed of that by saying: “You are wrong! 1022.”

3.2. Participants

The sample consist of students of Faculty of Organizational Sciences. Six students successfully finish the research test. Self-constructed general questionnaire was created for the purpose of this research. The respondents filled it out in the first phase – pre-test. General questionnaire consisted of demographic questions about the respondent and was not anonymous.
Table 1 shows the descriptive statistics of the sample.

Table 1: Descriptive statistics of the sample

Characteristic	Gradation	Frequency	Percentage (%)
Sex	Male	3	50
	Female	3	50
Age group	19-21	0	0
	22-24	4	66.7
	More then 24	2	33.3
Smoker	Yes	2	33.3
	No	4	66.7
Physical activity	Regularly	2	33.3
	Occasionally	4	66.7
	Never	0	0

3.3. Data analysis

Microsoft Office Excel was used to analyse data and interpretation. During the analysis process, frequencies, percentage were used. Data are presented descriptively, in tables and graphs.

4. RESULTS AND DISCUSSION

4.1. General stress level

The measured values show pulse variations during the test, compared to pre-test period. Sampling rate of GSR data was 0.2 Hz and for heart rate was every four readings per one beat.

Figure 2 shows mean values of measured heart rate in respondents.
We compared the average values of the pulse of the respondents in the pre-test and during the test. The average value of the pulse during the test increased by 13 heartbeats.

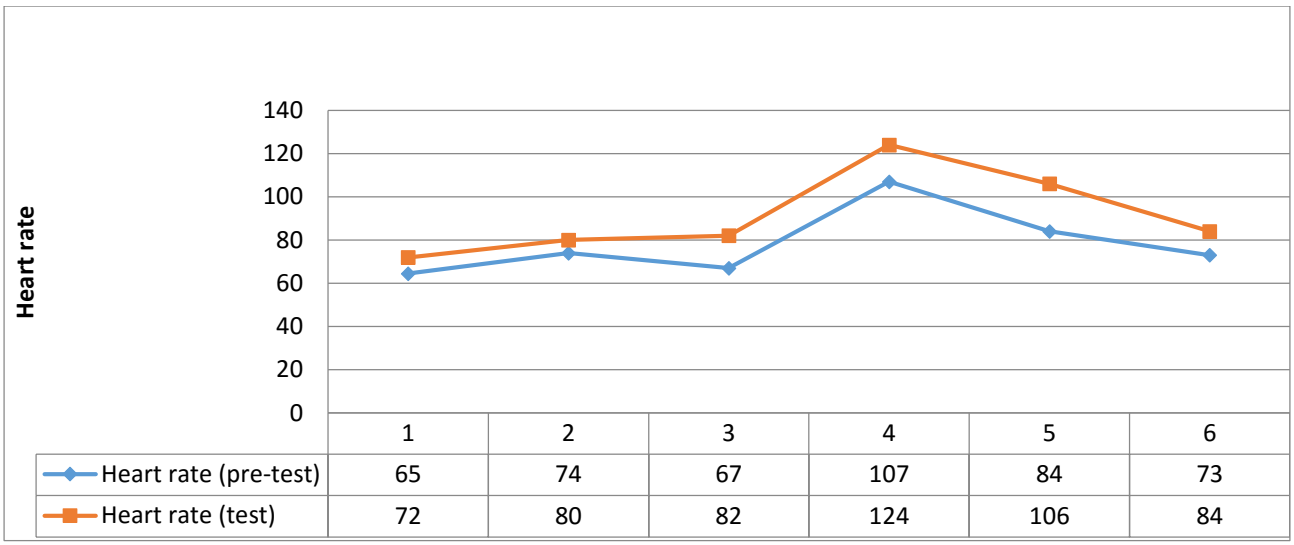

Figure 2: Mean of heart rate during pre-test and test period

Average relative change value of the pulse during the test compared to the period before the test in the subjects is shown in Table 2.

Table 2: Percentage increase in heart rate during the test compared to the period before test

Respondent	***1***	***2***	***3***	***4***	***5***	***6***
Heart rate increase (%)	11.6	8.1	22.4	15.9	26.2	15.1

Average measured GSR values in most respondents' shows variability, i.e. increase in values during the test according to period before test when respondents waits for testing.

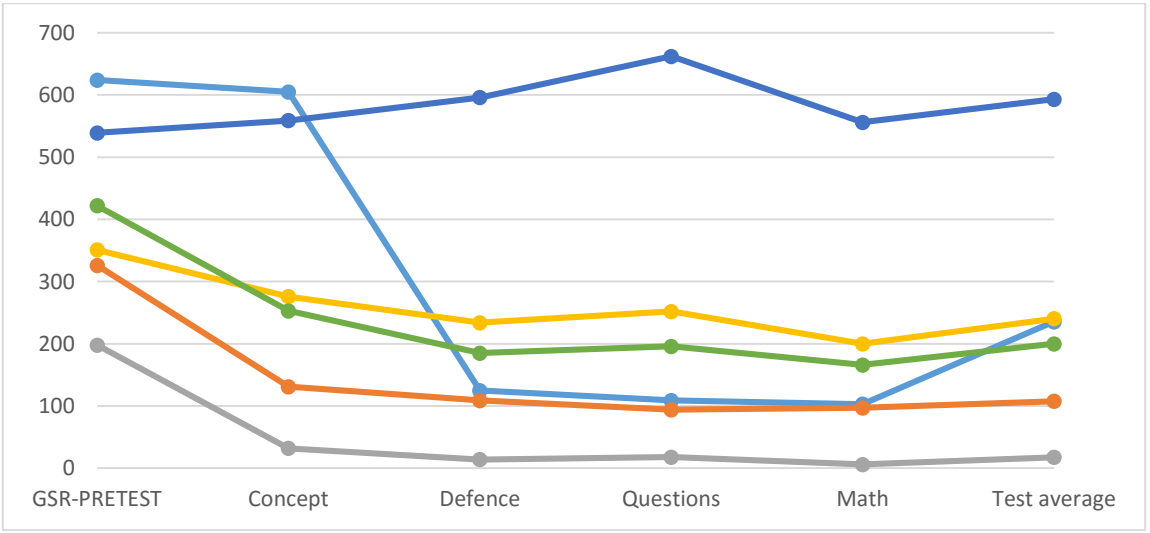

Figure 3: Average values of GSR (resistance changes) during different parts of testing

Reduction in value or drop in resistance begins at the start of the test, where respondents are writing the concepts, then while defense term paper. A slight increase occurs when the interviewer ask questions related to the topic, and continuous decline during the mathematic test.

Table 3 presents the relative GSR value change during the test compared to the period before the test in respondents.

Table 3: Relative changes in the value of GSR during the test compared to pre-test period

Respondent	***1***	***2***	***3***	***4***	***5***	***6***
GSR changes (%)	62	67	91	31	-10	53

Figure 4 shows a schematic of receiving signals through sensors GSR.

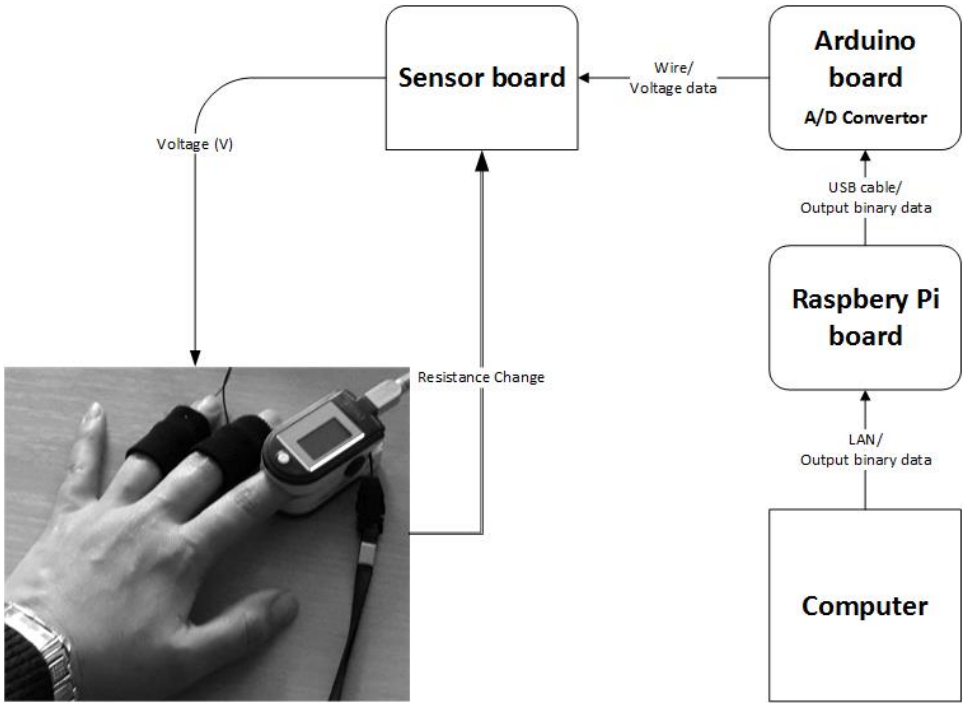

Figure 4: Path of the signal from GSR sensor to computer screen

Skin conductivity is expressed in μS (microsiemens), but output value from the sensor and microprocessor is resistance change. The measurement of resistance changes were measured with resistors of different values. Gain values were compared with output binary values from Arduino processor. Based on calculated values, we come to the exponential equation:

$$y = 125.02e^{0.0036x}$$

Calculated correlation coefficient is $R^2 = 0.9449$.

Based on the state that resistance = 1/conductivity, where the conductivity of the skin is obtained and expressed in μS, skin conductivity is shown on Figure 5.

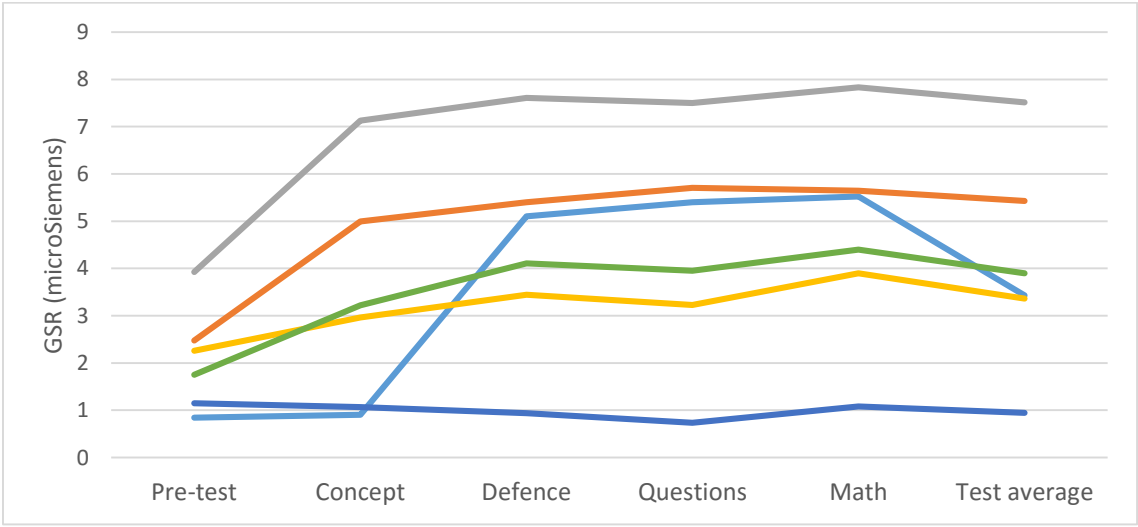

Figure 5: GSR values in microsiemens in period pre-test and different phases of testing

4.2. Well-being app usage

The average time of mobile health application for well-being with relaxation features use was 13 minutes and 1 second.

The overview of time spent on watching different application content is given on Table 4.

Table 4: Distribution of time spent at different contents of well-being application

Content	Total of time spent on content (mm:ss)	Average time on content (mm:ss)
Fun sport	33:22	02:05
SPA music	34:50	01:56
Relax photo	09:52	01:14

The longest time respondents spent listening to SPA music, followed by watching videos of funny sport scenes. Shortest time were spent watching relax photos. The longest average stay was on the funny clips from the world of sport.

4.3. Environment parameters

Sound level, air temperature and CO were measured in the environment. During the test, CO is not registered. Temperature values and sound levels are shown in Table 5 and 6, respectively.

Table 5: Mean of environment temperature values during test

Respondent	***1***	***2***	***3***	***4***	***5***	***6***
Temperature (°C)	28	28	28	28	29	27

Table 6: Mean of sound values during test

Respondent	***1***	***2***	***3***	***4***	***5***	***6***
Sound (dB)	41	41	40	41	41	41

Both, temperature values and sound volume were approximately equal in all subjects. The temperature values were higher than comfort level of room temperature that is around 20 to 24 °C. For a proper assessment of comfort in classroom, it is also necessary to measure the air humidity.

5. CONCLUSION

The collection of data of stress and stressors among students during the examination of their knowledge is a challenge. Each individual reacts differently to stressful events. In addition, many factors affect how a person will behave, or have a stressful event during the observation. In this survey, we examined changes in GSR and heart rate during the test in relation to the period prior to testing. The result indicates the existence of an increase in the value of the heart rate during the test compared to the period before the test. GSR values indicate changes in terms of reducing the resistance or increasing the conductance of the skin that indicates sweating due to intense emotional states.

Future research, in addition to measuring vital parameters, have to be based on other factors that could affect the response in a particular context. Collecting data in a variety of life activities of the respondents can reach steady pattern of behavior and expected reactions in the environment such as the university.

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AN APPLICATION OF INTERNET OF THINGS: MEASURING TRAFFIC FLOW

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***Abstract**: This paper shows an example of an application of IoT for measuring traffic flow. A model of measuring traffic flow based on IoT was shown. An application of IoT is developed in aim to measure traffic flow in real time. A web application for tracking statistical data is shown. The device that follows the sound and registers the number of vehicles that passed is shown. This web application should enable detection of traffic jam and sending notification about alternative routes to drivers. It can be used as a mobile application also. It is also possible to develop system that will send SMS messages and report all users where is traffic jam and ensure them that they will not be part of that jam. The example of implementation is shown by using sensor which measures traffic flow in real time. After the processing, all statistical data can be seen through developed web application.*

***Key words:** internet of things, smart traffic, traffic security, traffic flow, traffic management, web application*

1. INTRODUCTION

With every day number of people living in a city is increasing. Current estimations say that 50% of world's population lives in cities. Today's cities are not projected for these huge amounts of people. Streets are narrow, infrastructure is old, and systems for managing almost do not exist. With the advent of Internet, microcomputers, sensors and actuators it came to accomplishing all necessary conditions for building smart cities (SAS, 2016).

Smart cities are cities which have their own information systems. These systems do different things, from managing traffics to managing hospitals and schools. These systems are connected with each other and it is possible to control all of them from one place. Elements of smart cities are: smart lightning, smart system for trash removal, system for air analysis, smart traffic and many others. It is possible to implement street lightning which turns on only when somebody passes by and in this way saving a lot of energy. Instead of management vehicles (trash removal vehicles) which pass by buildings every day to remove trash randomly and emptying trash cans that are not really full it is possible to develop system that informs workers when trash cans are full. System for air analysis can track air quality and inform people who need these information which parts of the city they should avoid. Important part of smart cities is efficient traffic management (IBM, 2016).

Traffic management is a problem that lots of cities have deal with. Many cities are trying to find a solution to improve public transportation and provide better services inside the cities with smart traffic signs. Responsible for highways also are trying to find new ways how to ensure efficiency to the passengers on long journeys as well as efficient transportation of goods. They are also trying to reduce traffic jam with new parking system. Smart traffic increases capacity, pleasure of travellers and ensures transportation from one to another place as safe as possible. Local police, emergency services and other government organizations can use these networks of sensors to get a quick look about situation in the city, so they could help and milder crowding on the roads, but also quickly react to the accidents.

The model of measuring traffic flow is developed that should enable collecting traffic data in real time. A web app should enable improving traffic flow, reducing delays, increasing security and improving ecological situation. Collected data are shown in real time, so that each change on the road is spotted immediately. With good analysis of these data it is possible to improve traffic flow, reduce delays, increase security and ecological situation.

2. LITERATURE OWERVIEW

Smart traffic includes data processing that sensors collected in the streets and inside the vehicles (Galán-García, Aguilera-Venegas and Rodríguez-Cielos, 2014). Some cities already use different analysis for prevision and traffic reduction. This kind of system helps drivers and authorised personnel. Drivers use different mobile and web applications to detect and avoid traffic jams. Authorised personnel for traffic use collected data to determine where it is needed to include new bus lines or change the traffic lights working order.

One of the cities that invests in smart traffic implementation is Singapore. Singapore adopted intelligent transport strategy. It is one of the cities in which the least traffic congestion occur, with an average speed on main roads of 27km/h, compared to an average speed in London which is 16km/h and Tokyo where is that speed only 11km/h (Batty *et.al.*, 2012). City uses electronic pay toll system where price varies in relation to the traffic flow. Each taxi vehicle has a GPS system which sends data about traffic conditions in the city. Information from all these systems are sent to the main control centre which merges data and provides information about traffic flow in real time.

Intensity of traffic represents interaction between vehicles, drivers, pedestrians, cyclists and other participants and infrastructure including roads, signs and devices for traffic control (Caragliu, Del Bo and Nijkamp, 2009). Purpose of measurement of traffic flow is understanding and development of optimal traffic flow with minimal congestions. For traffic flow measurement as a main information is used average annual daily traffic (AADT) and it is obtained by total number of vehicles for a year on a specific section divided by number of days in a year (Galán-García, Aguilera-Venegas and Rodríguez-Cielos, 2014).

Basic parameters of traffic flow are (Lécué *et al.,* 2014):

- Vehicle flow. Flow is the rate at which vehicles pass a given point on the roadway, and is normally given in terms of vehicles per hour.
- Density of traffic flow. Density refers to the number of vehicles present on a given length of roadway. It is reported in terms of vehicles per mile or vehicles per kilometre.
- Speed of traffic flow. The speed of a vehicle is defined as the distance it travels per unit of time.
- Peak Hour Factor (PHF). The ratio of the hourly flow rate (q60) divided by the peak 15 minute rate of flow expressed as an hourly flow (q15). PHF= q60/ q15.
- Vehicle volume. Volume is simply the number of vehicles that pass a given point on the roadway in a specified period of time.
- Time interval between vehicles. Gap is very similar to headway, except that it is a measure of the time that elapses between the departure of the first vehicle and the arrival of the second at the designated test point.
- Distance between vehicles (Clearance). Clearance is similar to spacing, except that the clearance is the distance between the rear bumper of the leading vehicle and the front bumper of the following vehicle.
- Total distance (Spacing). Spacing is the physical distance, usually reported in feet or meters, between the front bumper of the leading vehicle and the front bumper of the following vehicle.

There are two types of counting traffic flow and they are static and dynamic. Static – vehicles which pass in certain period of time through the certain section of the road are counted. Dynamic – it is counting of traffic flows. Actually it is used to determine intensity, direction and path of traffic flows.

Not only that information are collected from the traffic, one of the great ways to stop traffic jams is improvement of parking systems. It is considered that 30% of city traffic jams are caused by drivers who are looking for a parking spot. In a study 15 city blocks are observed in Los Angeles for a time duration of a year. Researchers have found out that drivers have driven more than 1.500.000 km, produced 730 tons of carbon dioxide and used around 200.000 l of fuel to find a parking spot. Smart parking has a job to find quickly and efficiently parking spot for each user. Some of analysed examples allow users to reserve parking spots directly from mobile application (Wang and Wenbo, 2011).

Smart wireless sensors build in the parking spots can collect data in real time about certain parking spot. Sensors will follow if the parking spot is occupied, empty or expired. Device sends information to competent centre which is connected with mobile application for drivers. Using the application user can find a free parking spot, and the city can thoroughly change traffic patterns and driver's habits.

3. MODEL OF MEASURING TRAFFIC BASED ON IOT

In this work is shown model of measuring traffic flow based on IoT. System allows monitoring of number of vehicles which in certain point of time drive through certain section of the street. Basic component of the system is laser for distance detection. On the basis of work of laser it can be measured how many vehicles have passed. In case of cutting the laser beam, the noise level will be checked with the sound sensor LM393 and it will be determined if the car has passed or some other object. In addition to laser and sound sensor, Raspberry Pi microcomputer and Arduino microcontroller will be used.

In case number of detected vehicles passes the certain point, it is possible to conclude that on a monitored road traffic jam has developed. Another parameter to detect traffic jam is constant cutting of laser beam. In these situations, vehicles are moving slowly which leads to long-term cutting of laser beam.

Using this kind of model it is very easy to determine critical spots of traffic jams in the city. This information is of a great importance for drivers and authorized personnel. It is possible to inform drivers about traffic jams and offer them an alternative route, and authorized personnel can analyse traffic and implement changes that will decrease traffic jams.

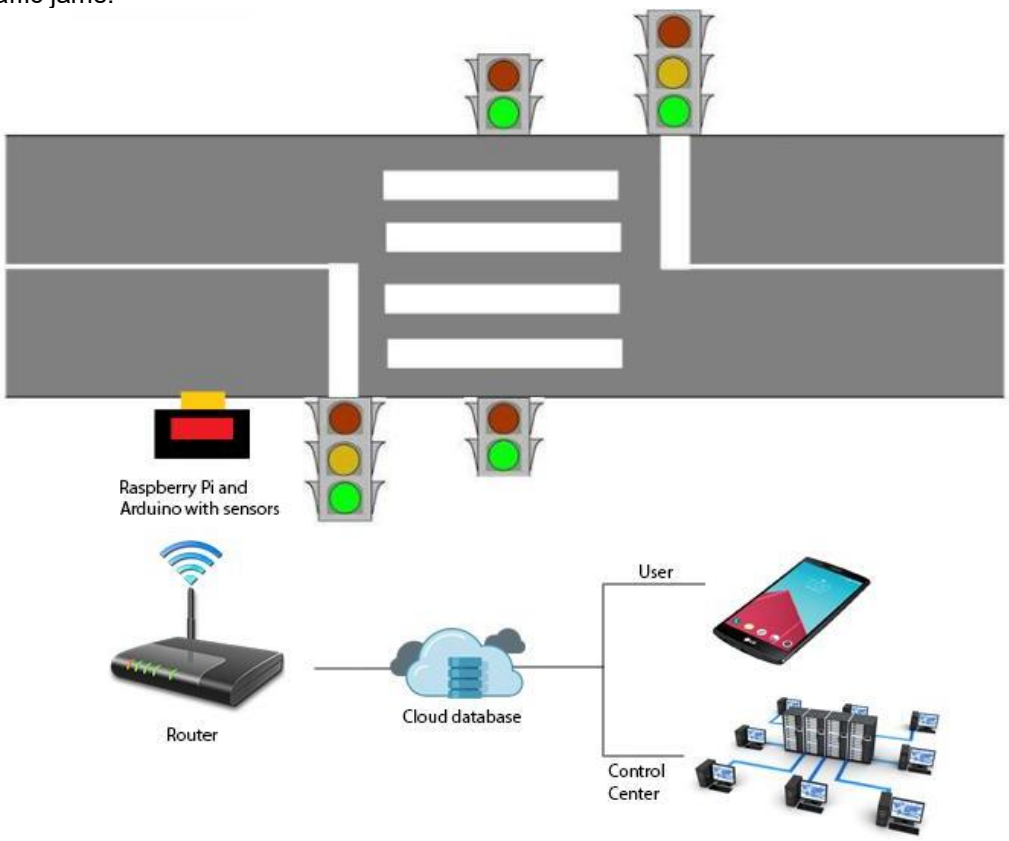

Figure 1: Model of measuring traffic flow based on IoT

Sensibility of the sound sensor is set to minimal, so it would avoid detecting any other sounds other than the sound of vehicles. The device follows the sound and registers the number of vehicles that passed. Remote following of the counter is also possible through web application.

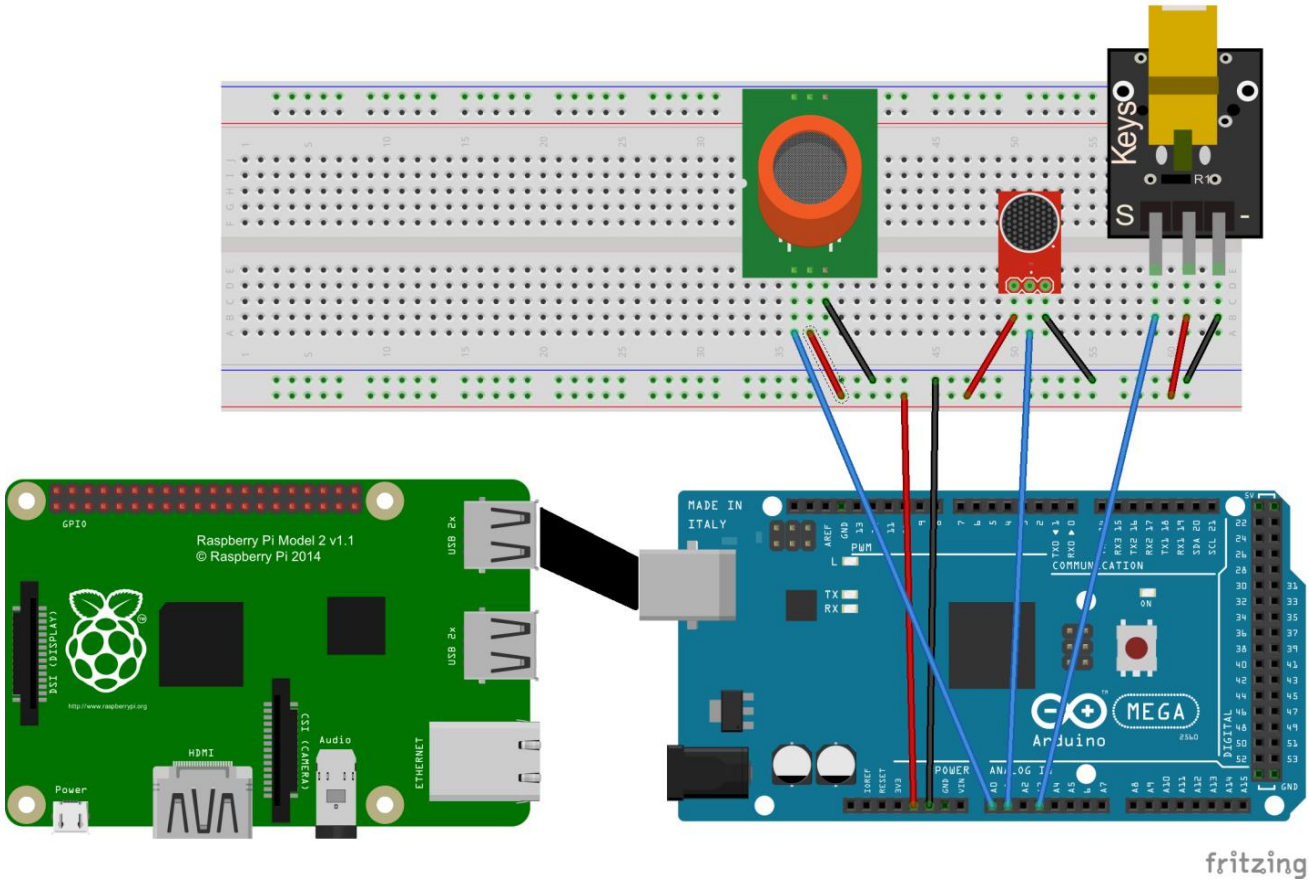

Figure 2: Physical connection of devices

On the picture are shown Raspberry Pi microcomputer and Arduino microcontroller connected with sensors and actuators. Black lines represent cables that are connected to the ground (negative pole) on Raspberry Pi. Red lines represent cables that are connected to power source of 3.3v or 5v on Raspberry Pi. Blue lines represent cables that transfer data between devices.

Raspberry Pi has a web server running. Arduino is connected to Raspberry Pi and sends data read from sensors. Laser sensor, sound sensor, CO2 air pollution sensor are connected to Arduino. Raspberry Pi is running on Linux distribution called “Raspbian”. Web server is developed using “web.py” framework and has a task to send information to service that saves them in database. Because of big amount of data the non-relational database is used (MongoDB) and it is located on the cloud.

4. DEVELOPMENT OF WEB APPLICATION FOR TRAFFIC FLOW MEASUREMENT

This paper shows a web application that allows monitoring the number of vehicles in real time. Based on collected data it’s needed to do analysis and represent results to user in graphical view. The web application is developed by using Bootstrap framework. For graphical view of data is used Chart.js library. Application logic on server side is developed in PHP programming language. Parts of the application logic that are being executed on client’s side are developed using JavaScript. For data insight in real time is used AJAX. All communication with web server takes place through sending and receiving HTTP requests that carry data in JSON format.

Alongside with the insight of traffic flow in real time, it is also possible to filter the data and get more information for previous period of time. Actually it is possible to choose previous day, week, month, year or any other time period. This information can help people who are responsible for highways to make some revolutional changes and make much better traffic system. Also, it is possible to get information about air pollution for certain sections of the road.

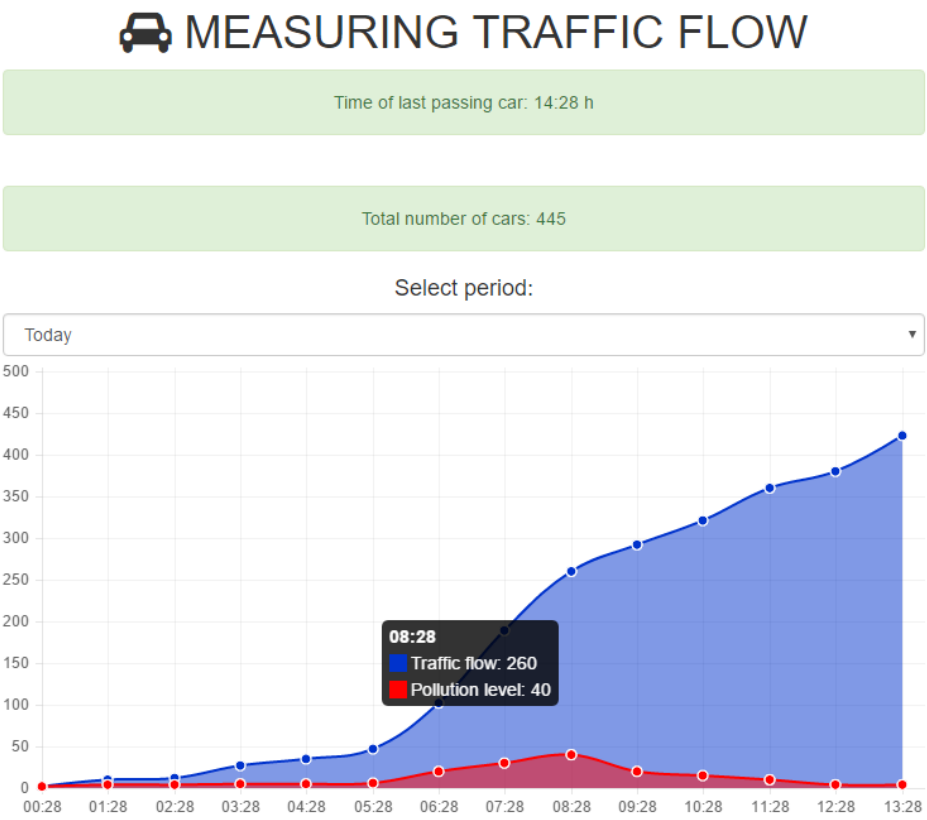

Figure 3: Web application

As an alternative to web application it is possible to develop mobile application. Within mobile application user would have an insight to the same data like in a web application, with some additional functions like push notifications. System would follow current location of the user and in case of noticing that user is moving through route where is traffic jam it would pop up notification with a new route. During suggestion of a new route it should do the selection of users so it doesn't happen that all users get rerouted to the same route. In case of traffic accident in certain street, operator can easily send notification to all users. It is also possible to develop system that will send SMS messages. User can send a message to the certain phone number to get some information about traffic flow and as a replay he/she will get list of the streets where is traffic jam.

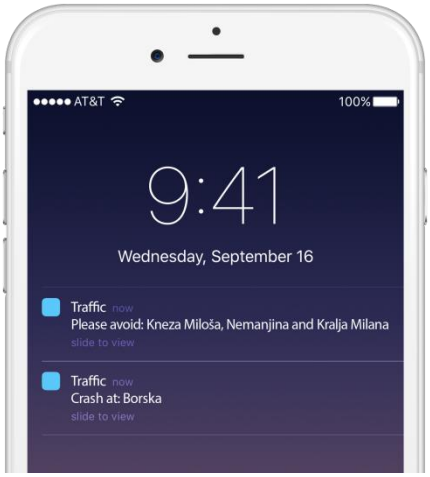

Figure 4: Proposal of system with push notifications

5. CONCLUSION

In this work is shown model of measuring traffic flow based on IoT which was developed on Department of e-business at Faculty of Organizational Sciences, University of Belgrade. Architecture of the proposed model is defined. Furthermore, implementation for model for traffic flow measurement and level of air pollution on the roads was shown.

Main advantages of this solution are simplicity, low cost of equipment and possibility of implementation in other smart environments like smart parking. Important advantage of this solution compared to other solutions is collecting information in real time which offers possibilities with smart traffic signs, traffic can be rerouted to less crowded roads and avoid congestions in this way. Model can be improved with additional sensors. Expanding the sensor network will increase data collection which will lead to improvement of system precision and it will allow recognition of driving patterns.

While other solutions relay on data from cameras (Calderoni, Maio and Rovis, 2014) and information from mobile phones (Khoo and Asitha, 2016), this solution is completely relayed to sensor information which is it's advantage. Cameras are more expensive, it is harder to estimate number of vehicles, and applications can undermine user's privacy.

Real-time and historical data collected from network of sensors are used for prediction of travel times. Travel times are usually posted on the web and on signs both on the side of highway and on overhead signs (Bickel, 2007).

All analysed systems are facing the same problem – rejecting users to use alternative routes (Khoo and Ong, 2011). In Malaysia the survey was conducted about using applications to avoid traffic jams. Only 26% of drivers was ready to change their route and use the one that application has suggested. This number is not big enough to make significant difference. Although this percent will grow, it is needed to increase conscience of the drivers about those applications and their advantages.

Today`s main focus is on technologies that are measuring traffic flow of vehicles, but in the future we might see new hybrid systems that are using similar technology to measure flow of pedestrians along sidewalks as well for counting bicycles on the roads.

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INTELLIGENT PARKING SERVICE MODEL

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Abstract: *The intelligent parking service model is a part of broader smart city project which was created with the aim to enable more efficient regulation of traffic in cities with reduction of harmful gases emissions and to increase the parking service profit. It is based on drafting of updated database on available parking space, definition of vision and goals of a new parking system, and on creation of conceptual framework for implementation of the intelligent parking system project (marketing, market analysis, improvement of cooperation with clients and extended business). Our forecast is that implementation of smart parking systems and application of Canvas business model with Testbed IoT, assuming reduction of labour force through automation of the majority of business processes, will increase revenues by 20%, while decreasing traffic congestion by 30%.*

Keywords*: IPS, wireless networks, business model, Testbed IoT*

1. INTRODUCTION

The goal of implementation of intelligent parking service in urban areas is related to implementation of plans pertaining to functioning of parking system within a positive balance, reduction of traffic congestion, noise and harmful gases emissions in traffic. Implementation of this idea is a challenge in terms of achievement of ideal balance between mobility, safety and environmental protection requirements. Regardless of greater automation of business environment, implementation of intelligent solutions in traffic, based on IoT technologies, requires the establishment of smart innovative management. The management will face a serious challenge how to solve a problem of inefficient parking space management and reduce traffic density on urban roads in the situation of constant growth in number of residents in urban areas with expressed tendency of further growth. Implementation and flexibility of parking space management model is the main motive which is the basis for business strategy of the parking service management. Implementation of intelligent parking service (IPS) could enable implementation of the following goals:

- Integration of available parking space into a unique parking space base which would be at public parking service disposal. This implies that in addition to state-owned parking space, the aforementioned parking space base would include parking lots owned by physical and legal entities, with definition of contractual obligations between parking space owners and public parking service.
- Implementation of reservation service in parking system which means that user can e-mail, text or call (voice identification) to require reservation of parking space at certain location. The user gets a possibility to define duration of reservation and payment option, applying the system *pay per use* (difference compared to the so far way of calculation based on initiation parking hour).
- Generation of offer of free parking spaces thus providing the clients with possibility of parking lot choice. Clients are offered several free places located in different distances from the required destination. Depending on the distance, the client is also presented a financial offer for each proposed parking place.
- Introduction of parking space classes, economic and business ones, in wider fenced parking lots and garages. Economic class would have more parking places, while business one would have fewer places, which would be wider and longer, with longer period of time available for parking, and would be closer to the exit.
- Central monitoring and configuration of devices from remote location, thus reducing need for hiring of controllers for supervision and enforcement of penalties on parking space.
- Introduction of discounts for certain free places, as well as different advertisements. This would enable direct inflow of funds through stimulation of users.
- Additional introduction of security systems, i.e. protection of information.
- Stimulation of use of electric cars through application of lower parking rates and electricity costs, with subscription on longer period for this type of vehicles.
- Charging of fees while passing, i.e. at the entrance and exit of vehicle to and from the parking lot by introducing RFID readers.
- Introduction of business promotions for other companies, as well as dual market actions.

- Introduction of voice navigation to a parking place, as well as video imaging of free parking places, with possibility to choose zones and places.
- Introduction of day-night charging system, which would offer to clients such parking spaces free during the day but occupied during the night and vice versa.
- Reduction of fuel consumption by implementing a system which enables shorter parking. This would influence reduction of pollution, thus leading to environmental sustainable development.
- Implementation of updated database which in case of disputes provides parking service a possibility to protect business interests of public parking service business based on exact data.
- Networking with police communication systems, which would enable automatic check of vehicle registration.

2. SYNTHETIC INTELLIGENT PARKING SERVICE MARKET

Dynamics of users' requirements and need to find fast and efficient solutions for them, as well as need for more efficient business are the main driving forces for market change. This is why advanced information-communication technologies are ever more frequently applied in different areas of economy, such as transport, energy, industry, trade, etc. Application of these technologies significantly alters processes and entire market, approximating them to achievement of the vision of smart market. Smart markets (SM) are a form of synthetic intelligence which requires a wide array of researches in the area of theoretic formulation and optimization of technical resources, including development of researches about individual users' behaviour and characteristics of market mechanisms. Dynamics and scope of changes in a society caused by the development of new technologies such as IoT impose the need for application of advanced solutions which would provide for high degree of intelligence in real time (Bichler, Gupta, & Ketter, 2010). In this paper, we have addressed the development of intelligent parking system (IPS) model, which would be based on advanced parking space management system in urban areas, i.e. establishment of smart parking space market. This market should function on the following principles:

- centralised disposal of available parking space in urban areas (regardless of the ownership)
- implementation of IoT application and continual updating of data about the availability of parking spaces
- definition of a dynamic pricing set based on readiness of clients to pay for example in auctions for lease of parking space on shorter or longer time period

The need for information exchange between users searching for free parking space and accuracy thereof are of crucial importance for the development of IPS. Traffic generated by vehicles searching for free parking space is a problem in urban areas from the aspect of traffic, but also from the aspect of environmental protection. The existing research indicates that circulation of vehicles increases concentration thereof on roads, especially in central urban zones, where there is a huge demand from drivers (multiple-car-chasing-singlespace phenomenon) (Wang & He, 2011). The need of drivers for recommendations, i.e. for the assistance in finding free parking space, influences expansion of service mobility and improvement of navigation service. Intelligent parking system should be designed according to method of "clients' attraction on the fly". The existing solutions in the area of parking service indicate that providers of this service paid small attention to drivers' needs, their wishes and frustrations. New parking system model should be designed to take care of drivers in order to develop trust in IPS model among them, thus making them ready to pay more for the service. Strategic investments into the technology and marketing of IPS, in accordance with continual development of urban development solutions within the smart city project are prerequisites for sustainability of the smart parking space market project. Functioning of IPS is heavily influenced by reliable system operation, since interruption in communication links would mean loss of revenues and significant influence on operator's reputation. The IPS model can be complex depending on facility type, but electronic payment must be continual and uninterrupted, with minimization of disputable transactions, misuse of credit cards and theft of sensitive information (Bayless & Neelakantan, 2012). The IPS model is based on offer to a new service to drivers, with a possibility of free parking place reservation. The service is implemented in such a manner to have three levels of autonomous functions: coordination level, local parking management level and parking spot level (Babic, Carvalho, Ketter, & Podobnik, 2015). The coordination level should be based on different monitoring sub-systems (Illustration 1), which would collect data from sensors about availability of parking places based on the principle "available-unavailable". Data is analysed in further steps, together with information about the vehicle having sent a request for parking space reservation. The IPS model is designed in such manner to provide drivers with possibilities to pay by card, text message, by invoicing etc. New dimension to IPS quality is provided by possibility to navigate, i.e. a driver can, upon the accomplished reservation of parking place, receive a preferable route through an application on their mobile device, with voice navigation, as well as with image of the parking place from the camera. Smart parking spare market implies a possibility to apply auctions in the stage of parking space reservation. Namely, distance of the parking place from the driver's destination location significantly impacts the driver's motivation to pay certain price for the parking place lease. The time needed to get to the parking place is 10 minutes maximally.

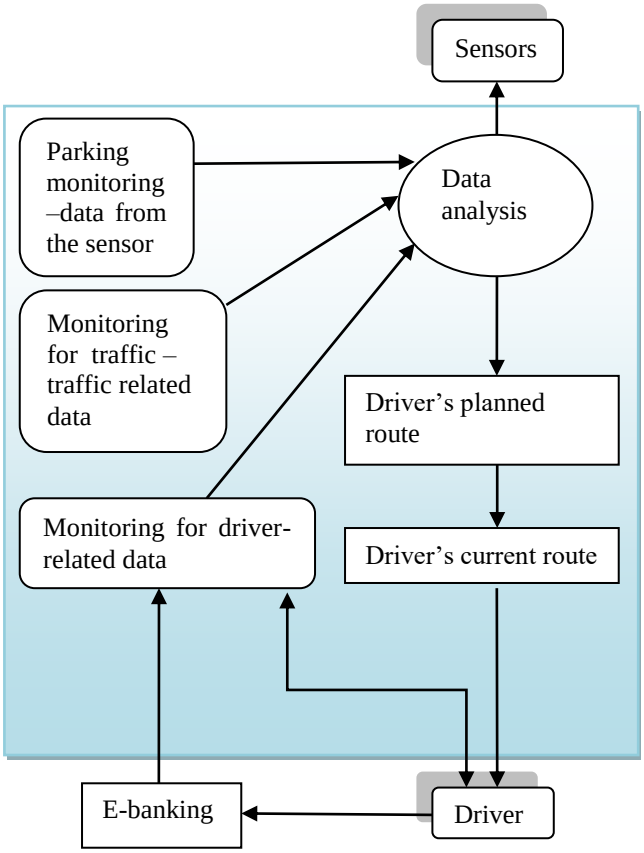

Figure 1: Schematic diagram of the proposed IPS monitoring system

If the driver does not follow the route recommended by the navigation, after the expiry of that period, the driver can request additionally free parking place because they are not entitled anymore to the previous one. The driver is directed to next free place with certain fee charged for the service. In the event that they do not reach that parking place on time, the driver loses the right to request additional parking place in the next two hours, and is not entitled to refunds. Parking time starts from the moment when driver parks their car and confirms the arrival through the application. Special position in our IPS model is given to a system for the protection of reserved parking places. This system implies "lighted" marking of parking place by emitting red light beam from the sensor in cases when other drivers searching for the parking place try to park their car there. In addition to the mentioned solutions, the proposed IPS model implies application of new charging policy which would additionally influence reduction of harmful gases emissions. Our IPS model anticipates stimulation of use of electric cars in order to reduce CO_2 emissions. In order to create technical conditions for the application of this type of stimulation, the parking lots would be equipped with smart battery electricity chargers. The complexity and dynamics of the environment is potential obstacle for the business perspective of this solution. The reason for that is actually the fact that parking transformation process implies the complexity of profit estimation of the smart parking owner and length of time required for the initial investment return (Iordache, Nemtanu, & Cormos, 2015). Electricity market, as a component of this system, would be considerably integrated with its solutions for smart market.

3. INTELLIGENT PARKING SERVICE BUSINESS MODEL

Business model in a usual word in the world of management, but over the past several years it has been attracting great interest for researchers (Morris, Schindehutte, Richardson, & Allen, 2006). Parking service is a system whose functioning is based on linkages of numerous information system segments. This includes data collection, selection, controlling, transferring, processing, distribution and protection. Marketing plan must be open and transparent with the following key and interest approach:

- Basic information about the company, company business philosophy, marketing definition of the company business, company vision and mission, SWAT analysis, business history.
- Analysis of introduction of business automation through wireless network and sensor communication.
- Reduction of costs, increase of revenues, safety in traffic, environmental protection.
- Creativity, use of Serbian and English language in user applications, marketing tactics through use of social networks and Google services.

- Development of new parking system would be designed in phases throughout a certain period of time.
- Graphic layout of cost-effectiveness threshold.
- Defining the needs of the existing and potential users.

The proposed platform, i.e. the model, would increase net profit, at the same time possibility to buy new plots of land for the construction of vertical garages, possibility of business outsourcing and improvement of advertising. The structure of revenues collected from parking subscription fees, sold electronic tickets, additional tickets and from sponsorships and cooperants would greatly influence development of a financial plan in the own funds segment. Nevertheless, credit lines should be involved in addition to own funds, because of the amount of initial investments and relatively fast return of the invested capital. The structure of estimated investment value includes: fixed and current assets. Fixed assets include financial costs for the product development (hardware and software), labour for the product development, market analysis, e-commerce and miscellaneous segment. The costs for labour invested in the product development include: concept and development thereof, documentation, programming, testing, prototype, customer support service, e-mail marketing, website, e-commerce solutions, web marketing, providers' services, advertisements and promotions. In addition to these costs, there are also fixed costs, such as costs for electricity bills, Infostan technologies – utility services, construction land, internet, telephone, stationery, fuel, etc. Operational monthly costs include administrative costs, sales and marketing costs. When it comes to depreciation, it has to be carefully considered, since usage period for sophisticated technology is short, and IPS development stage would take three to five years period. Data about labour force is very important, and implementation of IPS would surely affect the reduction. In order to maintain a "healthy" company while introducing new technologies and IPS model, cash flow should always have positive tendency and scale in balance sheets should always be rising. The value of the proposed is ranked according to consumers, in other words, if customers' needs are met, the value of the proposed system is greater. This means that the first basis should be found in the development part of *Testbed IoT*, incubating the IoT success, which could be subsidised as a part of the financial plan. The second level is implementation in the field, i.e. placement of the results obtained in the first stage through observations and responds obtained from end users. Testbed provides for reasoned guidelines for strategic decisions and investment plans, and it also selects strategic and non-strategic partners. Such logistics pertains to the example of the provision of equipment for Testbed, as well as to indirect call for companies which would develop and test their applications, hardware and communication protocols in real living environment. The interaction in creation of brand must be instrumental to consumers with innovations and support network. What s the most interesting for Testbed stage is double influence on revenues, influence to the IPS preliminary design and impact to attracting of other IT companies which would rent space to research their experimental-oriented services. Traditional business models are designed in such way to focus exclusively on the basic company. However, because of new technological dynamic development environment, companies must quickly adapt to market challenges. As a result of that, innovation business models are becoming a new, additional link or "new routes towards the competitive advantage" (Sun, Yan, Lu, Bie, & Thomas, 2012). With IoT *Get-ahead* and *Catch-up* strategies, companies primarily enable themselves to have the forecast time period. Namely, the get-ahead strategy is a set of actions and plans which enable achievement of a position above the competition, while catch-up strategy is a set of actions and plans which enable monitoring and learning from leaders through operational efficiency and quality. Taking the aforementioned into account, Table 1 demonstrates the process of structuring and evaluating of the IPS business plan, which is composed of four sets: infrastructure, proposed values, clients and finances. Infrastructure is divided into three topics: key partners, activities and resources. In addition, the main topic of customers is also divided into three sub-topics: customer relations, clients and client groups, and approaches to clients. Financial area is divided to the structure of costs and revenues. The identified topics are not autonomous, but are inter-conditioned. Key partners are associated with the common goal, and this is creation of alliance for the improvement of the business model, reduction of costs, risks and uncertainties, with the support of specific resources and activities. Key activities define what the partners are supposed to do and how to do that, e.g. consultancy offer, software development, etc. since every business model must have some sort of resources to create value towards the clients, key resources in this case would be means for maintenance and support of business. Resource type can be intellectual, financial, human or physical, and they should be provided by key partners, based either on ownership or outsourcing from another company. The value proposition will form innovation as new or similar solution for a certain product or service for the area of customers. Wise selection of clients by the company, as well as listening to their needs through adequate access channels generated mutual trust and accomplishment of the expected goals on both sides.

According to data of the Republic statistical office, the number of passenger vehicles in the Republic of Serbia has been increasing constantly over the past several years. For example, the number of passenger vehicles registered for the first time in 2015 was higher by 6.9% than in the year before, while mopeds and motorcycles record certain fall (Republic Statistical Office, 2016). This indicates that need for more parking places, using IoT solutions, is one of primary goals of city administrations.

Table 1: Business IPS Canvas model with Testbed IoT

<table>
<tr>
<td>KEY PARTNERS

➢ Institutions dealing with public transport
➢ City transport
➢ Authorised car representatives
➢ Authorised car mechanic services
➢ Auto-motorcycle sport media and organisations
➢ Social networks</td>
<td>KEY ACTIVITIES

➢ Networking with clients
➢ Networking with partners
➢ Coordination
➢ Development and research

KEY RESOURCES

➢ Information and knowledge
➢ Space for the monitoring centre
➢ Hardware and software architecture
➢ Patents and ownerhip rights of the Smart Parking Service
➢ Human and financial resources</td>
<td>INTELLIGENT PARKING SERVICE

➢ Integration of all parking places in the city (state- and privately-owned)
➢ Testbed IoT
➢ Introduction of sensor communication through a wireless network
➢ Remote control with control of parking place
➢ Introduction of pay per use
➢ Introduction of fitting systems for electric vehicles
➢ Gradual phase-out of controllers and paper tickets, i.e. daily tickets
➢ Rationalisation in human resources and expenditure
➢ Construction of vertical garages
➢ Better organisation of traffic
➢ Reduction of traffic congestion and of harmful gases emissions
➢ Greater interactivity with clients and adaptation to their needs
➢ Networking with the police
➢ Outsourcing business</td>
<td>CLIENT RELATIONS

➢ Assisting to clients in purchase of electronic tickets
➢ Automation of services
➢ Specific client relations for clients who often use IPS services, as well as with members
➢ Development of relations with other companies and their staff

CLIENT ACCESS CHANNELS

➢ Internet
➢ Mobile phones
➢ Printed advertising material
➢ Media</td>
<td>CLIENTS AND CLIENT GROUPS

➢ Younger drivers
➢ Elder drivers
➢ Car drivers
➢ Moped and motorcycle riders
➢ Families
➢ Clients with special needs
➢ Employees of specific companies</td>
</tr>
<tr>
<td colspan="2">COSTS STRUCTURE

Reduction of costs through automation
➢ Procurement and maintenance costs
➢ Activity costs
➢ Partnership costs
➢ Costs for the development of client relations</td>
<td colspan="3">REVENUES

➢ Website with electronic purchase model, purchase of products, services and contents
➢ Web business – advertising space would be ceded to other companies charging a proper fee for that, i.e. sale of advertising banner space
➢ Subscription model for access to certain facilities or services – e.g. motor racing, Nascar racing, etc. Subscription would be on monthly, semi-annual and annual levels
➢ Transaction sale could be applied in e.g. auction sale of spare parts and service offer, thus bringing commission to the parking service from salesmen who would gain revenues from the sale
➢ Sales model would be implemented through ticket, information and service sales
➢ Affiliation model would be implemented by referring the buyers to other companies who would buy products and get certain discount on them, and parking service would gain commissions for such referrals once the sale is finished</td>
</tr>
</table>

4. CONCLUSION

Application of advanced solutions leads to the improvement of the existing and introduction of new services for more efficient fulfilment of users' needs. One of these services includes possibility to reserve parking places at any time, from any location, and in any way. Implementation of this service would enable the users to plan and implement their activities more efficiently, but also to reduce fuel costs. From the aspect of city authorities, this model is an efficient solution for the reduction of congestions on urban roads and harmful gases emissions. However, implementation of IPS is complicated by the following: impossibility to complete the database due to the lack of regulatory provisions pertaining to which entity offers parking space (whether it is only the Parking Service or specific private and business owners), as well as regulation of mutual obligations. Would it be better to develop a separate system or an integrated platform, or to go through a network of telecom operators? Separate system based on cloud and SDN solutions is a better and long-term option, because it eliminates the dependence on telecom operators. The question is whether telecom operators would let that happen. How to make a good business plan to justify the investment if you cannot see the relation thereof to the operators? Is there legislation that would allow the use of stock exchange for the lease of parking spaces at busy locations? The need for qualified staff, in addition to all of these issues, is a bottleneck at the moment, but it is also a good starting point for modern traffic.

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AN APPLICATION OF TEXT TO SPEECH IN SMART HOME

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Abstract: *This paper shows an example of implementation of Internet of Things in smart house. The model for managing the smart house through voice commands is developed as purpose of increasing pleasure of those living inside the smart house and making the everyday situations easier. This paper shows an example of implementation of lightning, alarm system, fire extinguishing system as well as system for increasing environmental awareness. All these systems can be managed through voice commands or through a web* application.

Keywords: *smart house*, *IoT platform, TextToSpeech application, augmented reality*

1. INTRODUCTION

With everyday technology progress, first of all increasing processor's power and decreasing their size, totally new generation of computers has emerged – microcomputers. These devices have enabled us to create smart environments. The concept of smart environments represents "physical world that is richly and invisibly interwoven with sensors, actuators, displays" (Weiser, Gold and Brown, 1999.). Main purpose of smart environments is increasing user's pleasure (Cook and Das, 2005). Concept of smart environments is achieved by using Internet of Things.

Internet of Things (IoT) is a network of smart objects connected to the Internet which can communicate with each other (Tan and Wang, 2010.). As the number of smart devices connected to the Internet is exponentially rising, so is rising our ability to send, receive, collect and analyze data from any device at any moment (Hanne, Ovidiu, Tracey and Roy, 2012).

One of the elements of smart environment is a smart house. Smart house enables us to simultaneously manage large numbers of devices using lots of different services and applications. Definition of smart house is changing with the development of new technologies. Previously, it has been thought that the smart house is the one that has devices which are connected to the Internet and which we can access using the Internet. However, today smart house is the one in which devices are not only connected to the Internet, but they can also communicate between each other (Wu *et al*., 2010).

This paper shows a development of a system for managing the smart house through the voice commands. Web platform and mobile application are developed so the voice commands could be given to the system. Apart from the display of read values and actuator states on both applications, users will be provided with additional functionalities within the mobile application, like sending an e-mail or SMS messages. The main purpose of web platform is to assist the administrator in defining the environment, sensors and actuators. Web platform will provide a secondary way for managing the system.

2. LITERATURE OVERVIEW

A smart house is the house that includes advanced automatization of the system with the purpose of enabling more sophisticated surveillance and control over the functions inside the smart house. For example, in smart houses lightning, temperature, multimedia and security systems can be easily controlled. Users can not only manage these devices but they can also get feedback from the house with

their state and history. Smart house can be managed in many ways, the most common ways are: Web application, mobile application, SMS message, remote controller and voice commands.

One of the interesting ways of managing the smart house is using voice commands. Not only that it is very interesting and intuitive, but it enables it's user to simultaneously do more than one thing. For example, user can, while leaving the house, simultaneously activate the alarm, shut down the lights and get dressed. Feedback is provided through sound which enables user to stay focused on the thing that he is doing at the moment.

Automatic voice recognition is a process in which the computer is processing human voice and creating a textual representation of spoken words. Control over the voice commands is getting more and more popular with it being used not only in smart houses, but also in smart phones, smart cars, smart tablets and smart TVs.

After analysis of the literature, it can be concluded that the smart houses are different depending on technical equipment and technologies that they are using. Wireless technology, mobile applications, multimedia control and fast Internet access are usually used. Some papers highlight the importance of the smart medicine and e-health in smart houses. The focus of these works is facilitating life of the people who live in the house, increasing their security, information availability and managing the devices even though the user is at the remote location.

Some solutions are focused on decreasing the costs through user detection (Makonin, Bartram and Popowich, 2013). It is necessary to detect when users are not at home, so the smart house could adjust the environment, to be more precise decrease the temperature and shut down the lights. Result can be improved if the system knows when the user needs to come back home, that way more energy can be preserved. The energy efficiency of the house can be further improved by detecting the user's sleep phase (shutting down all the unnecessary devices).

An important element of the smart houses is health of household members (Juniper research, 2014). Internet of Things provides data about user on the level that was just not imaginable until now. Implementing different medical devices, it is possible to greatly increase the life quality of people with physical disability and it is also possible to detect symptoms of different diseases even before they occur.

Large number of studies are focused on security of the systems itself. During application development for smart houses it is necessary to pay attention to network security on which devices are connected, data privacy, communication security, identification and authorization of the user and many other parameters (Enisa, 2015)

3. SMART HOUSE SOLUTION DESIGN

In this work is shown development of the model for managing the smart house through voice commands. The model consists of: microcomputer, microcontroller, sensors, actuator which on request of microcomputer and microcontroller change the state inside the smart house. Communication with microcomputer is enabled through web service. The model is shown in Figure 1.

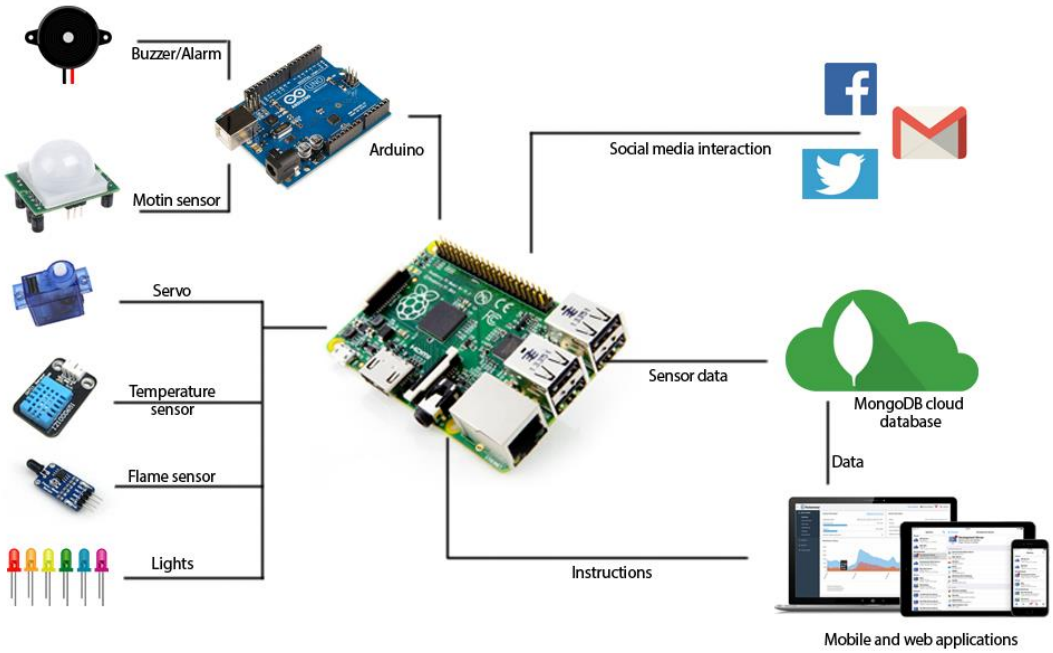

Figure 1: Model for managing the smart house through voice commands

The main purpose of the smart house is to provide to its household members the best and the most secured life style. It's supposed to provide way to managing the lightning, multimedia system, security system, system for maintaining temperature and air moisture inside the house as well as integration with social media.

Centre of the system is Raspberry Pi microcomputer. Temperature, moisture sensors, lightning and flame detector sensors are directly connected to the microcomputer. Except of these sensors, Arduino microcontroller is also connected with the purpose of working on security system. To the Arduino is connected motion sensor which is activated when something is moving. The Raspberry Pi microcomputer runs on Linux distribution called "Raspbian". Web server is located on the device and it is created using "web.py" framework. Because of the huge amount of data, two types of databases are used, relational MySQL database and non-relational MongoDB. In relational database are kept all information for the user and his/hers privileges, sensors and actuators, while in MongoDB database are kept all information from sensors. Within web server is a controller which, based on user's requests, decides which operations will be executed and on adequate way informs user about that. Physical connection of devices is shown in Figure 2.

Figure 2 shows Raspberry Pi microcomputer and Arduino microcontroller connected with sensors and actuators. Black lines represent cables which are connected to the ground (negative) on Raspberry Pi microcomputer. Red lines, in the picture, represent cables which are connected to output of 3.3V or 5V on Raspberry Pi microcomputer. Blue lines represent cables which are used for data transfer between devices.

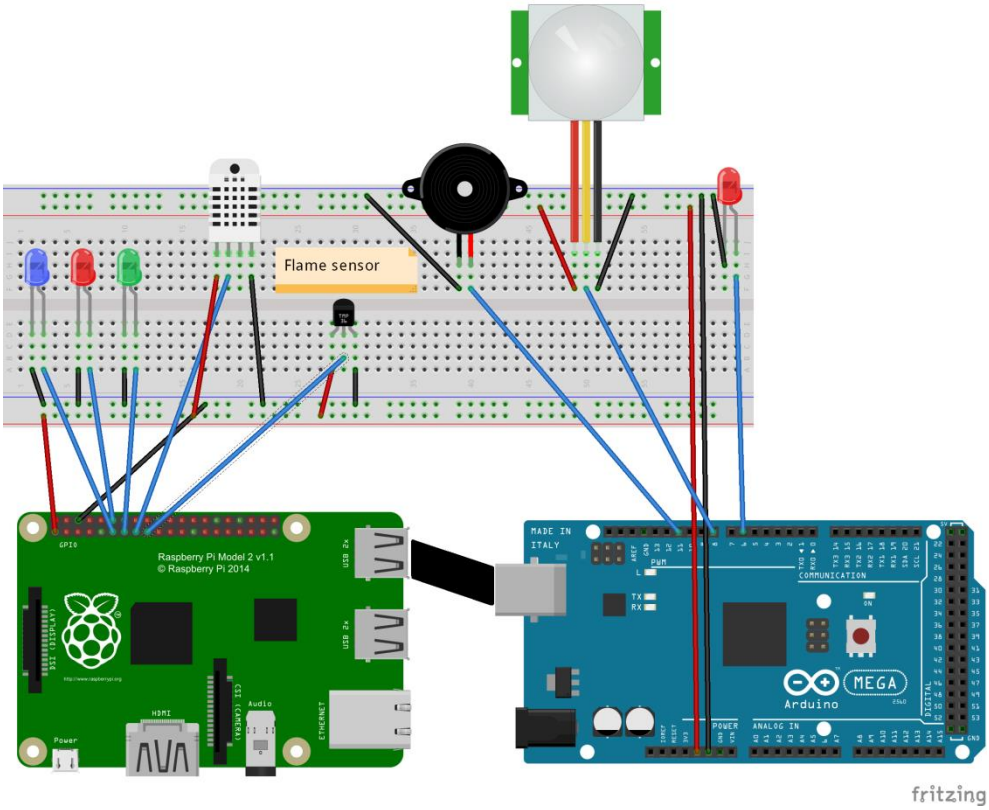

Figure 2: Physical connection of devices

4. DEVELOPMENT OF TEXT TO SPEECH APPLICATION FOR SMART HOME

Project of the smart house consists of 4 main parts. First part is a web server that's set up on Raspberry Pi microcomputer, it is developed in Python programming language. Second part is a web application. Third part is a mobile application for Android OS, which user uses to give the voice commands. Fourth part consists of an application for augmented reality.

Raspberry Pi microcomputer takes the central part in the system. It has the web server which on user's request sends information about current state of sensors. All values read from sensors are kept in non-relational MongoDB database held on cloud (Cyrus and Nayak, 2016). In addition to checking the state, Raspberry Pi manages different actuators like step motor. User with voice commands has availability to check notifications and messages on social media like Facebook, Twitter and Instagram. User can check number of unread messages on its mail account. With the sequence of voice commands it is possible to send an e-mail or SMS message to some of the contacts, as well as get the content of received SMS messages.

Web application consists of two parts: administrative and user part. Administrator can create main account and account for every household member. In addition to creating an account, administrator can change and delete existing accounts, as well as change their level of privileges. The application contains three levels of privileges: parents, kids and guest. User with the privilege parent has an access to every option of the smart house system. User with the privilege kid has an access of insight to a current state of the house and options to manage the systems which parent allows it. Guest privilege is just a temporary privilege which is created by the parent and has limited possibilities. Administrator gives proper sensors and actuators to each client to which he will have insight. Each sensor is given a name and unit of measurement. For actuator, name is defined and set of states which that actuator can have. For sensors

and actuators administrator can define the room which they belong to. Admin panel of the web application is shown in Figure 3.

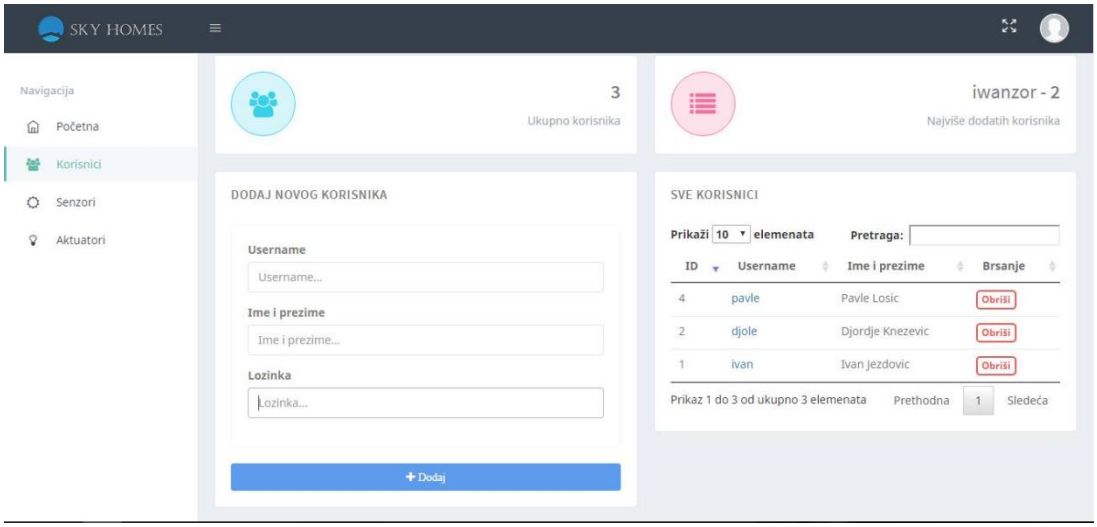

Figure 3: Admin panel of the web application

User is shown the state of sensors in real time in proper part of user interface. Main information are current temperature, air moisture and level of lightning. Also, user is given the possibility of filtering the results as well as graphical view of those data. Depending on the level of privileges, user can manage lightning inside the smart house. Also, on the user panel there is an option for lightning automatization, for example, turning on the lights in previously defined moment of time. User with privilege parent has an option of managing the alarm. On user interface panel there is an option of zoning the house, where it is possible to activate the alarm only in certain rooms.

Web application is developed using Bootstrap framework. Charts.js library is used for graphical interface of data. Logic of the application is set on server side and it's developed in PHP programming language. Parts of application logic which are executed on client's side are developed in JavaScript. For display of actuators in real time is used asynchronous JavaScript (AJAX). All the communication with web server is carried out trough sending and receiving HTTP requests where data is transferred in JSON format. User interface is shown in Figure 4.

Figure 4: User interface

Mobile application is intended for the client and it provides possibility of information review as well as giving the voice commands. For each sensor, user is shown proper information in real time. Same as with the web application, for chosen sensors information can be shown as graphic view for previous period of time. The application provides a way of managing the smart environment with simple speech. These commands are analysed and sent to Raspberry Pi microcomputer which executes them. User has access to these commands: turn on the light, turn off the light, is the light on, current temperature inside the house, temperature in Belgrade, alarm armed, alarm disarmed, check mail, check notifications, convert Dinars to Euros and commands for sending SMS messages and e-mails. Each voice command will give a feedback to the user in a voice format.

Augmented reality is integrated as a part of mobile application. Users can use their mobile phone to scan the marker to get insight in state of sensors in virtual space. When marker is detected, Raspberry Pi reads the value from sensor and sends this information to mobile application, which shows this value above the marker. Value of the sensor is visible only through the phone camera. Text to speech application and augmented reality is shown in Figure 5.

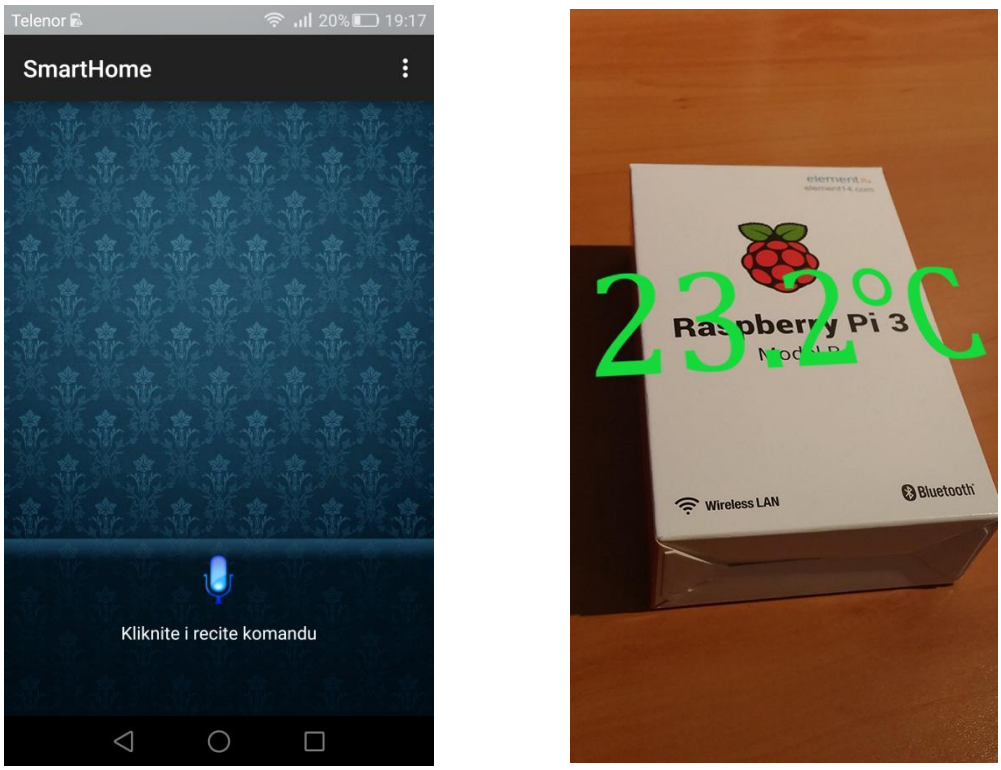

Figure 5: Text to speech application and augmented reality

Android application is developed in Android Studio IDE development environment. Within application is integrated Google's API for SpeechToText, which goes to Google's server and converts speech to text. Text is returned to Android application which sends it further to the web service on Raspberry Pi microcomputer, from which it gets feedback about executing proper action. Application notifies user in two ways, in text and voice formats.

5. CONCLUSION

This paper shows a solution for managing the smart house through voice commands. Model architecture is defined and implementation is shown through development of web and Android application. Advantages of shown solution are simplicity, low price of the equipment and possibility of easy

implementation in other smart environments. Shown application can significantly ease life of people with disabilities, and it represents complete solution compared to the other analysed applications. Applications analysed during writing this paper are focused on certain parts of the smart environment while defined application has control over most of the elements of smart houses.

During development we used large number of technologies and programming languages (Linux, Python, PHP, Android, Mongo, Vuforia) which is at the same time a flaw and virtue of the application. This work proves that large number of technologies can be used simultaneously to achieve concept of smart environments, but if application keeps developing it is necessary to limit the number of technologies.

Further development of the application can go in two ways. First way is expanding number of supported sensors and actuators. This way of development has no limits because it is possible to implement all devices that can communicate through the Internet. For example, we can create a smart heating system which would read information from different sensors and then control temperature and thus significantly decrease costs.

Other way of application development is focusing on augmented reality. It is believed that virtual/augmented reality is next step of human-computer interaction (Dong, Hyun, Jae and Jae, 2016.) so this way of development can be very interesting and challenging. It is possible to develop mobile application so that all information are shown in virtual space. Besides insight in current state, user can activate certain devices, so with only one gesture of the hand it's possible to manage music volume in whole house or shut down the light only by looking at it.

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SMART BUILDING, THE NATIONAL BANK OF SERBIA

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Abstract: *This paper describes the advantages of using technical and technological achievements and their implementation in a centralized and integrated management system of smart buildings. It also defines smart buildings and gives basic features, functionality, and integrated management and monitoring by implemented technical systems, which contributes to saving energy consumption. It gives an example of an integrated technical system of a smart building of a business premises of the National Bank of Serbia.*

Keywords*: smart building, automation, technical systems, management, energy*

1. INTRODUCTION

Climate change, which is an active topic today, marks above all the negative consequences of the impact of humanity on the factors of the climate system. More than 40% of the global energy (mostly made of fossil fuel) is consumed in commercial and residential buildings. The goal of any construction is to provide conditions for life and work in economically acceptable conditions in complete harmony with nature. Using technology and processes for creating a building that is safer for its users and more effective in operational terms for its owners is more frequent. There is a need for automating business-residential facilities primarily with the aim of saving energy. The intelligence deployed at buildings, together with the integration of renewable generation sources, has brought in new concepts, such as Smart Buildings and Smart Environments. These new environments imply deploying interconnected sensors and intelligent devices in order to obtain energy efficient buildings (Smart Buildings) and make the life of the users easier (Smart Environments) (Hernandez et al., 2014:1462).

Smart buildings can automatically adjust its internal temperature or the temperature of each specific entity within to external conditions or to interior inactivity in individual parts by automatic control of heating, cooling and ventilating. The same principles apply to other subsystems that integrated and centralized system management controls, such as interior, exterior and facade lighting, access control, fire alarm system and air quality control system, monitoring security system, pumps control, generators, elevators, fuses, windows and other equipment in the building (Kambić, 2014).

Smart building can be controlled by: PC, tablet, mobile or landline phone, universal remote control and other modern devices that have the ability to receive and send executive signals. The primary task of the embedded automation is to satisfy the need for better quality of a modern man`s life, but at the same time to accomplish significant energy savings. In achieving the optimum balance between these two apparently correlative sizes, automation achieves its full meaning and usefulness. Finally, the concept gets its full meaning by creating a safe, comfortable, economical and secure environment, while simultaneously saving energy, reducing maintenance costs, and longer life cycle of the equipment.

2. SMART BUILDINGS

Smart buildings are those objects with built in materials and systems that contribute to lower energy consumption and simplify the operation of all equipment. Office buildings, hotels, hospitals, schools and housing facilities are in need of cost savings and greater comfort.

The brain and central nervous system of the smart building consist of central computer servers and databases, which gather large amounts of information, which are analyzed, processed and consequently sent to executive devices that carry out activities. Numerous and various sensors and cameras are surrogates for the senses, which collect information and initiate action, where the blood circulation, neural networks or spinal cord could be imitated by some of the protocols and buses for the transfer of data and control signals, while many zonal controllers represent a kind of peripheral nervous system. Finally, there are the Internet and Intranet networks that connect individual organisms with the entire community (Marković, 2010:285). Central system for managing the building (Building Management System - BMS) refers to a large

number of management systems in the building, from special purpose controllers to larger systems that include central computer and printers. BMS consists of several subsystems that can be connected in different ways in order to form a complete system, such as a system for heating, ventilation and air conditioning, electrical systems, lighting system, fire alarm system, security system. BMS can be used for monitoring, control and management of the entire system or parts of the system.

The basic need for the introduction of the BMS:
- Increasing the reliability of technical systems;
- Reduction of costs;
- Increasing the productivity of employees;
- Increase the safety of employees and property.

Centralized and integrated building management aims to make possible proper work of implemented technical systems with a minimum number of fails. The fails in the system components almost always require higher costs due to repair or replacement, than would be required with the periodic maintenance. Additional costs are caused also by the interruption of business processes due to the fail of individual components or the system as a whole. In this sense, BMS makes a significant contribution by continuous monitoring and preventive maintenance of components.

BMS communication network that is installed throughout the building is used for reception of all alarm signals and sending executable commands. By using an integrated system in a quick and easy way, we are able to provide comfortable conditions for work and, with these positive effects, influence the increase in employee productivity.

3. SMART BUILDING – THE NATIONAL BANK OF SERBIA

In the mid seventies, it was decided that, for the purposes of the former National Bank of the SFR Yugoslavia, a new office building would be constructed on Slavija Square, in Nemanjina Street. It was officially put into operation on 21 March 2006. The decision that the building should be constructed was made by the Council of Governors of the former Yugoslavia in 1976, and a detailed urban plan for area of "Slavija" from 1980 determined the location of this building. The investment program was discussed for 9 years and finally adopted in 1989. With the dissolution of SFR Yugoslavia, the National Bank of Serbia inherited all the problems and costs associated with construction. Construction started in 1992 and it was attended by about 60 companies.

Figure 1: Office building of the National Bank of Serbia, Nemanjina 17, Belgrade

The building is an imposing modern building of about 53,000 m2, with four underground and eleven floors above ground. On four underground floors there are parking, warehouses, safes, printing office, power stations, diesel generator, various workshops and the like. At eleven floors above ground, in addition to the three cabinets for vice-governors and office space, there is a hall with 200 seats, a specialized library, a safe for numismatics, as well as centers for facility management and security, kitchen and restaurant.

This facility has modern equipment for security systems, KGH control, telecommunication systems, access control, lighting control, multimedia systems, electrical control system, the system of structured cabling, IP

network and the Internet, management and visualization, integrated BMS software and systems for special purpose facilities.

3.1. Electronic security facility

The electronic security system of the building of the National Bank of Serbia in Slavija consists of multiple systems that are inter-related by hardware and software, which is managed and controlled individually and is supervised centrally via SMS system (Security Management System) that other systems are hierarchically subordinate to.

Electronic security system consists of the following systems:
- Anti-burglary system;
- Closed-circuit television (CCTV);
- Access control;
- The system for managing and controlling the status of doors in restrictive areas;
- Central monitoring of the security systems.

3.1.1. Anti-burglary system

Anti-burglary system consists of the computer, central units, operating consoles, gateway, printer, address input elements, address control elements, sensors, cable installations and components for assembly.
There are two anti-burglary panels with 8 addressable loops each, out of which 14 were used. The panels are located in the Control Center (KOC – Kontrolni centar), under the supervision of employees from physical and technical security (FTO) and anti-fire alarm security (ZOP) departments. Supervision of the work of the entire system as well as the management is carried out via a PC which is also in the Control Center. There is a gateway for the concentration and flow of information between the panels, PC and central monitoring system. Address loops connect 176 addressable elements with four addresses or about 700 zones. The loops are fully controlled and monitored.

There are sensors installed, such as infrared ultrasonic motion detectors, passive infrared motion detectors, glass break detectors, ambient, seismic detectors, alarm rails, magnetic contacts, alarm buttons and other. Sensors are installed in all places where it is possible or where unauthorized entrance is expected into the building premises and facilities whose content and purpose is of special importance. Installation is carried out with halogen-free signal cables. Installation and distribution cables are laid at S shelf of the cable tray envisaged for the installation of weak electricity. The power supply for central units is realized via rechargeable batteries that are found in panels or through diesel generators.

PC Computer and Gateway is powered via UPS placed in the room of the Control Centre. This system allows for each event or incident, either automatically or after a call of the operator to get a graphical representation of the micro and macro location of the incident, emergency plan and the like. Anti-burglary system is connected with hardware connections (RO-PP) with a CCTV system so that the selected monitor gives an image of the place of incident.

3.1.2. CCTV

CCTV system is designed for video surveillance of all entrances to the building, perimeter (adjacent to the building), protective inner circumferential channels in the underground part of the building, entrance halls and vital corridors, communication in underground garages, entrances to the premises and the rooms with vital contents regardless of their type, doors in restricted areas, area in front of the treasury, and the like. There is video surveillance system consisting of a central video matrix 176/32, 2 PCs, 10 quad processors, 4 multiplexers, 11 digital video recorders, video printer, monitor wall (6x55"), the power block for continuous operation (RO-E and UPS), 155 camera places in the building, 46 infrared reflectors, cable installation, components for assembly.

Central units are located in three RACKs in the Control Center where there is 24-hour duty. The CCTV system, besides permanent control, responds to each incidental situation so that the monitors show images of the incident area. The system performs continuous capture of images from all the cameras to digital hard recorders which are high quality and reliable. All cameras and video monitors are in color, except the cameras in circumferential channels, which are black and white and communications that have the ability to transfer from black and white to color, depending on the brightness levels. There are also IC reflectors that provide visibility to the cameras even in complete darkness. The position and optics of the programmable cameras can be controlled remotely from a PC (RO-DK).

CCTV system is connected with hardware connections to the anti-burglary system (RO-PP) and the interphone system (RO-I), and via the central monitoring system with the access control system for the management and control of the status of doors in restrictive areas (CF9000) so that the selected monitor shows the image of the incident place.

3.1.3. Access control

The system is designed to control entry to the building, certain facilities and premises of importance. In addition, this system registers time attendance and movement of the employees in the Security Department during regular facility checks. This system controls access to more than 90 doors in the building. The system consists of a PC, hub, 31 controllers, "proximity" readers, fingerprint readers, "proximity" card and cable installations. Central PC controls the system, receives data from the reader and programs the right to use employee cards. Central PC is located in the Control Center and the terminals at checkpoints are connected through an autonomous computer network of the facility.

PC Computers are powered by the UPS, while controllers have their own rechargeable batteries and are powered via a diesel generator. Through the CF9000 system, access control system is integrated into the central monitoring system for facility security. Access control system is connected to the system for calculating the salaries through the computer network of the facility.

3.1.4. The system for managing and controlling the status of the door in restricted area

This system includes a door that is security door (locked permanently or outside working hours) and, in case of fire, it serves as an evacuation door (continuously open), and doors which require remote control from the Control Center (lock/unlock), which have a special regime of entry, chamber door at the entrance to the area pertaining to the Control center, at the entrance to the very center, at the entrance to count rooms, the revolving door at the entrance to the building and others. The system operates and controls 29 doors in the underground area, 10 facade evacuation, 11 in restrictive areas above ground, 3 pairs of chamber doors at the entrance to the Control Center area, at the entrance to the very Center, at the entrance to count rooms, and 6 rotating doors at the entrances to the building.

The doors are equipped with special electric or electromagnetic locks that automatically or manually unblocked remotely, via the automatic fire detection system, the control board or a personal computer through which it continuously monitors the status of the doors. Command desktop, personal computer and the controllers are located in the Control Center. Through modules for data acquisition, CF9000 system for managing and controlling the status of doors in restrictive areas is integrated into the central monitoring system for facility security.

3.1.5. Central security monitoring system

Central facility security monitoring system (Security Management System) is the integration of all the above mentioned systems in a single unit. The electronic security of the facility of the National Bank of Serbia, on Slavija, consists of multiple systems that are inter-related with hardware and software, which is managed and controlled individually and supervised centrally via the central monitoring system which other systems are subordinated to. Central monitoring system, the so-called LMSmodular system from Siemens, which is used in the building, consists of a central communications gateway (GW20.08) LMSModular software package (V2.46), two workstations (PC of high performance), protocol and a graphic printer and software license for employees control system and license PAK. All the equipment of the central monitoring system is located in the Control Center.

The central communication gateway GW20.08 provides network management, which consists of 8 different sub-systems and up to 4 workstations. Subsystems are two central devices for signaling burglaries and raids, central video matrix, the controller network of controller access (31 controllers), digital input/output system for connection to the control system of evacuation and security doors, and it can optionally connect fire-alarm system. Two units are connected to the Central monitoring system as workstations, one unit of the anti-burglary system and a network of units of access control system. The system can be easily expanded to support up to 20 subsystems in one-stage configuration, and up to 80 subsystems in a two-stage configuration.

Connection of the CCTV and the central system

As part of an integrated system of electronic security, the project envisages connection between the CCTV system and central monitoring system which is carried out via the appropriate port on the workstation for interactive and graphical access to all the electronic security systems, via a central communication gateway. The operator has the possibility to display the desired camera on the selected monitor by issuing a command or simply by clicking the mouse. Also, the operator should receive all the alarms from a central matrix, and should also have the possibility to certify and reset them. Color graphic terminals with the text part display automatically, after the outbreak of the incident, the location and layout of the facility, the base of each floor to the level of the said premises and, after the call of the operator, the image from the camera that monitors the endangered area. On the basis of any level, there are symbols that affect or form an integral part of the facility security system.

Connection of anti-burglary system and central monitoring
At the level of central monitoring of the microprocessor burglar alarm control panel, connection is made via the appropriate port to a workstation for interactive and graphical access to all the electronic security systems, via a central communication gateway. Color graphic terminals with the text part display automatically, after the outbreak of the incident, the location and layout of the facility, the base of each floor to the level of the said premises and, after the call of the operator, the image from the camera that monitors the endangered area.

Connection of the access control system with the central monitoring
At the level of the central monitoring system, the access control is connected via the appropriate port to connect to a workstation for interactive and graphical access to all the electronic security systems, via a central communication gateway. Color graphic terminals with the text part display automatically, after the outbreak of the incident, the location and layout of the facility, the base of each floor to the level of the said premises and, after the call of the operator, the image from the camera that monitors the endangered area.

Connection of system to manage and control the status of evacuation and security doors in restrictive areas with the central monitoring
At the level of the central monitoring system, the system to manage and control the status of evacuation and security doors in restrictive areas is connected via the appropriate port to connect to a workstation for interactive and graphical access to all the electronic security systems, via a central communication gateway. The corresponding number of status information from the system to manage security and evacuation door will be collected via a digital multiplexing i/o system. Color graphic terminals with the text part display automatically, after the outbreak of the incident, the location and layout of the facility, based on each floor to the level of the said premises and, after the call of the operator, an image from the camera that monitors the endangered area.

3.2. Automatic fire alarm

Automatic fire detection system protect all areas except sanitary and toilets, their hall, the waste channel, circumferential channels that are flame-resistant and space between floors that have the following characteristics:

- Ceiling height of less than 0.8m;
- No lines for security devices;
- The units which have maximum dimensions 10x10m;
- The fire load of less than 25MJ/m2.

In particularly high-risk areas, inergen fire extinguishing or fire fighting sprinkler systems with water or ansulex fire extinguisher is activated. In spaces that are extinguished with inergen, there is complete protection with automatic fire detectors that automatically trigger the extinguishing. In the space which is equipped with water sprinkler systems in the underground part of the building (it is activated by thermal ampoule), automatic fire detectors are not provided. In these areas, there are handheld fire detectors and automatic report of the fire through registering extinguishing using signals from indicators at the appropriate fire-alarm report panel. In the space which is equipped with water sprinkler systems in the above ground part of the building (it can be activated with thermal ampoule),it has also the fire alarm systems with automatic fire detectors and extinguishing registration using signals from indicators at the appropriate fire-alarm report panel. Flow indicators are arranged so as to correspond to the fire sectors. In space where fire is extinguished with ansulex in the thermal kitchen, and are activated automatically or manually, regardless of the applied system of automatic fire report, automatic fire detectors are not provided, but registering the beginning of fire extinguishing with the signals from the control cabinet. Due to the exceptional importance of the object, as well as the high concentration of equipment and a big number of employees, devices of the latest generation of microprocessor technology are implemented.

This system includes the following equipment:
- In the place of possible fire incident, setting up "intelligent" fire detectors uniquely addressed;
- D-BUS to connect detection lines;
- Anti-fire panels (PPC);
- Control console located in the Control Center and the intervention group;
- C-BUS to connect the PPC;
- Concentrator (gateway) for communication between panels with workstations;
- Workstations;
- Relay module for the management of systems for secondary fire protection;
- Input module for the confirmation of executive functions or the status of the door.

Consequently, a distributed system of organization of the panels for automatic fire detection and extinguishing activation with inergen was implemented. There are two communication C-BUSs, which form two independent loops, one for alert report, other one for the activating fire extinguishing. Each loop is closed physically through two vertical ascents. This solution provides a high degree of safety in systems in case of accidents and outages of devices, for example cable break on the C-BUS is immediately registered in the central panel, and communication is continued, even in the event of total failure, C-BUS PPs continue individually with their autonomous operation. This solution is applied to the detection line, D-BUS's.

Logical and physical structure of the applied system are completely separate, which allows the actual physical structure, i.e. detectors to connected in lines with the rational management of cables (shortest route), and within logical structures to be addressed and grouped in a software-defined fire zones and fire sectors that further dictate executive functions of PP systems.

3.3. Chiller plant room

The facility also includes two independent chiller plants depending on the work regime of individual consumers who use cooling energy. Chiller plant 1 is used for providing cooling energy of all spaces for general purpose (offices, halls, restaurant, etc.). Chiller plant 2 is used for providing cooling energy to the computer center and other facilities which operate 24 hours (on-call service, etc.).

Chiller plant 1
It consists of water-cooled centrifugal chillers. There are three chillers with power of 754 kW. The units are parallel connected. Through the evaporator of each aggregate, flow is made with independent pumps. The flow through the network to the consumer is achieved with network pumps. Terminal units (chillers) are regulated via motor pass-through valves which gives a variable flow in the network. Some of the chillers are provided with three-way motor valve which prevents the possibility of network pumps working without the flow. There are three possible network pumps (two working, one standby) with variable flow. Variable flow rate is achieved by changing the pump speed by varying the frequency of the power supply. Water for cooling the chiller condenser is prepared in cooling towers placed on the roof of the building. There are three cooling towers (one for each aggregate) coupled in such a way so that each of the three towers can work with any unit. The towers are controlled via two-speed fan. Prior to filling the water in the towers, there is chemical treatment in terms of adding polyphosphates to prevent the formation of scale and dosing of biocides to prevent the formation of algae. The pressure in the system is made through the water pressure booster system with pumps with overflow safety valve and the water tank.

Chiller plant 2
It consists of two air cooled chillers located on the roof of the building. Chillers have additional heat exchanger for cooling water in winter mode without the compressor ("free cooling"). The chillers are packaged type with built-in centrifugal pumps and expansion vessel. Within the cold water, the system is filled with a mixture of water and glycol of concentrations of 35% in order to prevent freezing in winter mode.
Cold water from these aggregates supply chillers of air-conditioners in the computer centre and chillers of chambers of duty services.

In summer mode, cooling energy is provided by compressor operating in aggregates. In the transition regimes, cooling energy is provided in part through the "free cooling", and in part with compressor operating in the winter mode only via "free cooling", without the compressor. Since this chiller plant cools locked rooms with a large internal heat gains that require cooling throughout the year, such mode of operation provides the maximum operating economy.

3.4. Electricity lighting management

Management of electric lighting is done:
- Locally via pushbuttons and pulse switches;
- Automatically (turning off) by the presence detector and microprocessor devices;
- Remote (turning on/off) permanently or periodically.

In most of the offices, there are two circuits to power lamps (network and diesel engine). For each circuit, there is a switch by the door which acts on impulse switch mounted in the junction box in the cabinet, in the false ceiling of the corridor. Touch switch is for voltage control of 230V, 50Hz and is a bi-stable device with a contact for signaling the status on and contacts for remote control. Local control is done by pressing the switch, where the light is on or off depending on the previous state. For the purposes of automatic control of FAN-COIL units in each room, there is one microprocessor device mounted below the parapet mask of the window. This device is used, besides regulation, for power savings, in such a way as to have one presence detector in each room, which is connected to the microprocessor device. In the event that nobody is present in the room for a certain time (adjustable to a desired value), the microprocessor device turns off the lamps. When re-entering the room, an employee may, if needed, turn on the light.

Remote control of the lighting in the offices is done through impulse commands, which are realized through a central system for remote monitoring and management of technical systems (CSNU). Control is performed as a function of time (time of day) and the reference brightness levels in normal working conditions in the facility. In case of emergency actions of the security services, the entire lighting in offices and other facilities on the floor can be activated. During the holidays, it can remotely turn on all the lights on the facade walls of the facilities.

Remote control allows that, in certain times of day and on the basis of the reference level of brightness, the electric lighting be reduced, in such a way that the impulse command turns off the first network light that is turned on, and then the light that is supplied through diesel generators. After turning off the light, it can be turned on again in every office locally as desired and needed.

3.5. Central monitoring and management system

For the purpose of automation of work, remote monitoring and management of technical systems in the facility, central system for monitoring and control is implemented (CSNU).

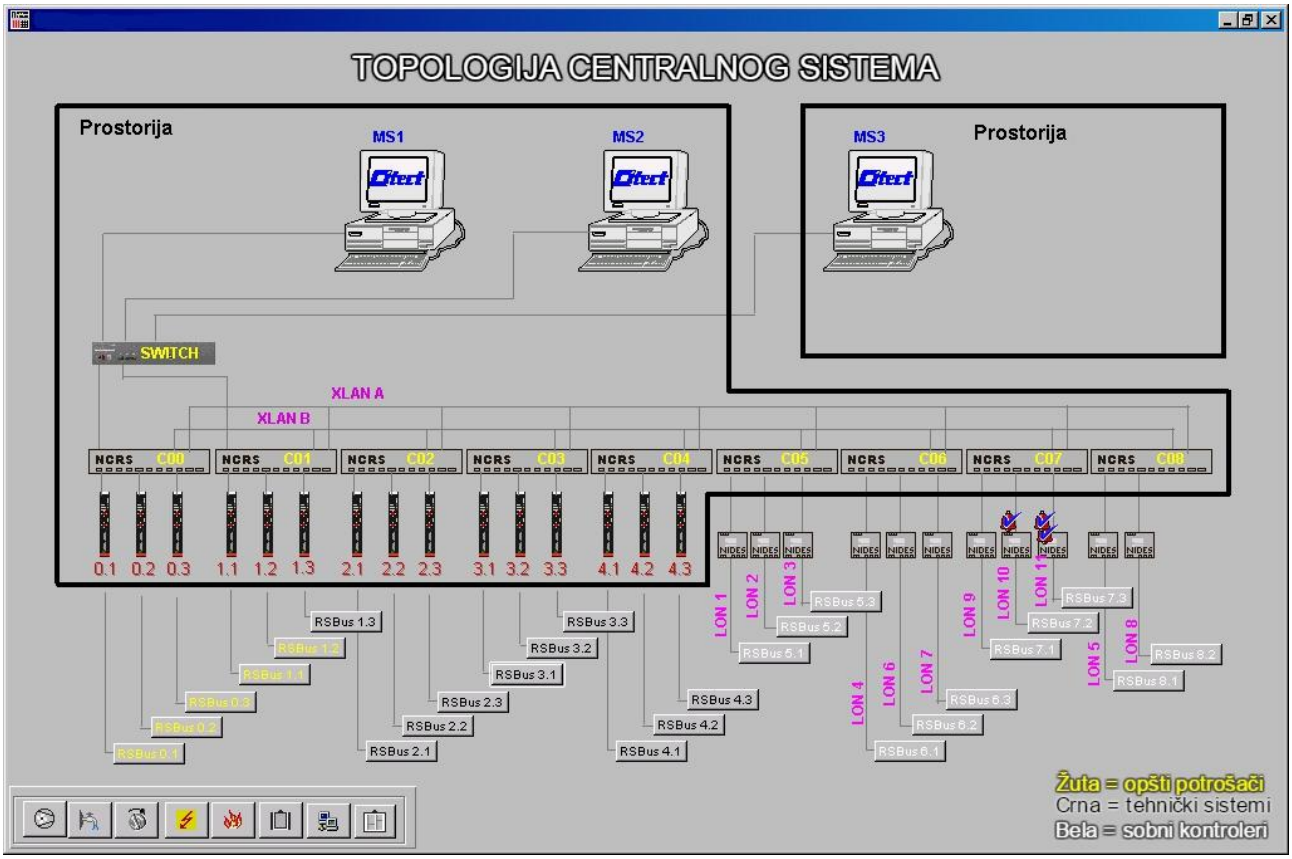

Figure 2: Topology of the central system (CSNU)

Central monitoring and management system (CSNU) performs the following functions:

- Remote control of all technical systems in terms of measurements (temperature, humidity, pressure, etc.); counting hours of operation, signage system operation (status), signaling the state of emergency, alarms (frost, motor protection, voltage failure, etc.);
- Remote software management of systems as a function of time and events;
- Direct (digital) control of parameters of the air and water to the desired set value with the possibility of remote control changes of the set value from the central computer;
- Optimization of consumption of heat, cooling and electricity (without disturbing the comfort conditions in the facility);
- Automatically collect data about conditions and events in the technical systems in time to analyze the work of preventive maintenance and servicing;
- The ability to represent the operator, in real time, all events on the color display in the form of a dynamic images with the current conditions of controlled sizes;
- Automatic printing and the protocol of the printer;
- Display graphics based on data collected in time;
- A modem (network) communication;
- Different levels of access to system functions depending on the jurisdiction.

The central communication gateway GW20.08 provides network management with different sub-systems and workstations. Interactions are possible between the subsystems connected directly to gateway and the locally connected I/O modules. Incoming messages can trigger one or more command messages to other subsystems.

Supported protocols:

- CDDL/CMSDL for LMS/CMS — up to 9600 baud;
- Cerban (CZ10, CC11, CS4, CS440, CC6, CC60) — 300 or 600 baud;
- ISO 1745 MK-7022/Cerloop — 1200 or 2400 baud;
- CMX-DL — up to 9600 baud;
- CCTV Burle (Philips-Burle) — 1200 baud;
- CCTV Siemens — 9600 baud;
- SEEP (Westinghouse SExxx) — up to 9600 baud;
- CerPass — up to 9600 baud;
- CDDL/CDSF (other control units) — up to 9600 baud;
- Stäfa port V2.0 or V3.0 NISE — 9600 baud;
- CDDL/CDSF FHI-pad (other host) — up to 9600 baud.

4. CONCLUSION

The energy crisis and the need for energy conservation, has resulted in a very rapid and remarkable development of technical systems that help us to effectively manage energy consumption. Buildings are the single largest consumers of energy, and thus the major pollutant of the environment.

Serbia is in Europe one of the countries with the highest level of energy consumption in buildings. The middle consumption per square meter of the building is about 2.5 times higher than in northern Europe, while half of households consume 340 kWh/m2 per year, which is 3 times more than in Western Europe. Chronic diseases, including respiratory diseases, are directly linked to significant pollution of the interior space. Serbia has an international obligation to save at least 9 percent of gross final energy consumption by 2018, and it should also reduce carbon dioxide emissions by the same amount by 2030. Using scientific and technological development, we are able to save significant amounts of energy in buildings.

The system for automatic control of smart buildings accounts for only three per cent in the price of the facility, and after five to seven years, it begins to "to earn". The savings that the system can achieve is in a range of 15 to 35 percent. If it is a large business facility, such as building of the National Bank of Serbia in Belgrade, there are huge savings in money and energy consumed. With automated and integrated technical systems, we realize significant cost savings and energy consumption, but also increase comfort. With the development of internet technologies (ADSL, cable DSL, satellite and mobile internet, etc.), there is a possibility of connecting smart buildings to the Internet and remote access devices in the system. This means that in a

simple way, wherever you are, you can access any device in the system to obtain information about the current status of all devices and control any of these devices.

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Elektro projekat izvedenog objekta, Projekti integralne elektronske zaštite, Mapa 1- opšta dokumentacija.

Elektro projekat izvedenog objekta, Projekti integralne elektronske zaštite, Mapa 2 - protivprovalni sistem .

Elektro projekat izvedenog objekta, Projekti integralne elektronske zaštite, Mapa 3 - nadzorna televizija (CCTV).

Elektro projekat izvedenog objekta, Projekti integralne elektronske zaštite, Mapa 4 - kontrola pristupa.

Elektro projekat izvedenog objekta, Projekti integralne elektronske zaštite, Mapa 5 – sistem za upravljanje i kontrolu statusa vrata u restriktivnim prostorima.

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AMBIENT INTELLIGENCE TOOL FOR MULTIMEDIA USER PROFILING

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Abstract: *This paper presents a model for creating a multimedia user profiling tool. The idea is to create an open source profiling tool that is mainly for developers and users with advanced computer knowledge Multimedia user profiling tool should be a very important part of a personalized intelligent home media center. Presented model is Linux based, easy to implement and easy to enhance. Additional user profiles can be introduced and existing ones can ban configured on a way user wants. In addition, rules for certain behavior can be configured and rules can be assigned to a user profiles. System is using ambient intelligence as well as rich users' database to record environment variables and user's behavior in correspondence to the variables. Presented model is distributed and each of the components has its own settings and it can be easily configured, enhanced or, even, replaced with a new component. At the end, system is using external APIs to gather the data about the movies in order to find an appropriate content for the user and to offer multiple movie titles for the user. Default system settings are using Netflix API, OMDB database and movies trailers API.*

Keywords*: Ambient intelligence, user profiles, artificial intelligence, smart home, multimedia center.*

1. INTRODUCTION

This paper presents a model for creating multimedia user profiles based on user habits, free time, expectations and things users like. Presented profiling tool should be a part on a personalized intelligent home media center. The idea is to track user's behavior, habits and all accessible data about the user in order to create a user profile that is as rich as possible. A well-formed user profile gives an opportunity to offer an appropriate multimedia content to the user. Also, predefined user profiles can offer new users a content that might be interesting to them. That means, for example, if user loves to watch thrillers with a good IMDB grade on Friday night, exactly that kind of content should be offered to the user. The tool should store all the data that can be found about the user. In that purpose, a lot of external APIs should be contacted. External APIs connectors should be modular and easy to develop and configure. In that purpose social network APIs (LinkedIn, Facebook, Twitter...) and as well as others accessible (YouTube, forums...) APIs are contacted and used. Introducing new APIs is easy configuration part of the system. Tool is, on scheduled time, contacting all available APIs and gathering the data about the user. Data is stored in MySQL database which is implemented on a very modular way. User profiles and prediction rules are available in the system. Second peace of the puzzle is user's behavior. Each time user plays some multimedia content, content length, genre, age, actors, producers, etc., is stored as well as external factors such are time of the day, weather, date, amount of light in the room, etc... Combination of these parameters allows the system to track what user likes or dislikes. Also, based on existing user's data and data gathered from external APIs, when new user is logged in, or a user without no too much data already stored is using the system, tool can automatically offer some multimedia content to the user which may or may not be appropriate to the user, but from the very beginning forces the user to enrich his profile. For displaying multimedia content and searching multimedia content database system uses external APIs. This part also is, also, very modular and easy to change. Default system configuration is using OMDB movie database and YouTube APIs to gather multimedia content data, Movie Trailer API for getting movie trailers and Netflix and YouTube APIs to play multimedia content.

2. LITERATURE OVERVIEW

Precise identification of users, their attributes and interests is the most important thing of the prediction and personalization systems. There are theories that say that what users do on social networks is highly connected with their interests and approaches in real life. For example, pictures users are posting on social networks can tell about their interests and how they feel currently. *You, Q., Bhatia, S., & Luo, J. (2015).*

User experience with some software is highly connected with how software adopts to the end-user. Categorizing users by their behavior and creating user categories out of their common habits brings end-user experience on a highest level and helps users easily adapt to the software. *Katerina, T., Nicolaos, P., & Charalampos, Y. (2014).*

With today's technique it's very easy to gather user's data out of everywhere. For example, new approaches are using a smartphone application to gather data about the user. Background applications that does not bother user are used to collect data about the user. Different sensors and components which smartphone has, such are GPS receiver and Bluetooth can be used in order to collect data about the user. *Eskes, P., Spruit, M., Brinkkemper, S., Vorstman, J., & Kas, M. J. (2016).*

User profiling is a commonly used approach. It helps users to feel comfortable using application, but it has some privacy concerns. Personalized informational systems and user profiles, bring on one side, great user experience, but on the other hand big privacy risks in terms of sharing your habits and data with third parties. *Parra-Arnau, J., Rebollo-Monedero, D., & Forné, J. (2014).*

Smart homes are becoming more and more common thing. But, now challenges are different. It's not anymore the idea to adopt users to a smart home. Now the idea is to have a smart home that adapts to the user. Smart home providers should survey needs of a user and create a smart home that fits user's needs. *Luor, T. T., Lu, H. P., Yu, H., & Lu, Y. (2015).*

Intelligent home media centers are becoming more and more convenient. Comparing to a classic home media center or a dvd player, an intelligent home media center has more options, better user control and user experience as well as better coverage of multimedia formats it can play. *Đurić, I., Ratković-Živanović, V., Labus, M., Groj, D., & Milanović, N. (2015).*

There are several researches about how user's mood can be connected with their opinion about some movie. For example, depending on user's current mood, they can like or dislike some movie. Also, depending on user's mood, users will want to watch different genres of movies. Recommendation approaches for movies should be changed and now it should take into the account user's mood in order to offer an appropriate content to the user. *Winoto, P., & Tang, T. Y. (2010).*

Choosing a movie to watch can be a boring and long work. It happens to users that they don't have any idea what they would like to watch and they cannot find a good recommendation online. One of the approaches for recommending appropriate movie content to the users uses hybrid combination of movie tags and ratings in order to offer the users a movie title they would like to watch. On that way time is saved and users can expect a movie title that could fit to their expectations,*Wei, S., Zheng, X., Chen, D., & Chen, C. (2016).*

Also, there are approaches using data mining in order to offer an appropriate movie to the user. One of such approaches uses as input arguments both movie attributes and user preferences in order to offer the right movie title to the user, *Thrasher, J. F., Sargent, J. D., Vargas, R., Braun, S., Barrientos-Gutierrez, T., Sevigny, E. L., ... & Hardin, J. (2014).*

Depending on a country we are, we can find different opinions are multimedia content appropriate for some users. For example, in some countries we can find an attitude that movies containing drugs, sex or violence are not an appropriate for young people to watch. On the other hand, in some countries that are more liberal such movies are considered an appropriate for all people to watch, *Moreno, M. N., Segrera, S., López, V. F., Muñoz, M. D., & Sánchez, Á. L. (2016).*

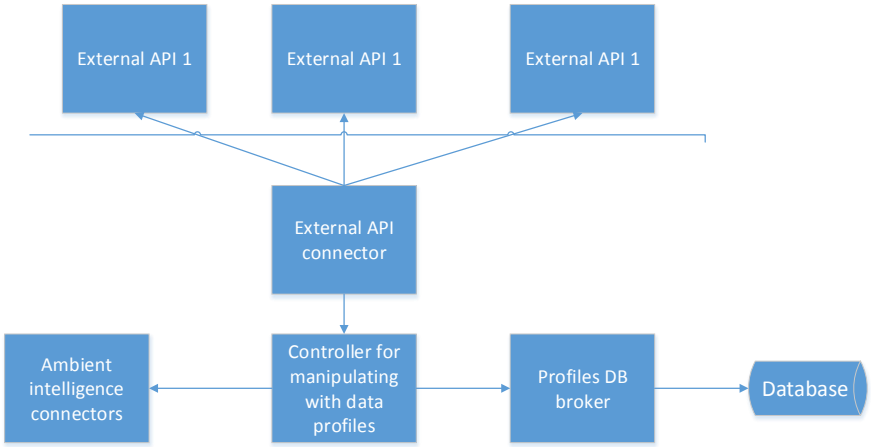
Thanks to increasing number of online multimedia services, users are each day less watching TV and turning to online TV services. Some of benefits online TV services are: watching what users currently want to watch, absence of commercials and some advanced features that are not present on the classic TV, *Lee, S. Y., & Lee, S. W. (2015).*

3. DEVELOPMENT

It is required to create a model for collecting user's data in order to make a user profiles database and a mechanism working with the database that is capable of distinguishing users by their profiles and to offer an appropriate content for the user based on his profile.

System should have the following components:

- External APIs connector
- Controller for manipulating with the data and profiles
- Ambient data collectors
- Profiles database broker
- Profiles database



Picture 1: System components

3.1. External APIs connector

External APIs connector should communicate with external APIs. It should represent the connection between Intranet and Internet. These APIs should be used to get the data that is appropriate to the user based on the requests received from profiles controller. External APIs connector should have a possibility to communicate with multiple APIs in order to get the content that is the most appropriate and as comfortable as possible for the user to evaluate and understand. External APIs connector does not need to have too much application logic behind it. It should have registrations for all the APIs that is contacting and order in which APIs should be contacted to maximize data quality and occurrence. On a high level of abstraction, we can split all contacted APIs to two major groups:

- APIs for collecting information about the user and
- APIs for getting multimedia content

APIs for collecting information about the user should be, mostly, social networks. These APIs should give the data about the user in order to find out as more as possible user habits, social and bio data.

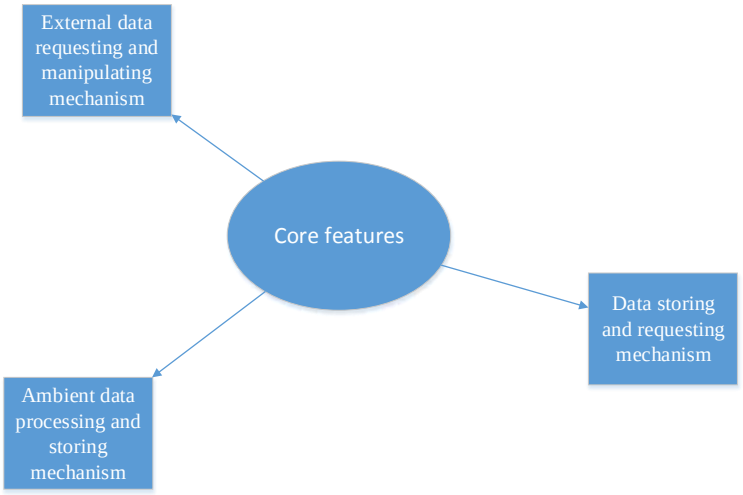
On the other hand, APIs for collecting multimedia content are not user specific. They should provide data such are movie trailers, movies and multimedia meta data such are IMDB grades, movie titles, length, directors, actors, etc.

3.2. Controller for manipulating with the data profiles

Controller for manipulating with the data profiles should do the most of „magic“. It should be the heart of the system and communicate with external APIs connector, profiles database broker and with all present ambient data collectors. Also, controller for manipulating with data profiles should contain all logic that is needed in order to process all the data.
It should contain several sub components:

- Data storing and requesting mechanism
- External data requesting and manipulating mechanism
- Ambient data processing and storing mechanism
- Core features

Model showing Controller’s components is displayed below:



Picture 2: Controller for manipulating with data profiles - components

The main idea of each of the components will be described in detail:

3.2.1. Data storing and requesting mechanism

Data storing and requesting mechanism will be in charge of communicating with profiles database broker. It should prepare data for sending to database broker to be stored or to prepare requests for getting data from the database broker.

Also, it should contain extensible components for mapping user profile data with the user habits. Data storing mechanism should have a possibility to store any data about the user.

3.2.2. External data requesting and manipulating mechanism

External data requesting and manipulating mechanism should do very similar thing as data storing and requesting mechanism, but with external APIs connector. It should prepare appropriate requests for external APIs connector and to manipulate with the data received from the external APIs connector.

3.2.3. Ambient data processing and storing mechanism

Ambient data processing and storing mechanism should process the data received from an ambient data collectors. It should investigate all the data, eliminate non useful and prepare all the data that could be useful for the system for sending to data storing and requesting mechanism.

3.2.4. Core features

Core features should balance with all sub components of controller for manipulating with the data. It should be „the brain„ of controller. All the data processed inside the controller for manipulating with data should be transferred over core features. That means that core features should be a connection between all other components in the controller for manipulating with the data profiles. This component should also have mechanisms to convert the data in all forms that are required to be understood by all other sub components of the controller for manipulating with data profiles.

3.2.5. Ambient data collectors

Ambient data collectors should receive all available data from environment and pass it to the controller for manipulating with data profiles. Ambient data collectors should be modular and easy to extend. These components should not contain any logic. They should simply transfer all collectible data to the controller for manipulating with the data profiles.

3.2.6. Profiles database broker

Profiles database broker should be a very simple component. It should be modular and easy to change or enhance. It should be unique for each database type that could be present in the system. Profiles database

broker should have CRUD operations implemented in order to allow core features to manipulate with the data from database.

3.2.7. Profiles database

Profiles database should be in a tight connection with the profiles database broker. Profiles database broker should communicate with the profiles database by storing data in the database and returning in on request from Core features. Profiles database should be implemented on a way that allows quickly getting the data from the database and easily storing the data.
Also, profiles database should have a structure that allows introducing new fields without changing the database structure. Structure should be implemented on a way that allows introducing new sensors, APIs and user attributes without a need for changing database structure or introducing new fields.

4. IMPLEMENTATION

This chapter explains how each of the components is implemented, in which technologies and why exactly each of the technologies is used and what benefits it has for the system. Common thing for all the components is that they are implemented on CentOS operating system. CentOS is chosen because it's stability, easy maintenance and big community that helps user's seeking for stable operating systems to find what they are looking for. All scheduled tasks are performed as cron jobs. For web interfaces Apache web server is used with modPERL because all the web interfaces are written in PERL. For frontend development HTML, CSS and JavaScript are used. Since system is made out of scalable components and it is not in user's interest that something goes wrong, a log of logic is placed on client side and it's a part of JavaScript code. This approach enhances scalability because it allows weaker servers to run the system because a lot of logic is done on a client side. Since, system is planned to be a part of internal user's network, there's no risk of hurting the system from the user's side. Also, Python programming language is used for collecting some data from the controllers.

For settings and configuration files XML notation is used. And, for web services, both REST and SOAP protocols are implemented in order to cover all the possible web APIs. Database engine that is used is MySQL.

4.1. External APIs connector

External APIs connector is a component made of one Perl script and several additional XML files. The idea is to allow users to register an additional API connectors. Since external APIs connector does not need to have knowledge on how to process received data, only thing it needs to understand is what to connect and what data to expect. That's why additional APIs can be registered as an additional XML files. PERL script, after receiving a request of which API to contact, replaces passed arguments with already defined placeholders and returns a response from an external API to the requester. It also has some mechanisms to prevent malicious data to enter.

Request can be sent out via two web service protocol REST and SOAP.
When new API is registered via XML, preferred web service protocol should be chosen. For contracting external APIs, this script uses REST::Client Perl library to contact REST services and SOAP::Lite library to contact SOAP based web services.
Preferred mechanism for replacing input arguments for web requests with data is through PERL template toolkit. Template toolkit is a Perl developers preferred way because it allows users to send different variables in any wanted order, as long as their names are unique. External APIs connector is returning a hash of response values.

4.2. Controller for manipulating with the data profiles

Controller for manipulating with the data profiles is also written in Perl and uses xml files for configurations as well as web interface. Each of the controller's components will be described in detail.

4.2.1. Core Features

Heart of controller for manipulating with the data profiles is core features. Role of Core features is to do an orchestration: to control all the other components and to contain all the logic on how to deal with user profiles. Since understanding of user's behavior can be changed, all conclusions and further actions after conclusions are configurable and easy to extend or maintain. This is done also through configuration files. User can add new configuration file or edit an existing one. Configuration files are XML files. Configuration file should contain the following information:

- Rule priority - As higher rule priority is, this rule will be considered more important.
- Rule conditions: List of conditions that should be accomplished or not accomplished In order for rule to kick in.
- Number of occurrences for rule to kick in: Depending on this parameter, rule will kick in when number of occurrences is breached
- Actions: Actions which will be performed after previous conditions are accomplished

Rules can be assigned to user profile. That means, if user has some profile assigned, all rules assigned to a profile will be applied for a user. User can have zero or more profiles assigned to him. Profiles are assigned when user's behavior is accomplishing all the profile conditions. Since checking profile conditions takes a lot of time and resources, it is done once per day on a scheduled time. Profiles rebuild script is running as a cron job.

For example, profile might be called "Youngster" and have the following conditions:

- User is younger than 22 years
- User has Facebook and Twitter profiles
- User is watching more than 70% his movies after 22h
- User is watching mostly comedies (more than 60% movies that user is watching are comedies)

Also, several default profiles are be provided. These profiles are used for users who still do not have a lot of data collected in the system. These rules are simpler and their main point is to predict how user will behave based on actions of previous users that used the system.

4.3. Ambient data collectors

Ambient data collector is an expandable list of the components. It contains one main script for running data collector files that are already configured. When new script is added, an xml registration should be introduced. XML registration contains name of the script that should be run and expected output data. For example, default setting contains script for amount of the light in the room. Each time user starts a multimedia content amount of light in the room is measured and stored. At the end, ambient intelligence data collector is returning all possible data information to the core features and waiting for a new request. When request is received, this component is opening all configuration files and running each of the configuration files on a selected way. Using PERL Template Toolkit is also supported.

4.4. Profiles database broker and profiles database

Profiles database broker is storing all collected data in the database. It is also returning all the requested data about the user. Profiles database broker represents a PERL script which is selecting the data out of the MySQL database. Script has only CRUD (Create, Read, Update, and Delete) operations. All additional and more complicated operations should be performed on the Core features side.
Since, user's data is highly configurable, only basic user information is stored in separate columns. All configurable user data is stored in one column in JSON format. On that way user's data can be easily expanded with new information without changing database structure. Database, by default, has only two tables:

- Users and
- UsersBehavior

Users table contains all the data about the users. It has several fields like user name, id, gender and date of birth and additional field called custom user data. Custom user data contains all custom user data collected by external APIs. This might be user's Facebook, Twitter on LinkedIN profile data as well as data user has entered manually through web interface.

Other table is called UsersBehavior. UsersBehavior has columns id, user_id, date_time and custom_data. Same approach for storing custom data in JSON format is used.

5. CONCLUSION AND FUTURE PLANS

Presented framework is an open source, easy to maintain, self-hosted solution.
Benefits that presented approach has are:

- If new social network is introduced, framework will easily adopt to it
- It can be easily combined with Internet of Things
- User can configure the system by his own needs
- System can learn from the users and as much it is used, it will work better

- Any movie player can be used with the system because prediction and play mechanisms are separated
- System does not require an expensive hardware
- It does not require licenses or any payments
- It is distributed in several separated units
- It is highly scalable and can work on almost the same way with any number of users
- Thanks to Linux operating systems in background, it is highly reliable and should not stop working in any conditions

Constraints of the presented framework are not big, but implementation like this definitely has them. They are the following: Since a lot of components are used and system is highly distributed, it takes a lot of developer's or, at least, Linux administration knowledge to setup the system. That's why this implementation won't be attractive to the users who do not have a big Linux knowledge. Other similar solutions have their own installers that are easy to run and setup. On the other hand, setting up a system like this will take several hours of setting up components and installing missing Linux packages System upgrade and setup is very easy thing to do, but it's not simple at all. To setup an additional API for receiving the data, user at least must understand XML files to setup host name to contact, web services to choose an appropriate way of contacting the service and PERL template toolkit in order to choose which components will be sent to the server and which will be received and how will they be processed Additional profiles are also a little bit complicated to introduce because they require XML knowledge and good prediction mechanisms in order to predict how system will react on new settings. Also, adding a wrongly configured user's profile could cause whole system to work on inappropriate way

Some extensions require Python or PERL knowledge in order to introduce additional data received from sensors and, optionally, to involve some actuators to make an environment more comfortable for the user

If we take all the previous points in to the count, we can say that presented framework is a highly configurable system, mostly made for power users who have a solid developer's knowledge. On the other hand, it's a nice starting point for new developers or students who do not want to start from stretch with creating their own implementations, but have nice ideas that could be easily implemented and could have some benefit in multimedia world. Since whole project is an open source and available to change or enhance, the author hopes that other developers will join the project and try to make it even better.

Similar solutions relay on heuristics and systems usually try to learn what user's want to see and get. Presented solution uses a different approach. Instead of telling users what they want, it allows them to configure what they want to get based on their behavior. This approach is harder, but it might lead to precise suggestions.

Similar solutions are mostly working like black boxes with their own APIs and hidden logic. Presented solution is fully opened to the users and tries to motivate the users to configure it by their own needs and wishes.

In future, framework should be much better and bigger. It should come up with fa lot of predefined profiles by default which could help users to start using the system on a right way after installation. It should also be preconfigured to work with several external APIs in order to help user's to set up the system by their own needs.

Regarding settings, new version should use web interface for introducing additional settings and profiles instead of XML files. Also, all other possible setting and configurations should be done through the web interface.

Since system installation is very complicated, system should, in the next versions, come with an installer which can install all the components on several Linux distributions, and as well, to setup it's own Linux distributions out of an image. It should also install automatically all dependencies and components in order to work on a default way.

And last, and maybe the most important thing to introduce in the system is a central Cloud storage for the data. Cloud storage should contain new profiles, rules, API connectors and scripts for manipulating with sensors. The main goal of this approach is to allow user to choose a component or a rule they like and to automatically install in from the Cloud.

Also, Cloud should work and vice-versa. Users should have an option to share their own code and settings in order to help other users to easily configure the system and to get the best possible user multimedia user experience.

New version approach should motivate users who do not have too much experience in development to start using the system and to interest them in multimedia user profiling.

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USING BIG DATA ON LARGE DAMS

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Abstract: *Large dams are structures of great importance. Dams are used for power generation, irrigation, water supply and control of water flows. Improvement of the system for monitoring dams increases the number of data for collecting. Existing relational database can't handle large amounts of data and it is necessary to implement new technologies like big data, Cloud, Iot (Internet of Things). Use of Big data allows processing of large amounts of data in real time and it is possible to get real state of dam. The goal of this paper is to describe big data concept and present possible application of big data on large dams in order to improve the system for monitoring and data analysis.*

Keywords*: Big data, Large dams, Serbia, hydrology, monitoring, IoT*

1. INTRODUCTION

Process of monitoring and collecting data is very important for dam management. The collected data are used to predict the behavior of dam which is very important for dam safety management. Dam safety and reliability of instruments are affecting the entire eco-system in the area of the dam.
Risk of dam damage increases with dam age, so it is necessary to constantly improve the system for monitoring and dam safety, in order to avoid unwanted disasters (Association of State Dam Safety Officials, n.d.).
Most dams in Serbia were built in the 60s and 70s of 20th century. Most dams have monitoring systems which dates back to the time when the dams were built. Because of the age of dams it is necessary to improve the system for monitoring. One way of improving system is the implementation of big data concept in process of storage and data process. Big data is generated from everything what surround us in every moment (Big data, n.d.). It is produced by every digital process and exchange of social data. Systems, sensors and mobile devices are all used for data transfer. Big data comes from different sources with alarm speed in large volume and different variety. To process big data it is necessary to have computers with optimal process power, analytic ability and skills.

2. GLOBAL USE OF BIG DATA

Big data is a term which means large and complex sets of data, where traditional application for data process can't be used (B. Radenković, M. Despotović-Zrakić, Z. Bogdanović, D. Barać, A. Labus, 2015). Those sets of data are characterized by the diversity of formats, high speed processing and access and large amounts of information.
Big data have found different application in various fields. Further in the paper big data application in the world will be explained.
Rao, BBP et al. describes application of IoT (Internet of Things) in combination with Cloud and Big data (Rao, BBP ; Saluja, P; Sharma, N; Mittal, A ; Sharma, SV, 2012). Authors describe IoT as set of all data which surround us connected to the Internet. When all devices are connected to the Internet and between themselves, they enable complex and smart processes and services which give support our basic needs, economy, environment and health. Devices connected to the Internet offer different services which produce large sets of data and information. Cloud computing is explained by the authors as a model which enables on-demand access to shared configurable resources. Cloud platform enables access to the devices which surround us anywhere anytime. Application which communicates with devices like sensors, requires large storage to store big data, big process power to process data in real time and high throughput network which enables streaming of audio and video. In this paper, authors also describe Sensing as a service on Cloud which use several application like Augmented reality, Agriculture monitoring and environment.
Sowe, SK et al. explain appearing big data as key point of connecting between objects and things on the Internet (Sowe, SK; Kimata, T; Dong, MX; Zettsu, K, 2014). In that cyber-physical space, different type of sensors affect through the wireless network, collecting data and providing services for monitoring of

environmental pollution, management and recovery of disasters, improving of home life and enabling operation of smart cities. Usage of smart devices brings with it certain challenges like designing infrastructure to collect and store different types of product, finding practical application of collected data from sensors and management of IoT community so the end user can easily search, find and use the information. Authors propose IoT integrated architecture which combines functionality of Service-Controlled Networking (SCN) and cloud computing.

Big data is topic that is studied and will be studied for many years. Sets of data increase more and more, because they are collected with ubiquitous computing, mobile devices which read data, technologies of antenna sensors, remote reading data, logs of software, camera, microphone, RFID readers, wireless sensor networks (WSNs), etc. (Huang, Y; Ma, XQ ; Zhang, YD; Liu, YY, 2015). Big data has changed the way we collect and store data, enabling devices for data storing, architecture of data storage and mechanisms for data access. Cloud computing migrates application software and database on large centers of data, where data and service management may not be entirely reliable. Storage is one of problems that stop growth of Cloud. To solve the problem facing big data authors discuss about Cloud storage platform based on MapReduce for Big data.

Big data is concept of modern age that is used for processing large amounts of data from different fields medicine, remote monitoring, support services, etc. (Srivathsan, M; Arjun, KY, 2015). Prognostic computing is connected with Big data analytics and like a process, can require collecting, processing and analyzing extreme large amounts of structured and unstructured biomedical data, which comes from different experiments collected form hospitals, laboratories, pharmaceutical companies, and even social media. The results of predicting can improve efficiency in providing a better life for people.

In this paper authors give overview of background of Big data and overview on related technologies like Cloud computing, IoT, data centers and Hadoop (Chen, M; Mao, SW; Liu, YH, 2014), then focus on 4 phases of the chain value of Big data, generate data, acquisition, data warehouse and data analyses. Each phase is covered in detail along with description of the latest developments in these fields. At the end of paper authors describe several reprehensive application of big data including company management, IoT, social networks, media application, collective intelligence and smart networks.

Recently, water policy direction is changing from a typical plan for water usage and flood control to a sustainable water management, in order to improve quality of life (Kim, Yonsoo; Kang, Narae; Jung, Jaewon; Kim, Hung Soo; , 2016). These changes consist of information which is associated with water resources like data sets, management and supplying. All those resources are very important for deciding about water resource policy. Rae, Kang Na et al. have analyzed structured data according to type of usage. This study suggests an application of big data and cloud computing in field of water resources and usage of water. Data in this study are related to Korea and nearby countries.

3. MONITORING

Monitoring of the dams is important in process of dam management. Monitoring of dams is very important because it effects on dam operation and safety. If dam safety is disrupted, catastrophic consequence can happen for the people and surrounding eco-system. The process of dam monitoring includes significant number of sensors, which measurements are stored in database. In Serbia, system of monitoring dates to the tame when the dams were built.

Several dams (Djerdap I (Iron Gate I), Gruza …) started process of modernization of system for monitoring using new technologies and software (Lj. Petrović; S. Djurić, 2008).

Most dams use relational databases. Relational database can store limited set of data. Using new technologies like WSNs (wireless sensor networks) and intelligent sensors, amount of data is extremely increasing, which complicates the storage process and processing.

Data processing is also an important item for dam management safety. With data processing and simulation models, it is possible to predict the behavior of the dam and help in dam management.

On dams, there are different types of sensors which perform a variety of measurements. Some of sensors (instruments) are shown in next table.

Table 1: Measuring instruments

Measuring value	Measuring instrument
Pressure of groundwater	Piezometer with manometer Tele-piezometer
Relative movement of dam	Coordinometer Tele-coordinometer
Change of dam slope	Clinometer with vertical base Clinometer with horizontal base Tele-clinometer
Work of expansion joints	Deformeter
Air temperature	Thermometer for air

The following figure shows current mode of operation of piezometer, i.e. how piezometer collects data. Piezometer measures value and temporarily store data in Data taker in XML format and then acquisition server takes raw data and stores them in relational database. Central server takes data from acquisition server, validates data and store them also in relational database. End-users use utilities for taking data and analyze them and report on their computer.

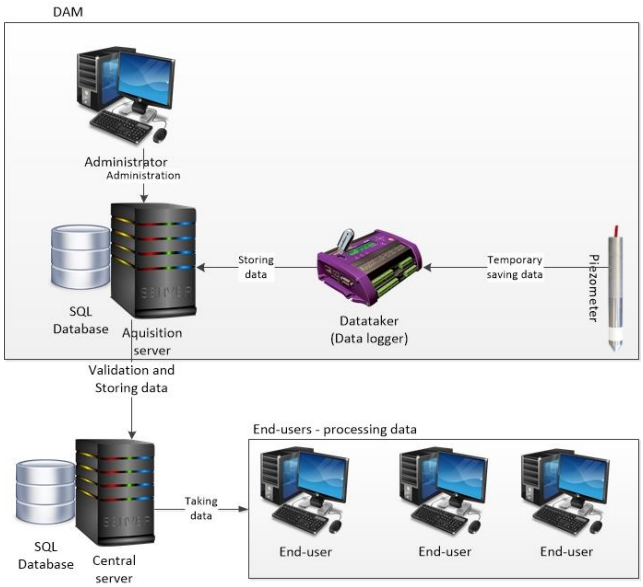

Figure 1: Monitoring on Large Dam

This way of collecting and processing data can work for databases which are smaller than 1TB and whose process doesn't require real time data process and use of current measured data. For processing large amounts of data and use of current measured data it is necessary to implement big data concept.

4. BIG DATA

There are "four V's" that characterize big data: Volume, Velocity, Variety and Veracity (Sathi, 2012).

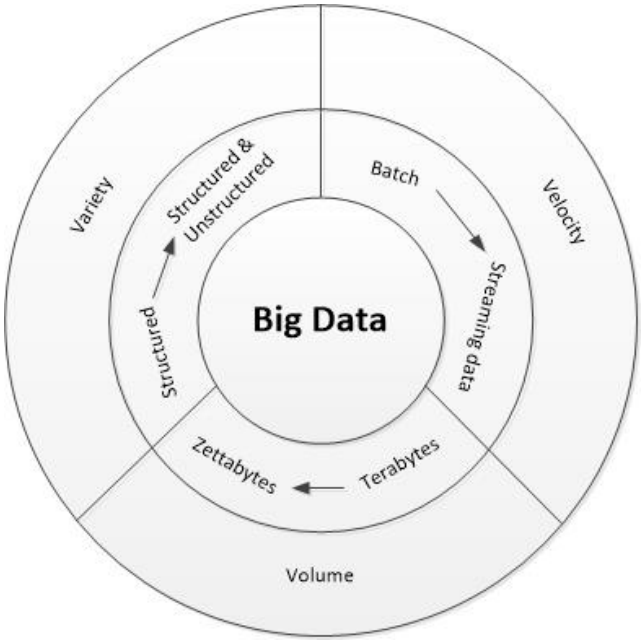

Figure 2: Big data (adopted from (Patel, 2013))

4.1 Volume

Most large companies are faced with the problem of increasing amounts of data. According to Fortune magazine, until 2003, 5 Exabyte of digital data was created. The same amount of data was created in 2 days

in 2001. For 2013 it was expected that this amount of data will be created in 10 minutes. In the past decade, organizations have had databases that are used for analytics and measured in terabytes. Today those organizations have databases measured in petabytes.

4.2 Velocity

There are two aspects related to the speed. One presents speed of data flow, and another latency.
The amount of global data that is transmitted through mobile devices rose up to 78% of total growth and is expected to reach 10/8 Exabyte per month in 2016, because users share more pictures and videos. To analyze this data, it is necessary to improve the infrastructure, which requires larger pipes and doing more parallel process.
Latency is the second measure of speed. Earlier, analytics operated on the principle of "store and data report" and makes reports with yesterday data. Today, analytics is included in business processes using fresh data with reduced latency.

4.3 Variety

In the last decade of 20th century, when the technology of Warehouse was rapidly introduced, the initial movement was to create Meta model which will represent all data in one standard format. Data was collecting from different sources and processing with the help of ETL (Extract, Load, and Transform) process. The basic idea was narrow range and structured content.
Bid data has greatly expanded the horizons, which allowed for new data integration and analytics technologies. Data sources contain unstructured text, sounds and videos as opposed to structured data. An example of enabling technologies is IBM's InfoSphere Streaming platform, which faces with various sources of real analytics and decision making, including medicine instruments for neonatal analyses, seismic data, CDR's, network events, RFID tags, patterns for traffic, time data, mainframe logs, voices on different languages and videos.

4.4 Veracity

Unlike the carefully ordered intern data, the most of big data comes from sources outside of control. Such data are not reliable and one is facing a defective and incorrect data. Veracity of data presents both credibility of data sources and similarity of the data for the target audience.

5. HADOOP

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 (Hadoop Apache, 2016). It was made to scale up from single servers to thousands of machines. Local computation and storage can be made on each machine individually. Rather than rely on hardware to deliver high-availability, the library itself is designed to detect and handle failures at the application layer, so delivering a highly-available service on top of a cluster of computers, each of which may be prone to failures.

The project includes these modules:
- Hadoop Common: The common utilities that support the other Hadoop modules.
- Hadoop Distributed File System (HDFS™): A distributed file system that provides high-throughput access to application data.
- Hadoop YARN: A framework for job scheduling and cluster resource management.
- Hadoop MapReduce: A YARN-based system for parallel processing of large data sets.

Other Hadoop-related projects at Apache include:
- Ambari™: A web-based tool for provisioning, managing, and monitoring Apache Hadoop clusters which includes support for Hadoop HDFS, Hadoop MapReduce, Hive, HCatalog, HBase, ZooKeeper, Oozie, Pig and Sqoop. Ambari also provides a dashboard for viewing cluster health such as heat maps and ability to view MapReduce, Pig and Hive applications visually along with features to diagnose their performance characteristics in a user-friendly manner.
- Avro™: A data serialization system.
- Cassandra™: A scalable multi-master database with no single points of failure.
- Chukwa™: A data collection system for managing large distributed systems.
- HBase™: A scalable, distributed database that supports structured data storage for large tables.

- Hive™: A data warehouse infrastructure that provides data summarization and ad hoc querying.
- Mahout™: A Scalable machine learning and data mining library.
- Pig™: A high-level data-flow language and execution framework for parallel computation.
- Spark™: A fast and general compute engine for Hadoop data. Spark provides a simple and expressive programming model that supports a wide range of applications, including ETL, machine learning, stream processing, and graph computation.
- Tez™: A generalized data-flow programming framework, built on Hadoop YARN, which provides a powerful and flexible engine to execute an arbitrary DAG of tasks to process data for both batch and interactive use-cases. Tez is being adopted by Hive™, Pig™ and other frameworks in the Hadoop ecosystem, and also by other commercial software (e.g. ETL tools), to replace Hadoop™ MapReduce as the underlying execution engine.
- ZooKeeper™: A high-performance coordination service for distributed applications.

Next figure presents related technologies to Hadoop.

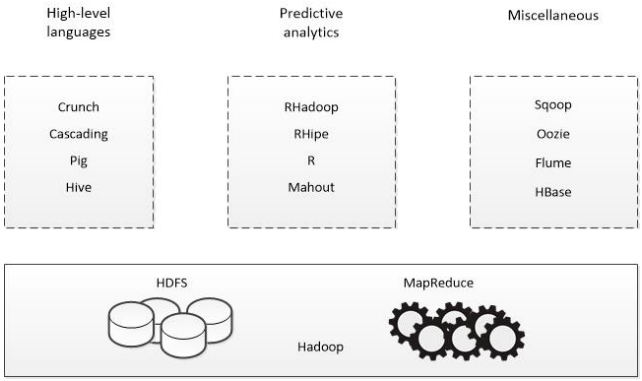

Figure 3: Hadoop related technologies (adopted from (Holmes, 2012))

Hadoop proper, as shown in Figure 4, is a distributed master-slave architecture that consists of the Hadoop Distributed File System (HDFS) for storage and Map-Reduce for computational capabilities. Traits intrinsic to Hadoop are data partitioning and parallel computation of large datasets. Computational capabilities scale and store with add in of hosts to a Hadoop cluster and can reach volume sizes in the petabytes on clusters with thousands of hosts (Holmes, 2012).

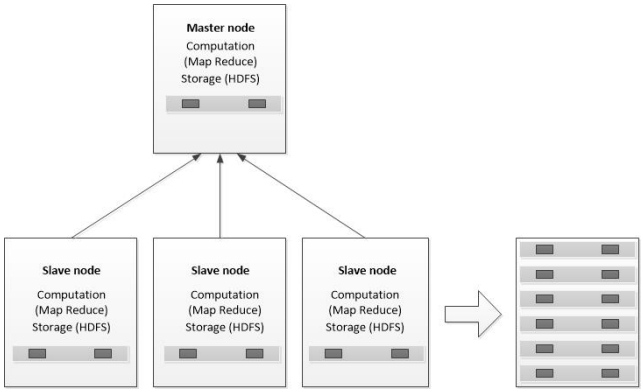

Figure 4: Hadoop architecture (adopted from (Holmes, 2012))

6. BIG DATA ON DAMS

Modernization of the instruments for monitoring requires the use of big data. Use of new, advanced and modern measuring instruments generates much larger amounts of data than the current situation, which can multiply size of database. Databases with hundreds of gigabytes will reach the size of over 1 terabyte. For processing these databases it is necessary to have computers with excellent performance, i.e. big process power. Implementation of Cloud concept would solve the problem of data processing.
Following figure shows suggestion of big data architecture on large dams.

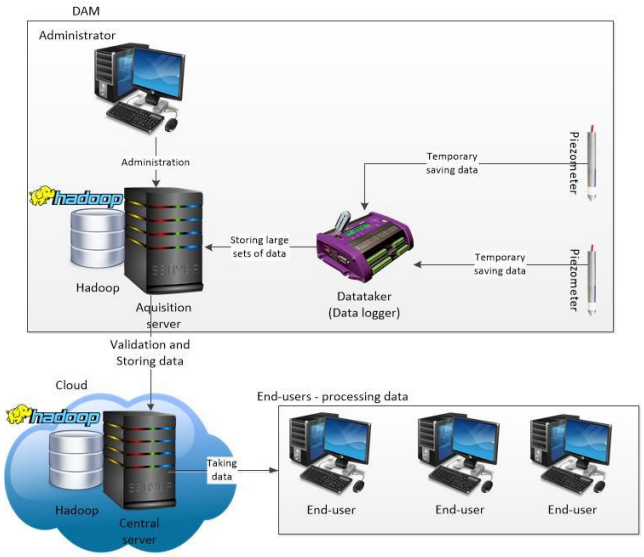

Figure 5: Hadoop integration in monitoring of dams

Process of collecting data is the same as before the implementation of big data. New process of monitoring is different because it uses big data concept and Cloud computing instead of relational databases. Use of Cloud computing allows the use of computer with better performance. Cloud enables faster data processing. Data processing in real time is of paramount importance for the prediction of the behavior of dams. Figure 5 shows measuring instrument Piezometer, which measures pressure of ground water. Measured data are temporarily recorded in data logger. From data logger, data are being transferred through computer network and stored in Hadoop database (HBase). The synchronization process is performed between Central and Acquisition server. End-user executes different tools (Mahout, Ambari, etc.) on Central server to analyze and utilize data in real time. Analyzed data will be used as input parameters for further simulation models of dam's behavior. In the case of natural disasters, such as floods, data processing in real time can help in the water resource management and reduce the possibility of damaging the dam to a minimum.

7. CONCLUSION

Dam monitoring is very important in dam management. Since dams in Serbia are old and of good quality, it is necessary just to improve the monitoring process.

Monitoring process can be improved by implementing new measuring instrument, which requires new approach in dam operating. Data process in real time and use of simulation models can predict dam behavior in some cases, which can lead to a more effective response in the event of natural disasters and save thousands of lives as well as the eco-system.
Use and application of big data concept improves process of dam management to a much higher level, increases dam safety, enables data process in real time and better prediction of dam behavior.

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TRAFFIC FLOW WEB MONITORING BASED ON THE MONGODB

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Abstract: *Monitoring traffic flow is very important not only for monitoring purposes, but also for predicting possible causes of traffic accidents. Use of sensory devices allows easy data collection, but involves processing of large amounts of data, also called Big Data. Data query and statistical analysis are becoming less efficient with the growing amount of data. The aim of our paper is to present a new approach to data storing and processing in the traffic field. We collected data from automatic traffic counters (ATC) at ten checkpoints and stored it in a NoSQL MongoDB database. The main features of such database are flexibility, strength, speed and ease of use that have enabled us to create a reliable web application for monitoring traffic flow in real time. Applying this model, we were able to overcome the problems connected with rapid and efficient processing of collected data.*

Keywords*: Web application, MongoDB, NoSQL, Big Data, Traffic flow*

1. INTRODUCTION

Contemporary information and communication technologies and intelligent devices such as sensors provide traffic and transport systems, a steady inflow of enormous amounts of data. Intelligent transportation system (ITS) is a real-time, accurate and efficient integrated system for transport, traffic monitoring and management (Xiao et al., 2009). ITS have received much attention in recent years (Tarapiah & Atalla, 2015). Nowadays, the problem is not collecting data, but the difficulties in storing and processing of continuously increasing amounts of data. Big Data has been swiftly expanding into the transportation arena (Vlahogianni, Park, & Van Lint, 2015) and sensors are becoming ubiquitous (Aydin, Hallac, & Karakus, 2015). The enormity of Big Data is not confined only to velocity and volume, it is also reflected in the variability, variety, and complexity of the data. The velocity and volume of the data within traffic systems make it difficult for typical algorithms to scale and retain their real-time characteristics (Hayes & Capretz, 2015). The emergence of Big Data technology has changed the view of many scientific fields, including the field of transport (Shi & Abdel-Aty, 2015). It is expected that Big Data technology in traffic systems will make possible advanced behavior monitoring of the traffic system, identification and analysis of anomalies in its functioning (Hayes & Capetz, 2015), as well as automatic rerouting of traffic in case of congestion prediction, dynamic change of speed limits, detection of hazardous road conditions, more efficient processing of heterogeneous traffic accidents data and their consequences (Kumar & Toshniwal, 2015), construction of smart cities, faster reacting to damage to roads, etc.

In order to collect traffic data, automatic traffic counters are used (ATC). ATC devices measure relevant traffic parameters such as the number of vehicles, vehicle length, vehicle classes, vehicle speed, the lane in which the vehicle is moving. The model of ATC that we used, QLTC C-10, has a 1 GB SD card for data storage. Memory capacity enables the device to capture 1 (one) year of traffic data. After this period, the data is automatically overwritten. In addition, the device integrates a GSM / GPRS module, that connects one or more devices via the public network GSM 900/1800. It allows the user to monitor and collect traffic information from a distance. Traffic data and system information may be obtained remotely or manually using a PC and a GSM modem or automatically using a QLTCnet server. However, this device enables powerful and modern solutions for surveillance and traffic monitoring.

After data collection, the next thing that needs to be reliable in the application is certainly the database. Regardless of the application which is created for any device type, there must be an appropriate database. Applications store more and more data and access it at higher rates. However, the larger the amount of data, the slower the relational database operates. That is one of the reasons for the increased utilization of NoSQL databases in recent years (Khan & Mane, 2013). Generally speaking, a NoSQL database is one that uses a different approach to data storage and access when compared to relational database management systems (Lourenço et al., 2015). These databases provide the ability to store data in a single file so that multiple processors do not slow down operation of the database. Because of that, read and write functions operate more rapidly. NoSQL databases are used to solve two major problems: Big Data problem and searching

large amounts of data. As regards the type of data, MongoDB can incorporate any data while providing all the features needed to build any apps. If the database runs on a single server, it will reach a scaling limit. MongoDB scales adding more servers, and it was designed to work with commodity servers. MongoDB is relatively new in information systems which are not based on tables, schemes, SQL Query Language, or columns and rows. Likewise, transactions, ACID properties, joining functions do not exist in the MongoDB. The essential characteristics of the MongoDB are flexibility, strength, speed, and ease of use. For these reasons, we have decided to work with NoSQL MongoDB, which will enable us to handle the large amounts of data collected by automatic traffic counters.

The aim of our paper is to present a new approach to data storing and processing in the traffic field. The concept of the system is based on precise traffic counters, namely the QLTC-10C, and on modern telecommunications and information technologies, which enable reliable publishing of traffic data in real time on the web. First, we collected traffic data from ten measuring points, that are the result of traffic counts throughout 2015. The data generated by traffic counters are stored in textual (.txt) files. After that, we created a web application, which enables traffic flow monitoring and reporting on the state of traffic through automatic counter devices. With the appropriate technology, rapid and efficient processing of collected data is provided. The web app contains the main indicators of traffic flow and graphically displays data for the selected measuring point in the observed period. Some of these indicators are average daily traffic (ADT), annual average daily traffic (AADT) and monthly average daily traffic (MADT), as well as minimal speed, maximal speed, average speed of vehicles, etc.

2. TRAFFIC DATA AND IMPORTANT INDICATORS FOR MONITORING AND CONTROL

In the model that we propose, we decided to use the aforementioned automatic traffic counters. For each registered vehicle, ATC creates a record in the text file during the whole day (24 hours). An example of a text file generated by ATC is presented in Table 1. The first column shows the *Vehicle ID*, followed by *Date*, *Time*, *Channel* which takes a value of 0, 1, 2, 3 depending on the order in which the vehicle runs into the loop, *Lane*, which takes a value of 0 (vehicle in lane 1) or 1 (vehicle in lane 2), *Vehicle category* which refers to one of eleven vehicle classes, *Vehicle speed* in km/h and *Vehicle length* without correction factor measured in cm. At 10 measuring points during 2015, all ATCs generated 365 files, each file containing between 4.000 and 14.000 records, more than 35 million records in total.

Table 1: Daily data text file generated by ATC

Vehicle ID	Date	Time	Channel	Lane	Vehicle category	Vehicle speed [km/h]	Vehicle length[cm]
00001	01.01.15	00:04:30	0	0	A1	46	473
00002	01.01.15	00:05:16	0	0	A1	34	363
00003	01.01.15	00:06:19	0	0	A1	36	407
…	…	…	…	…	…	…	…
02467	01.01.15	23:58:15	0	0	A1	45	380
02468	01.01.15	23:58:23	0	0	A1	58	428
02469	01.01.15	23:58:28	0	0	A1	84	325

The following indicators are important for monitoring and traffic control that will be implemented in the web application: minimum vehicle speed, maximum vehicle speed, average vehicle speed for each measuring point, the total number of vehicles, average daily traffic (ADT), monthly average daily traffic (MADT), annual average daily traffic (AADT). Also, an overview of velocity distribution and a graphical overview of the total daily flow of traffic compared to the same period of the previous year will be enabled.

AADT estimation is fundamental to the analysis of transportation data sets and the management of transportation systems. AADT is used as an important basic data in the traffic and road sector (Ha & Oh, 2014). By monitoring these indicators, anomalies in the traffic system can be detected, and identification of factors that influence causing of traffic accidents on the observed road section can be made.

3. MODEL DESIGNED FOR MANAGING BIG DATA IN TRAFFIC

The total amount of collected data by automatic traffic counters is 15.4 GB. Due to a large amount of collected data that needs to be stored, as well as the speed of data processing, we decided to consider Hadoop Big Data platform and MongoDB database. It should be noted that if the data model is not flexible, it can slow down development.

Using the collected data, we considered which of these solutions is more appropriate for web application development. We chose MongoDB, which unlike Hadoop, is designed for real-time processing, and can also store a massive amount of data, while data processing at the time is performed on a small subset of data. Another advantage is processing time, which is measured in milliseconds.

QLTC-10C, the model of sensor that is used, can be equipped only with the unit solar cells (16 to 20 W), as can be seen in Figure 1 and the battery cell (12 Ah), which is sufficient for autonomous operation. It is designed for low voltage, with an electric power consumption at an integrated GSM / GPRS module of less than 120 mW.

The device is placed in a plastic roadside cabinet that protects the hardware against mechanical and atmospheric influences.

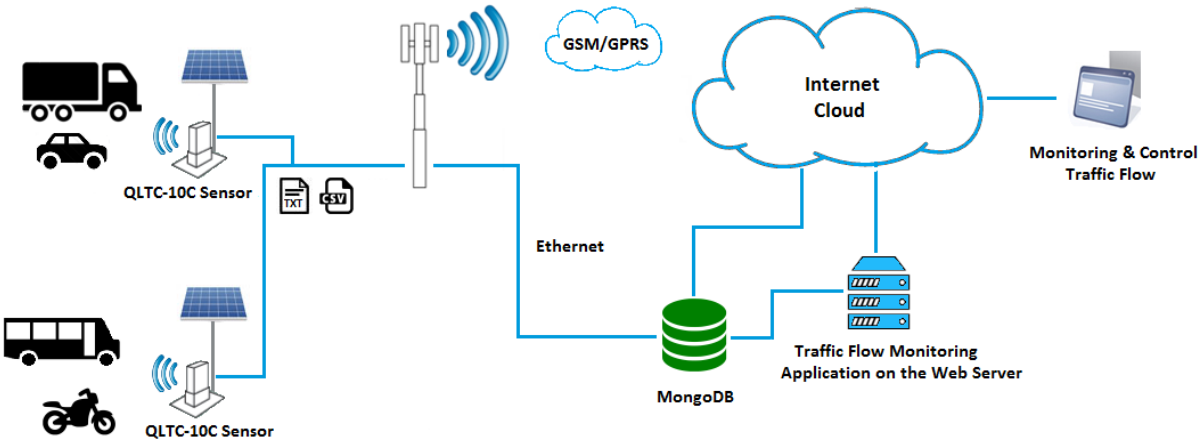

Figure 1: Model for managing Big Data in Traffic

By using the product software QLTCnet for a sensor device, it is possible to adjust the options that will execute transfer of the collected data in the required format. QLTCnet allows automatic transfer of data from remote locations using a public GSM / GPRS or private Ethernet network. Data is stored in a powerful NoSQL database. The database can be local, or it can be stored in the cloud.

Maintenance software enables fast handling of vehicle counters QLTC-10C. It allows configuration of device parameters, control of the device operation, data transmission in the standard .csv format. The device can be handled directly from the USB interface or remotely via a public GSM / GPRS network. The software consists of several modules. Each module is a standalone application that can be used separately from the other modules. Such an approach means that administration can be simplified since it requires less powerful laptops. Also, it allows faster loading of data, and enables easy adaptation to the specific needs of users.

The generated files are sent in the proper format .txt, .csv via the GSM / GPRS network or Ethernet to MongoDB as shown in Figure 1. Another key concept of MongoDB is that there must always be more than one copy of the database. If one database ceases to operate, the system will immediately take a copy from another server, and will continue to function normally. MongoDB uses JSON, XML or BSON, which is the binary-encoded serialization of JSON format to query and store data (Rupali & Aggarwal, 2013). It is important to note that MongoDB is not ideal for all types of problems. However, for many things, such as web application development, MongoDB is a great solution for the implementation of the database.

4. PROGRAMMING THE WEB APPLICATION AND MODEL IMPLEMENTATION

In this section, representative parts of the web application code, as well as its GUI will be shown. In the model implementation, we have used PHP language that is especially suited to web development and can be embedded into HTML.

Connection to the database.

```
function db_connection(){
                $conn_string = new MongoClient("mongodb://147.91.183.26:27017");
                $db = $conn_string->selectDB("traffic_db");
                return $db;
        }
```

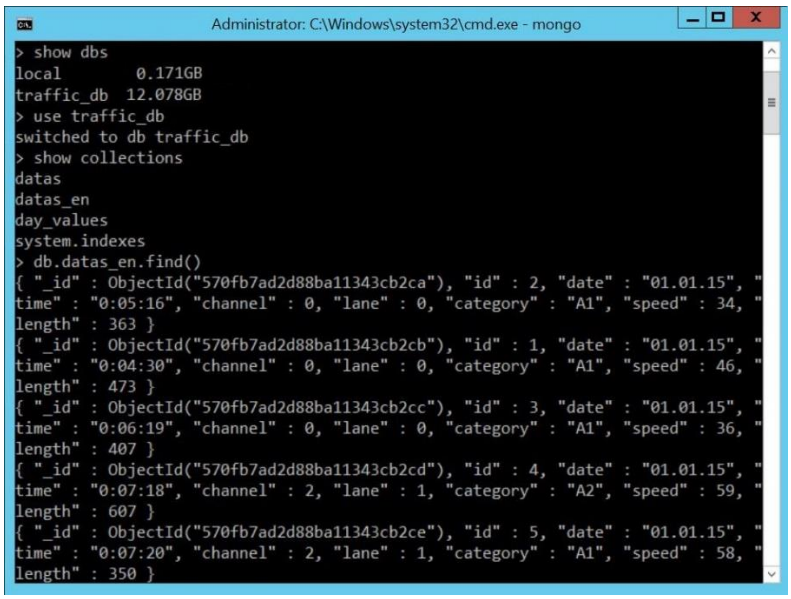

Figure 2: Review of collected data stored in MongoDB

Figure 2 shows traffic data collected by ATC. If we want to list all existing databases and chose the database that will be used, that can be done with the following code.

```
showdbs
use traffic_db
```

Two more lines of code, in order to show all collections and data respectively.

```
show collections
db.datas_en.find()
```

In order to use the web application, the user must log into the system. After the user successfully logs in, the startup screen appears as shown in Figure 3. At the top of the form, there is a menu that has three options: Data, Chart, and Exit. Data is related to the initial screen that the user can return to at any time. To view traffic indicators, the user enters the checkpoint parameters (selected from the combo box) and the period of observation. All checkpoints are loaded at startup form. In the fields for the observed period; the user must enter the start and the end date. Afterwards, he must check lane, at least one category of vehicles and an indicator such as a minimal speed, maximal speed, average speed, total number of vehicles, traffic volume. If the user checks velocity distribution or traffic flow, these indicators will be displayed in charts. By clicking on the submit button, the results will be shown on the right side of the same form as shown in Figure 4.

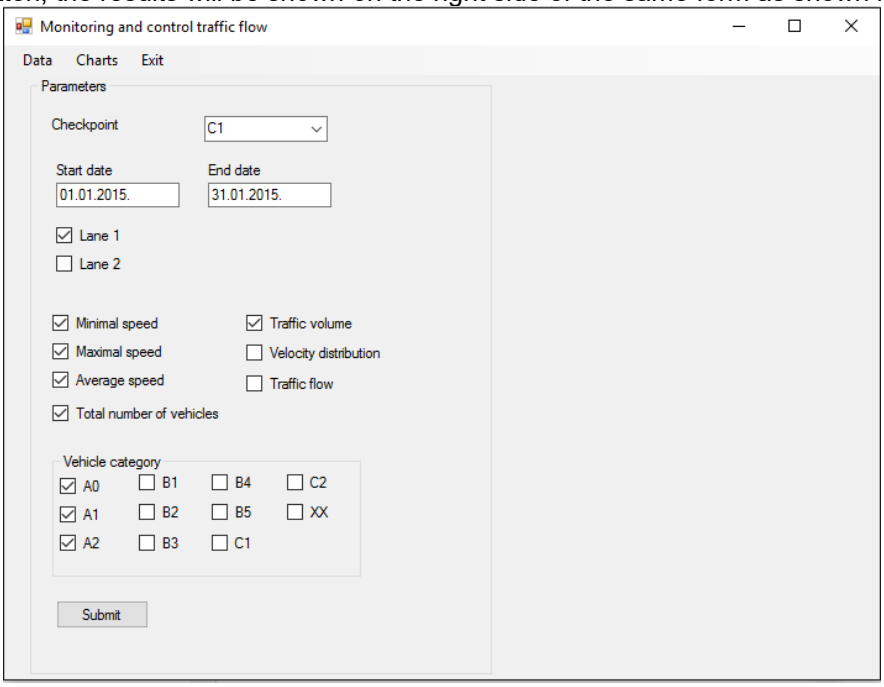

Figure 3: Startup screen of the web application

If the traffic volume is selected, parameters such as average daily traffic, monthly average daily traffic, and annual average daily traffic are shown as a group. These indicators are one of the essential for measuring air pollution (Jerrett et al., 2014).

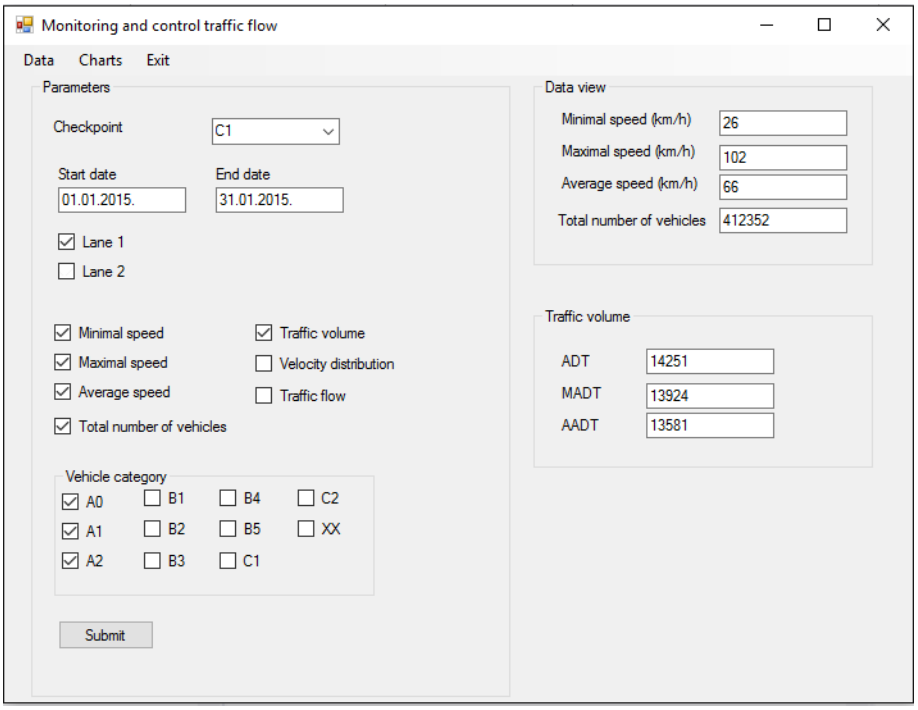

Figure 4: View of selected data

The user can easily change parameters within the same form and click on the submit button for a new view of the data. Displaying the charts is possible by selecting the velocity distribution and/or traffic flow within the parameters in Data window. The same chart view is enabled by selecting the menu item Charts from the top menu.

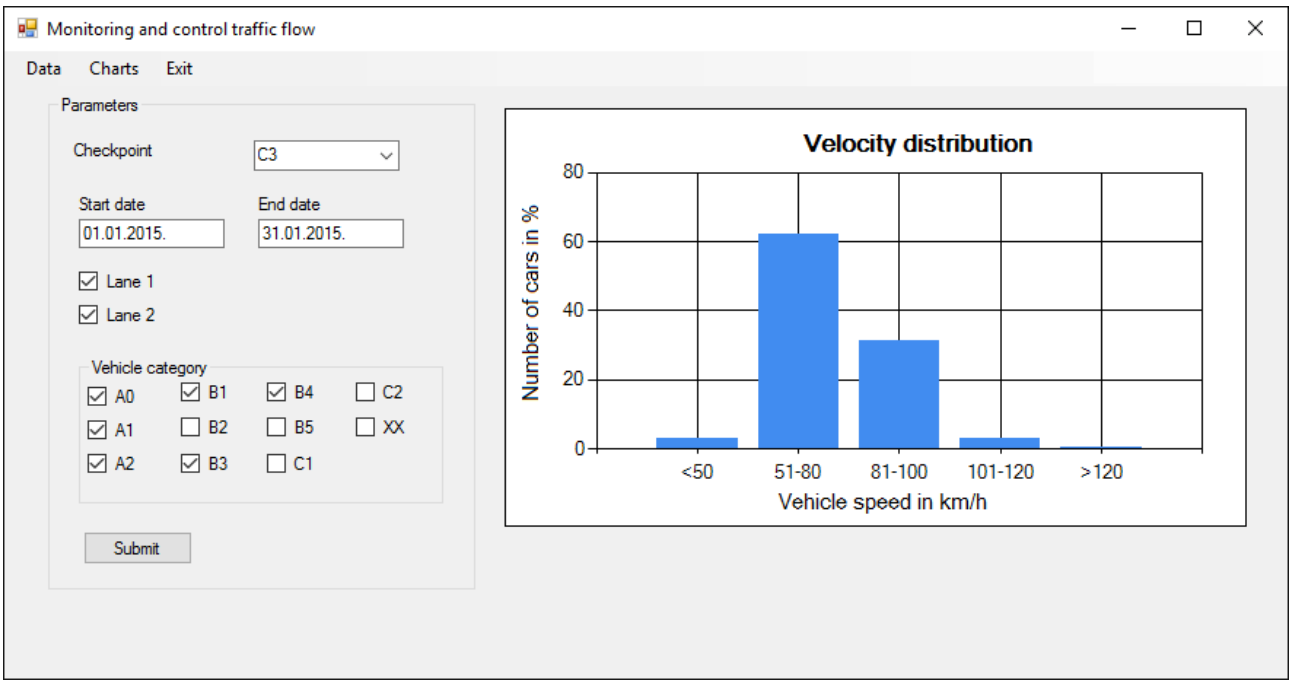

Figure 5: Chart of velocity distribution

Figure 5 shows a column chart for vehicle velocity distribution for the observed period, more specifically January 2015, checkpoint C3, lane 1 and lane 2, for categories of vehicles A0, A1, A2, B1, B3, and B4.

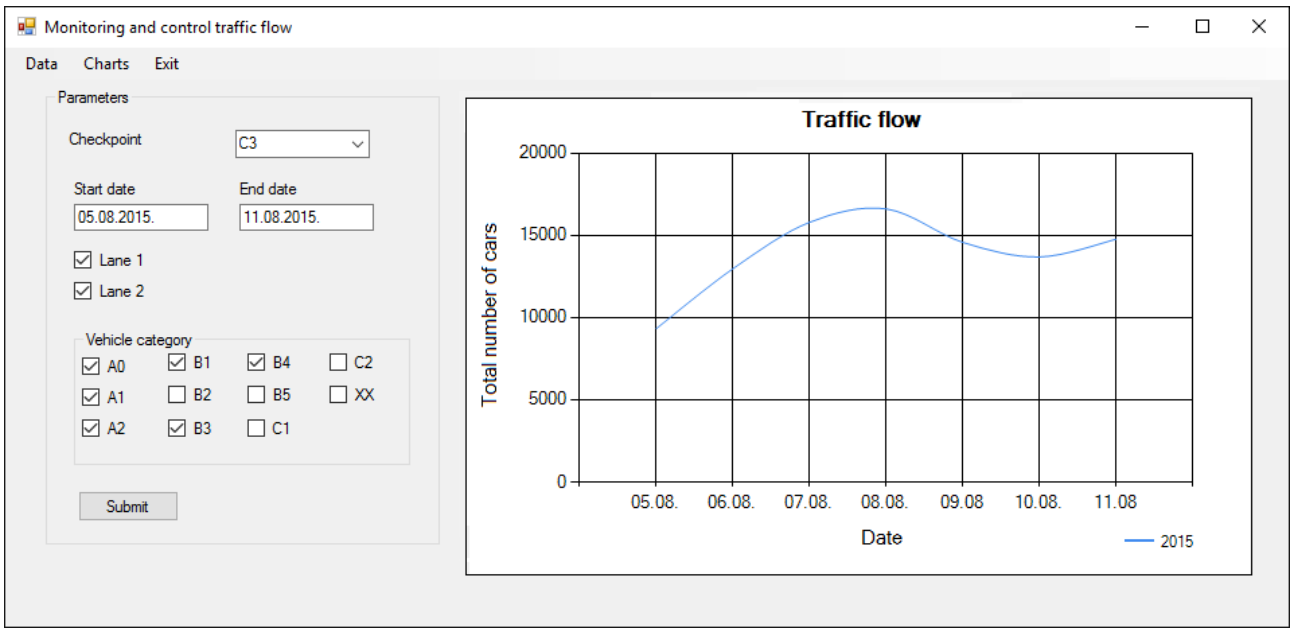

Figure 6: Chart of weekly traffic flow

The line chart shown in Figure 6. allows the user to monitor the daily traffic flow. The chosen observation period is the month of August 2015, when there can be more congestion due to vacations. The chart clearly shows that the highest number of vehicles occurred on August 8. This review of data is very convenient if we want to compare the traffic of the current year with that of the previous year. To end the work session, the user clicks on Exit in the top menu, and the application terminates.

5. CONCLUSION

Traffic is becoming one of important problems in our society (Cao, Li, & Zhang, 2011), which is possible to be resolved by the application of ITS and web monitoring. Web applications based on the use of sensory technologies place high demands regarding scalability, availability, and continuity that relational databases have difficulties in meeting. On the other hand, availability and scalability are two highly desirable properties pertaining to the reliability of a web application (Khan & Rao, 2014). A new trend in storing and processing of data is NoSQL open-source MongoDB database that is designed for very fast big data processing measured in milliseconds.

In this paper, we demonstrate the model for collecting and processing Big Data and develop a web application for traffic monitoring and control. As a result, we show that using MongoDB database as a data container and management with a web application represents an excellent solution that achieves high performances with large volumes of sensory data. The developed web application allows the user to monitor all significant traffic parameters such as average daily traffic, monthly average daily traffic, annual average daily traffic, the total number of vehicles, minimum, maximum, average vehicle speed. At any time, the user can observe any preferred checkpoint for an overview of the current state on the road and for predicting possible traffic jams. The reliability of the web app and high data processing speed is based on the NoSQL database.

The future research and development are directed to comparative analysis of traffic flow web monitoring implemented in relational and NoSQL databases. The presented model can be scaled to support a large number of traffic sensors as well as big data sizes. Moreover, it can be used to support further research in the application of Mongo database for real-time big data processing.

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THE POTENTIAL OF *BIG DATA* IN HEALTH SYSTEM

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Abstract: *The paper gives an overview of the concept of big data and its significance in the health system. Big data is a new term that refers to the large amounts of data that are found in different forms and at different bases. Managing this data makes the entire business process more efficient and more effective, which is the case with the health care system. More specifically, applying of big data in the health care system leads to better health care to the exact diagnosis, more effective decision-making, better quality of work of health care institutions, etc. The paper points out that Big data in the health system has the potential to improve patient care, save lives and reduce healthcare costs. That potential in the health system lies in combining the traditional data with new forms of data at the individual level and at the population level.*

Keywords: *health system, big data in healthcare, Big Data Analytics, Volume, Variety, Velocity*

1. INTRODUCTION

The health system is now faced with a large amount of data. Given that we all strive to keep our health, it is necessary at every moment to have precise and accurate information (Jovanovic Milenkovic, Jeremic, Martic, 2014, Mr. Zhang, Ou Sh.X., Huang YH, Wang Ch.R., 2015). However, today in the health care system there could be found the large amounts of data that are not updated and that appear in different forms. The authors of the modern era have introduced a new term big data. Big Data in healthcare is being used to predict epidemics, cure disease, improve quality of life and avoid preventable deaths. The drive now is to understand as much about a patient as possible, as early in their life as possible – hopefully picking up warning signs of serious illness at an early enough stage so that treatment is simpler and less expensive (Forbes, 2015). For the patient it will mean better, quicker and cheaper diagnosis and treatment, and better information about health care providers. In the following section of this paper it will be explained what *Big data* is and what is the potentional big data in health system.

LITERATURE REVIEW

Digital healthcare solutions have promised to transform the whole healthcare process to become more efficient, less expensive and higher quality (Liu, Park, 2014). Modern business indicates that all health data should be in electronic form. Electronic health system (eHealth) is allowed to be easier and faster access to such data.

But in some case, electronic health data is unavailable, inadequate, or unusable. The healthcare databases not link all data. Other challenges related to big data include: the exclusion of patients from the decision making process, and the use of data from different readily available sensors (Gaitho M, 2015).

Development and improvement of Big Data Technologies has opened up a gateway to its introduction in e-health, and also is becoming increasingly urgent to initiate its integration, as, simultaneously, other technologies are being developed to solve many of the problems in the sector (as tele-monitoring, tracing and labeling of patients, staff, drugs, equipment, etc..) that will be generating even more data (Díaz, Juan, Lucas, Ryuga, 2012).

In the healthcare of the future, it is necessary to manage more and better, both patients and supplies, whether internal or external. Furthermore, the use of Big Data technologies together with concepts such as Health Cloud will allow to change the data structure of the sector, focused on health centers or institutions, into one more focused on patients as individuals with a track record that are attended by centers in a time stamp. One of the strong points of the Big Data is that there are various specifications, which can be adapted to the particular needs of the different fields of the e-health, to give very specific and efficient solutions (Díaz, Juan, Lucas, Ryuga, 2012).

2. BIG DATA

What is *Big data*? Although in literal translation it means "a large amount of data," Big Data is a complex phenomenon (Vukmirović, Vukmirović, Jovanović Milenković, Vukmirović, Brbaklić Tepavac, 2016). Today there are many definitions. One of them is from the report which was submitted to the US Congress in 2012 that defines Big Data as "large amounts of data, high-speed, complex and variable data that require advanced techniques and technologies to enable the capture, storage, distribution, management and analysis of that information".

According to another definition, *Big data* is a set of techniques and technologies that require new forms of integration in order to detect hidden large data values (Abaker, Hashem, Yaqoob, Anuar, Mokhtar, Gani, Khan, 2015).

The term *Big data* should not to be identified only with the large amounts of diverse data, but with the techniques used in the processing of these data and the ways of making conclusions and important business decisions based on that. Due to this characteristic the more often used term is Big Data Analytics or "analytics of the large amounts of data," as its purpose is that by the application of advanced technology and statistical techniques finds the hidden patterns in data and generate information for making important business decisions (Chawla, Davis, 2013).

Big data is based on three basic dimensions that make up the "3V concept'': Volume, Variety, Velocity (McAfee, Brynjolfsson, Davenport, Patil, Barton, 2012).

- Volume – high speed of growth in volumes of new data and storage of the existing data leads to the situation that hundreds of terabytes or even more are now stored. According to IBM, 90% of the data that exist today have been created in the last two years. On the other hand, according to the McKinsey Global Institute, it is expected that the amount of data generated globally to grow at an average annual rate of 41% and that in the period from 2008 to 2020, this amount will increase by 44 times, from 0-8 zettabytes in 2008 to 35 zettabytes in 2020. The best indicator about the quantity of data is the fact that every day on Facebook generates 10 and Twitter 7 terabytes of data (McKinsey Global Institute, 2011).
- Variety - is no longer enough to keep only structured data, but also images, data from social networks, logos, sensor data ... Thus there are the following data (Ronk, 2014, Syed, Gillela, Venugopal, 2013):
    1. Unstructured data – the data by which the classical arithmetic operations can not be performed, account for over 80% of the data. These are the various data such as audio files, video files, text files, etc..
    2. Semi-structured data - make up about 10% of the data. These are mostly data that can easily be transformed into the form suitable for the performance of conventional arithmetic operations, such as, for example, information obtained through the Web analytics.
    3. Structured data - make up only 10% of the data. These are data that are created by using a variety of analytical tools such as business analytics, databases, etc.
- Velocity – the new data are generated at high speed, which is far greater than the speed of data processing. For example, within one minute in the world (Al-Taie, 2016):
    1. over 3,500 transactions on stock exchanges are performed,
    2. over $ 3 million is spent on online shopping,
    3. over 200 million e-mails are sent,
    4. over 2 million searches on Google (3.5 billion daily)
    5. over 700 thousand new content are published on Facebook
    6. over 400 thousand on Twitter,
    7. over 600 new video content on YouTube,
    8. over 400,000 minutes of talking on Skype and
    9. over 1,500 blog posts are published.

To these three dimensions some authors add other dimensions, creating an expanded concept of Big Data. Some authors add the dimension of reliability data (Veracity), making the "4V concept", while on the other hand, some authors add another dimension and value (Value) and effectiveness (Viscosity), making extended "6V concept".

Most researchers concerned with the traditional methods of research suggest the following (Mishkin & Hodson, 2014):

- Traditional research reveals why customers feel the way they do. Big data reveals what customers do.
- Big data can tell you a lot about people: When they do it, What they do, Who they are doing it with, Where they are doing it but it can't tell you why.

3. *BIG DATA* IN THE HEALTH SYSTEM

3.1. The types of data

Most of the data is useless from the standpoint of quality and timeliness, but their availability is the imperative that makes the companies to: find the right data (Big Data), save them (Cloud), process them (Map Reduce) and finally analyze them (Data Scientists) in real time. The time factor plays a key role because today's users are very well connected (online) and informed (social media) and communicate with each other in real time (smart phones, tablets) (Vukmirovic, Vukmirovic, Jovanović Milenkovic, Vukmirovic, Brbaklić Tepavac, 2016).

As abovementioned, in the healthcare there are large amounts of data that are kept for one patient. The volume of health data is expected to increase dramatically in the coming years. Data are increasing with 80% of unstructured medical data.

A lot of these data are in paper form with the trend towards the digitization of these data. These data are of different structures and are located in different databases. The data is located in different places in the patient records, in the form of laboratory data, notes, doctor ... The basic characteristic is that data are becoming more and more "unstructured" (Vukmirovic, 2015):

- Texts,
- Audio,
- Video,
- Images,
- Geospatial and
- Internet data (*slick streams, log* files).

Big data in the health care system is becoming dominant, not only because of the size of data but also because of the diversity of types of data and the speed which must be managed. The health care industry needs to identify and establish proven strategies and best practices for big data management data. The totality of the data related to the health care of patients includes:

- Clinical data, systems for decision support, written notes of doctors and prescriptions, medical imaging, laboratory data, insurance data and other administrative data;
- Data on patients in an electronic patient file;
- Monitoring the data on social networks, including Twitter (aka. Tweets), blogs, Facebook and other platforms;
- Web pages where you can find information, news and articles in medical journals.

From the above we can conclude that the sources and types of data can be found at (Raghupathi, Raghupathi, 2014):

- *Web* and on social media: Interaction on *Facebook, Twitter, LinkedIn*, blogs, etc.
- Loading data by using the devices;
- *Big data* transaction: The institutions that have the transactions perform with semi-structured and unstructured data;
- Biometric data: fingerprints, genetics, handwriting, blood pressure, medical imaging and other similar types of data;
- Human-generated data: unstructured and semi-structured data, such as electronic patient record, physician's notes, *e-mail*, paper documents...

3.2. The potential of big data in health system

Collecting all the information from those sources creates the access to monitoring the health status of an individual or the entire population. However, different stakeholders have different goals and hopes for Big data and its analysis:

- Patients - want daily use of new technologies in order to get better care with the correct diagnosis;
- Providers – the access to the patient data by the clinics in order to improve decision making, achieving efficiency in the work without error;
- The researchers - want a new tool to improve the quality and quantity of the work flow. These include the various statistical tools, algorithms;
- Pharmaceutical companies - they want to better understand the causes of disease and thus get the safer drug market;

- Companies for the production of mobile devices – integrate the users data with the data they can collect about them via the data collected by using mobile devices;
- Governments – are trying to reduce the costs, introduce the regulations;
- Software development companies - see opportunities to serve the wholesale market, to develop software that will find its application in the health system.

Big data has the potential to improve patient care, save lives and reduce healthcare costs. The potential in health system lies in combining the traditional details with new forms of data at the individual level and at the population level. In Table 1 we can see the differences between traditional analytics and Big Data analytics in relation to data sources, processing techniques, intensity, time and purpose of data processing.

Table 1: Traditional analytics vs. *Big data* analytics (Lazarević, 2015)

Parameter	Traditional analytics	*Big data* analytics
Volume of data	The analysis of the part of data (*Partial Data*)	The analysis of all data (*All Data*)
Sources	A small number of homogeneous data sources	A large number of heterogeneous data sources
Data processing techniques	Standard tools and techniques (classic software, classical statistical techniques)	Advanced tools and techniques (advanced software, advanced statistical techniques)
Data processing time	After generating the data (Ex-Post)	In the course of generating the data (Real-Time)
Data processing intensity	Occasional data processing (Ad-Hoc)	Continuous data processing
The aims of data processing	Diagnosis and description of the event	Behavioral analysis and forecasting of events
The types of reports	Standard uniform reports	Complex reports

Therefore, all these data should be aggregated into a single integrated system that will contribute to an efficient and well managed health data in order to help doctors be able to timely and accurately provide health services to each patient. The components and architecture of *big data* in the health system are shown in Figure 1.

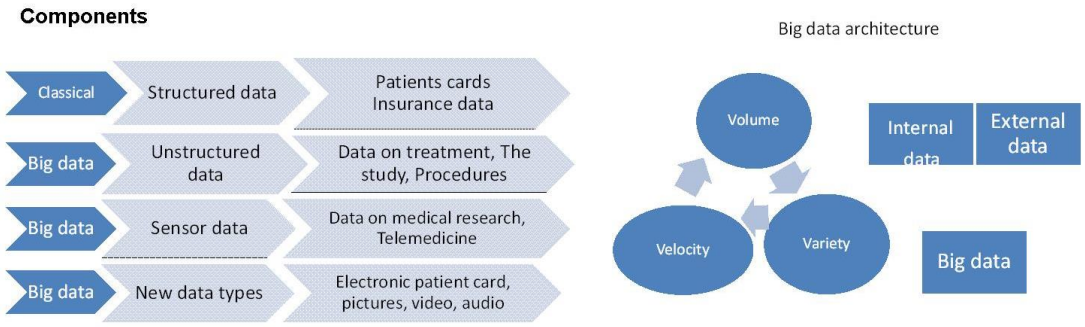

Figure 1: The components and architecture of *big* data in the health system

The *open source* platforms like Hadoop/MapReduce, available on the cloud, encourage the use of big data in the health sector. Fortunately, the advances in data management, especially virtualization and cloud computing, facilitate the development of platforms for the efficient capture, storage and manipulation of large amounts of data.

MapReduce is designed by Google as a model of efficient execution of a set of features over a large amount of data in *batch* mode. The first component of this solution is the "Map" component. Its function is to distribute the problem of programming or task that inevitably occur due to excessive number of data in the system, and manages the set tasks in a way that balances the load, as well as to manage the process of recovering from mistakes. After the process of distributed calculation is completed, the second function of this solution gets activated which is titled "reduce" that connects all the elements together again, in order to provide the results (Figure 2) (Vukmirovic, 2015).

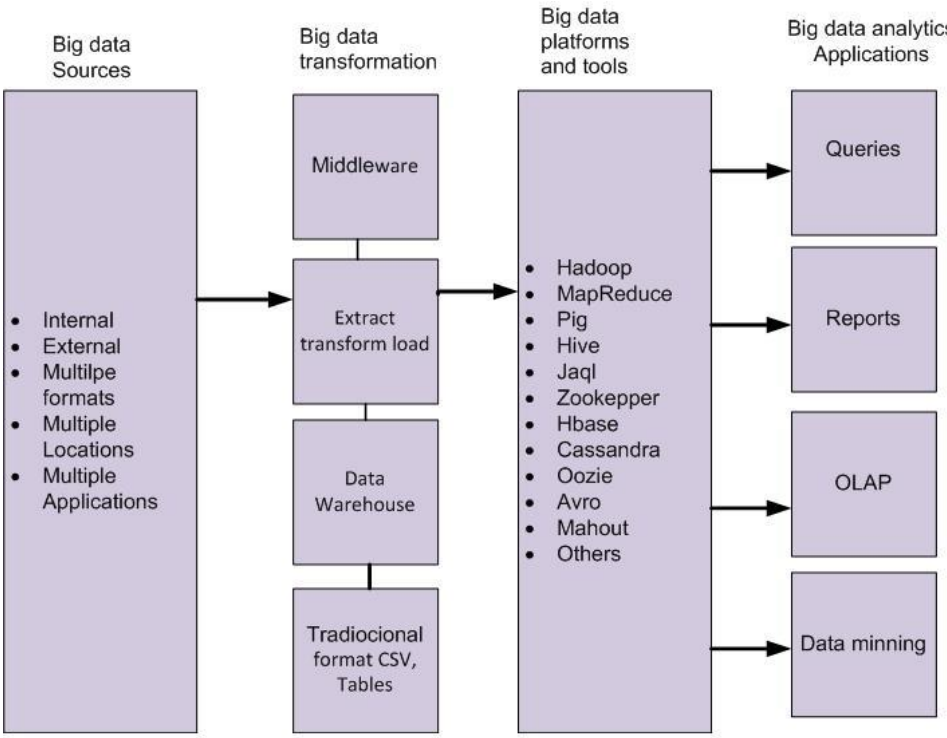

Figure 2: The conceptual model of *Big data* (Raghupathi, Raghupathi, 2014)

By using *Big data* databases the medical institutions may save the money, increase revenue and realize a multitude of business goals:

- Developing of new applications. *Big data* enables the organizations to collect real-time billions of data related to their products, resources and users, as well as on the basis of these data immediately optimizes the user experience and the use of resources.
- Improvements in efficiency and cost reduction of existing applications. *Big data* technologies are generally "open source" that can be used, exchanged and modified by everybody. Therefore the implementation and use of Big Data technologies is much cheaper compared to the development of proprietary technologies..
- The outputs of new sources of competitive advantage. Big data allows the organizations to quickly adapt to changes in relation to its competitors. For example. MongoDB platform has enabled one of the largest providers of support for human capital management to develop in record time a mobile application that integrates data collected from multiple unrelated sources.
- Increase customer loyalty. Increasing the amount of data exchanged within the institution and the speed at which they are updated allows the organizations to quickly and accurately respond to user demands.

4. CONCLUSION

Big data in the health system has the potential to transform the way and to contribute to health care workers use sophisticated technology on the basis of which they will be able to make better decisions in health care. *Big data* and applications in healthcare are emerging development, but the rapid progress in the platform and tools can speed up the ripening process of work and contribute to better decision-making in health care. This will bring the more accurate diagnosis of patients. In this way the efficiency and effectiveness in the implementation of big data in the health system are achieved.
A lot of health data are in paper form with the trend towards the digitization of these data. These data are of different structures and are located in different databases. The data is located in different places in the patient records, in the form of laboratory data, notes, doctor ... The basic characteristic is that data are becoming more and more "unstructured".

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insurance data and other administrative data; data on patients in an electronic patient file; monitoring the data on social networks, including Twitter (aka. Tweets), blogs, Facebook and other platforms; Web pages where you can find information, news and articles in medical journals.

Big data has the potential to improve patient care, save lives and reduce healthcare costs.

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IMPROVING E-COMMERCE SYSTEMS WITH BIG DATA TECHNOLOGY

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Abstract: *This paper presents one of the aspects of using Big Data technology in e-commerce systems. The main goal of this document is to present a solution of how a non-relation database can be integrated to e-commerce platform. Mongo database is used, as a Big data storage solution, to improve data scalability and search performance with enormous amount of products data on Magento platform. The first part of this document describe Big data technology and present a Magento platform. In this document also is presented a solution model of how big data technologies works on practical application in real electronic store. Document will be analyzed problems of electronic store which related to search and analytics of products data. Results can help another e-commerce systems to improve their services and continue to work on further technology improvements.*

Keywords*: Big Data, Magento, Mongo DB, Non-relation DB, E-commerce*

1. INTRODUCTION

With a grater amount of data comes a bigger problems, therefore, the more data the company holds, it is going to be harder to manage them, from the perspective of keeping the data and form the perspective of analyzing the same. Big data is designed to offer to companies a huge business insight. Today, the available amount of data reach units of petabytes and exabytes where traditional architecture and infrastructure simply don't gives a good results.

These days, in hyper-competitive business environment, companies do not need only to find and analyze a particular data, they also must do it as soon as possible. In the last few years, as a results of the expansion of electronic stores and e-commerce as a whole, there was a need for better application quality development and optimal use of technology to achieve a better results. Big data in e-commerce has received a special attention and provoked many questions which are opened the door for the future business opportunities.

2. BIG DATA TERM

Big data comes with their dimensions. Different authors emphasizes different dimensions, but common elements are: Volume, Variety and Velocity and they will be explained in this research, but before continue with dimensions it's important to mention a couple of facts that are characteristic for Big data.

When is talking about big data and a huge data information, it is necessary to point out a few facts:

- Big data are ideal for the analysis of both, structured and non-structured data, which come from a different sources.
- It help us in situations where the traditional relation databases are unusable.
- It will manage data better.
- Benefit from speed, capacity and scalability of cloud storage.
- Data analysis methods, capabilities will evolve.

Volume: Differences of storage have changed through time, year by year, and today are reached the size of zettabyte. Beside the growth in size there comes to a decline in price of memory. The expected growth of memory is a huge and with this information we get the fact that someone must analyze this amount of data. All this does not mean that scientists or analysts have problem to store the data, this indicates more to possible problem in the analysis of these data, where the Big Data technology simply can help.

Variety: Special attention relates to the diversity of the analyzed data. We have structured data stored in databases and semi-structured and unstructured data which makes the most of it and which we concerned. This is not suggest that unstructured data don't have a structure, it's about their subcomponents do not have the structure by default (comments, pictures…). It's important to focus on all the data and with their combination increase the value. In fact, the example of this can be found in e-commerce solution. The companies all the

time receive the calls from customers, which represent an unstructured data, and they can combine them with structure data (orders, transactions and so on) and from this we get personalized model of customer, which represent combination of structured and unstructured data.

Velocity: The Velocity, actually is the speed of creating, storing, analyzing and visualizing the data. Big data allows a real time, work with orders, products and customers even better. There was a time when the users just used information from day earlier, similar to newspapers, where information was collected and analyzed for the next day. Today, with new technology and availability of large number of services, user just won't wait even the few seconds and everything after that is considered as old data. Products that we present on our service must be analyzed and presented to the right buyer in real time, this high velocity data, represent big data.

3. NON-RELATION DATABASE

In recent years, NoSQL or non-relational databases have gained great popularity in terms of storing large amounts of data and their ease of expanding. There is debate about whether the non-relation database in the future will replace the relational databases. With the increasing number of social and other unstructured data, the following questions began slowly but surely to be placed over relational databases.

- Are the relational databases able to cope with large amounts of data (Big Data)?
- Are the relational databases is able to reduce the large amount of data?
- Are the relational databases suitable for the modern era of data?

The technology which used for big data storage are non-relation databases. For this document research we used Mongo database engine as database system based on non-relation database technology.

3.1. Mongo Database

One of the most well-know open source of NoSQL databases is Mongo database. It's design by company 10Gen, written in C++. Query language is written in JavaScript and reminiscent on SQL. It's licensed by GNU Affero GPL license and from popular company used by Foursquare, SAP, Github and others.

Indexing: It allows a high performance of operation executing on most used queries. Mongo database index represents the structure of data which allows very effective document positioning based on particular value in fields of document.

Aggregation: Mongo database provides a function aggregate() which is used for data aggregation and it used on particular collection. It also using additional operators: sort (document sort), skip (ignoring the particular number of document on start of collection), match (document filtering based by value of field), group (document grouping), project (defined fields from the document, which will be included in the result) and unwind (transforms a string).

Replication: This mechanism allows data synchronization between more Mongo database instances. There is just one primary instance and all others are secondary. Replication must to provide redundancy, increase availability and facilitate some administrative tasks such as backup. Mongo database provides a mechanism where if crash the primary instance, with the mechanism of votes it select the new primary instance.

Auto-sharing: This mechanism allows participations collection of documents and their distribution to larger number of instances. The idea of this mechanism is to improve a capacity of the system.

Map Reduce: Allows parallel processing of large amounts of data.

Ad-hoc query: Dynamic (ad hoc) queries allow working with Mongo database infection in a similar way as to RDBMS. Therefore, this feature is ideal when switching from RDBMS system on Mongo database.

GridFS mechanism: This mechanism allow storage of large documents. In particular, MongoDB can work with the document size of 16MB. Because of this limitation, GridFS mechanism is used as mechanism which separate document into series of pieces. For storing the large documents there are use two collections: collection of 'files' which represents a meta data of document and collection of 'chunks' which contains parts of document. Size of the parts of a document is usually 256 KB.

Mongo database offers very good performance for situations that containing very high write loads, but where data integrity isn't a pressing concern; a good example are the comments sections of large, busy websites like Craigslist or The New York Times, both of these use Mongo database.

4. SOFTWARE SOLUTION FOR THE IMPLEMENTATION OF ELECTRONIC STORE

E-commerce represents a business model that allows management business via the internet and with using applications that are located on the internet. Online business is a clear advantage because it is available all the time and provides efficient service to customers.
One of the most important parts of an e-commerce portal is the fact that you can explore a large number of products and services, consider their fully purposes and view the price without physical presence in stores. Today, users want to be able for ease use and access to systems, where they can finish the shopping by a few clicks. This fact will completely change the approach to trade and allow purchases anywhere and at any moment through different devices.

Magento represents a very powerful and flexible e-commerce platform that is now one of the most developed and fastest growing platform in the world of e-commerce solutions. Magento is an e-commerce platform that allows employers to the various modules that are flexible, which have dynamic content, and which the seller can control and adapt to their needs. It represents an open source technology that has strong marketing tools, which support the search and optimization to meet and adapts to any type of business. It is vary scalable and widely available platform because of its stability and flexible nature.

Magento is e-commerce CMS platform is based on a PHP/MySQL structuring and relying on a Zend framework. With Magento, customers are able to completely manage their online store, display specific product and provide customers various payment methods and shipping, and many other options.

Magento benefits:

- Open source platform
  It represents an open source system which is available on the Internet. As such, the system allows developers access to the core of the system and allows the use of new functionality through its extensions.
- Easier way of content management
  Magento has functionality that can allow a management of more stores under the same platform. It also supports multiple sites management that are the part of a particular store. The main functionality is reflected in the use of the common Admin panel for the overall management. All sales may be administered through a single base. With their flexible contain management system, Magento is very useful for those who want to sale 10 products or a 10 million products. In the moments when sales grow dramatically, with the help of Magento you can more easily manage the sales process so that in the event of an increase in sales and profits.
- Scalable platform
  Magento is a flexible platform. It's available for both, small and large companies. It can be adapted depending on the business and the complexity of the requests. As a scalable and flexible system, with its customization they can be delivered to any business model.
- User friendly
  Introducing products through Magento platform is simple and offers different functionality. Allows customers a great experience in terms of purchases. Efficient design allows for easy navigation and an ideal system which customers can easily manage. Zoom image product, the review comments of other customers, a large selection of images for such a product as well as other functionalities are Magento system user simple and inspire visitors to buy and re-visit the web site.
- Optimized for search engines
  Optimization and search are also one of the strength of Magento platform. Different search mechanisms easily using the Magento structure. Magento defines very clear URL names, and also adding tags and keywords in the description. These functionalities directly assist and contribute to improved purchasing and services implementation. Magento uses the powerful tools such as Up-Sells and Cross-Sells to stimulate users to purchase more.
- Mobile devices support
  Web technologies are integrated and supported by the Magento system. Magento platform provides better access to the shopping experience for visitors of different mobile browsers and systems. Systems online sales written in Magento support functionality such as image scaling, integrated video and audio, drag-and-drop functions intended purchase baskets and many other functionalities.
- Analysis and reports
  Analytics and reporting system is also one of Magento strength in business which can identify the best sellers on the site, in terms of brand, manufacturer and profit. Furthermore, this SaaS system can provide

vital insight into which customers, products and regions generate the most profit, making it easier in future decisions on product management and sales forecasting.

- Security and payment
  Magento is very secure platform. Implementation of SSL protocol and dedicated IP address is simple. Using the portal allows the beneficiary easy and secure shopping with using various methods of payment. Because of its structure, enables easy implementation of different models and services for a payment, in the standard package comes with services such as PayPal, Authorize.net, Google checkout and other popular payment systems.

5. INTEGRATION MONGO DATABASE ON MAGENTO PLATFORM

Magento use ORM (Object-relational mapping) approach. Most of the data access will be via the build in Magento models and models which was build from different sources, customized. Magento models, the default one, can be categorized in two ways, there is a basic 'one object one table' model and there is also an Entity Attribute Value (EAV) model. Each model also get a model collection. In PHP programing collection are objects which used to hold a number of individual Magento Model instances.

Magento has a highly flexible and abstract, concept of what the model is. Therefor, Magento models do not contain any connection to the database. Each model use resource class that communicate with the database server. This solution where logical Model and the code that talks to the database are separated, allow us to create the new resources classes for a different database schemas while the keeping the default Magento Model logic structure. (Magento for Developers; www.devdocs.magento.com. 2016)

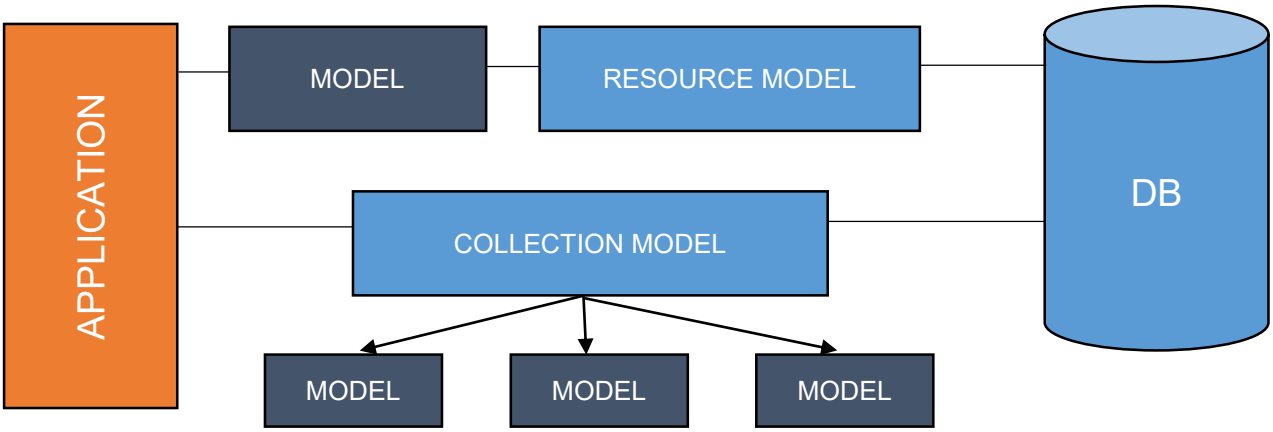

Figure 1: Magento model

Flexibility of EAV (entity-model-view) database model turns into a wound when Magento used it in projects with a very large number of products. At least while using classical relational database. Practice has shown that the classic RDBMS is not quite suitable for large-scale projects, however, be sure to look back a little to other ways of storing data and implement Magento integration with databases of the next generation.

Magento flexibility in terms of product attributes by EAV model maybe the best paint application document-oriented model non-relation databases. Based on the functionality that should be provided, access to the application Mongo database among other documents-oriented databases like NoSQL database that integrates with Magento.
When Mongo database is used, all information regarding a product will be presented as a document. The document in Mongo database can be used to store any kind of data structure, representing different types of products that can be easily extended with new attributes or simplified by removing the attributes in the database. In addition to the flexibility obtained by using document-oriented design Mongo database, we can also count on the scalability and high performance that provide these types of databases.

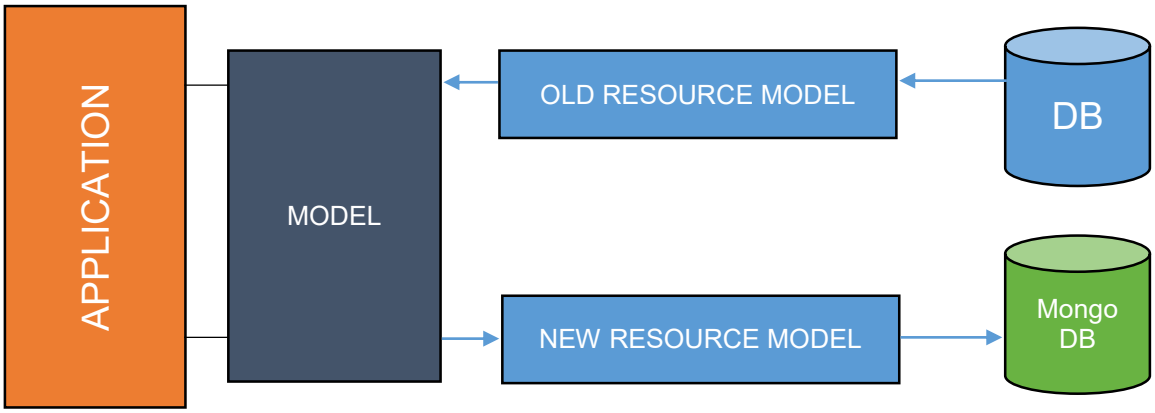

Figure 2: Data migration

The resulting model allows us to go far beyond the limitations of Magento in terms of product management. The changes are significant when it comes to creating products in a single request can see the difference. The collection of products from a huge database of products with a lot of attributes is far more efficient than ordinary connecting table (join) that the use of the classic RDBMS. Often referred to horizontal scalability of NoSQL (Mongo database), but the biggest advantage here is actually related to an improved data model that perfectly suits this purpose.

Through the integration of Mongo database the size and use of database is significantly reduced. Thus, giving more availability for dealing with other tasks and facilitating maintenance. Magento was designed to operate on heterogeneous catalogues containing millions of products, while reducing the impact of the Magento EAV model. The use of the NoSQL Mongo database for storing product attributes reduces the load on the MySQL database while retaining the flexibility of the document model. (Scaling Magento with MongoDB. 2016).

6. FUTURE MODEL IMPROVEMENTS

Future improvement of model is to create resources classes for another Magento entities. Beside product entity, customer model has very big potential to be represented as non-relation data. Analyzing this kind of data can be crucial for business purposes.

7. CONCLUSION

Characteristic of non-relation database (NoSQL) is that it can be easily distributed and infinitely expanded. With combination of infinitely possibilities NoSQL with Magento, we can achieve scalability as we expect.
Today, the standard Magento platform using dedicated servers they'd gone pretty far in databases resources, and reached full capacity. We consider the possibility of replacing a standard relation databases. But, overall, NoSQL databases are not implemented to replace MySQL (relation database). By combining Mongo database as the data warehouse Magento trendsetting products and MySQL database for other data, it came to the optimization in loading the MySQL so the possibility of expanding the base went away a lot further. When we integrate Magento with Mongo database, MySQL database can handle a lot of front servers, make sure these features must be tested in advance. In the future, looking to deploy Mongo database integration NoSQL databases in the Magento platform will become the practice in order to achieve far better results.
With this kind of implementation, when Mongo database integrate with Magento, results can be implementation and support the 30 or 50 million a products at the current time and here big data solutions become solutions that we need.

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BIG DATA IN POSTAL TRAFFIC AND POSSIBILITIES OF USE

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Abstract: *The term "big data" has become very popular lately. Universal Postal Union has huge amounts of data and treats these data as a public good. In the past few year and more, postal organizations are talking about the concept of "big postal data". Big postal data are messages about electronic data interchange between postal administrations, ie. real-time scanning of parcels between postal administrations. The aim of this paper is to show where big data are used in postal traffic, as well to explore where they can be used too. It also analyzes the Serbian post and segment that are generating big postal data.*

Keywords*: Big data, big postal data, electronic data interchange, new segments, real-time scanning*

1. INTRODUCTION

The term big data is becoming more and more important. There is a number of people who are interested in it, especially interdisciplinary scientists. To understand what is big data, it is best to start from the definition of that term.

There are many definitions related to big data, but one of the most accepted definition that is commonly found in the literature is: "Big Data is a phenomenon defined by the rapid acceleration in the expanding volume of high velocity, complex, and diverse types of data. Big Data is often defined along three dimensions - volume, velocity, and variety. Big Data is a term that describes large volumes of high velocity, complex and variable data that require advanced techniques and technologies that enable the capture, storage, distribution, management, and analysis of the information (Agarwal et. al, 2012).

If we keep this in mind, it is clear that the postal sector has huge amounts of data, which can be very easy to use to improve their own operations. The paper is divided into several parts. The part big postal data talks about big data in postal sector, where they are generated and how can they be used. The special focus is placed on the POST * Net network of the Universal Postal Union, a special Postal telecommunications network for the exchange of information between the post office, customs, etc. The United Nations, through its Global Pulse initiative, spread awareness of the use of big data. Also, they have a special task force who is investigating new sources of big data, like postal data. Part of the paper is devoted to the use of big data in logistics with concrete examples. The most important part of the paper is identification of big data in Serbian postal system. At the end of the paper everything is summarized in the conclusion.

2. BIG POSTAL DATA

Big data include electronic collection of bits of information through various sources, such as sensors, track and trace systems and more. Post offices are the main generators of big data. Big postal data can help overcome the information gap in areas that are not connected (Anson, J., Helble, M. 2014).

Miguel Luengo-Oroz's speech about big postal data in Geneva at TedXNations event on Dec 11th 2014 pointed to the huge potential of postal data to identify human and economic trends(Universal Postal Union, 2014). Post office processes about 1 billion letters and 16 million packages around the world on a daily basis. Each item is marked with barcodes, postal codes and other bits of information, and that information are followed by the Universal Postal Union and through special electronic networks exchange data with a variety of entities (customs, airports…). The main conclusion of meeting in Geneva is to follow trends that can lead to warnings before the crisis happens in order to take corrective measures (Universal Postal Union, 2014).

More than 100 million records circulated through the POST*Net network in the form of EDI messages. On an annual basis, international postal exchange generates more than 2 billion events, and they are recorded in real time and each event has from 20 -100 records as separate pieces of information, for example: the weight of the postal item, code, city name, postal code, time etc. Figure 1 shows real time scanner of United States postal service. Real time scanning enables the monitoring of postal flows in real time, finding

bottlenecks in the international postal routes, identification of critical barriers and their impact over time (Universal Postal Union, 2013).

Figure 1: Real time scanner

Universal Postal Union has a global postal telecommunications network called the POST * Net, which is used for the transmission of electronic information between airports, customs, post office or other transport organization. The telecommunications network is used exclusively for the purposes of the postal community. Flexible POST * Net infrastructure can meet any postal company. Within this network is circling the huge amount of data that can be used for the improvement of international postal services.

Postal Technology Centre, together with several postal companies, created the International Postal System in 1995. It is an integrated email management application that combines mail processing, operational management and EDI messaging into one application (http://www.ptc.upu.int/ps/ips.shtml).

3. GLOBAL PULSE INITIATIVE AND BIG DATA PROJECTS

Global Pulse is an initiative of the United Nations Secretary-General on big data. The main objective is to discover, develop and adjust big data innovation for sustainable development and humanitarian action. There are numerous Global Pulse's projects in various fields: Climate resilience, Food & Agriculture, Humanitarian Action, Public Health, Real Time evaluation etc (Figure 2) in various regions of the world. The goal of pulse labs, that make the network, the joint efforts of government experts, various UN agencies, academic institutions and private sectors, is to develop new methods of using big data for achieving stated objectives. Labs are located in different parts of the world, with the main labs in New York, Jakarta, Indonesia, Kampala and Uganda. The experts are made up of people from different disciplines: data scientist, data analytics, data engineers ...(http://www.unglobalpulse.org/).

Global Pulse initiative was launched by the UN Secretary General in 2009. By 2014 they have over 25 innovative big data projects and issued 135 press articles. Through various partnerships, Global Pulse gets access to big data which will be used for innovation projects. One of the biggest advantages is that the partnership expands the necessary expertise. Innovation process begins with brainstorming in which everyone participates. After that they create multidisciplinary teams, conducting various analyzes and develop prototypes, then the results are presented to the public. There are various projects carried out by the Universal Postal Union. Through collaboration with the Universal Postal Union, they uncover the new data sources. One of them is “Discovering a new proxy for economic activity”, which analyzes the postal data and the postal sector is being seen as the main economic activator in the community, especially in regions where there is no access to modern information communication technologies (United Nation Glubal Pulse, 2014).

Figure 2: Global Pulse Project Series

4. BIG DATA APPLICATIONS AND CASES FROM THE PRACTICE

Many postal operators create various applications based on big data that enable them to reduce costs, improve interaction with customers, create new products, and that is how they introduce innovations in the postal sector. In the future, the goal is to set up low-cost sensors on vehicles, mailboxes, sorting centers to collect valuable data. DHL has created a tool for the analysis of the correlation between external factors such as weather, flu epidemics, Google trends and shipment data. Result is model that allows predicting volume of packages and determine the number of vehicles and requirements for staff. Italian post set up low cost sensors on electric vehicles to gather the necessary information. Some postal companies are using big data to help those who send direct mailings to better target their campaign. DHL has introduced geomarketing GeoVista tool, that serves companies to identify and analyze the location and potential of the product (U.S. Postal service office of inspector general, 2014).

Special attention is devoted to big data by DHL, and this company emphasizes that logistics and big data are made for each other. They use big data for the last mile optimization using DHL Smart Truck, Crowd-based pick-up and delivery, Predictive network and capacity planning, Parcel Volume Prediction (Jeske, M., Grüner, M., Weiß, F., in cooperation with Detecton consulting 2014).

We also analyzed the Track and trace system of Serbian post and possibility to use big data. Items are scanned and in this way is obtained valuable information like weight of item, postal codes etc. The possibilities for their use are numerous, and they are primarily related to the creation of new services, increase customer satisfaction, innovation, improving efficiency etc. It would be interesting to consider the introduction of modern applications like GeoVista in near future.

5. IDENTIFICATION OF BIG DATA IN SERBIAN POSTAL SYSTEM

In this section there will be represented the parts in which big data are generated during the transfer of postal items. In the production cycle of transfer of postal items, there are 5 production phase:

- Receiving of item
- Shipping of item
- Transport of item
- Arrival of item
- Delivery of item

Production-technological processes of postal services begins with *receving of item*. This phase begins from the moment of acceptance of item from the sender and ends up with stamping the item. The most important conditions that users must be introduced to in order to postal organizations receive a item are:

- Addressing of item
- Packaging of item
- Pay postage

Data at item must be indicated in the following order:

- Name of recipient
- Street, port number, apartment number and zip compartment with a number
- Postal code and the name of the destination post
- Sending destination country for international traffic

The next task for this item is that it must be packed in an appropriate manner to ensure the content of the item. The beneficiary has to pay postage.

Shipping of postal item includes the preparation of items received in units of the postal network for transport towards the destination.

Transport of item is the phase that includes the process of dispatch to arrival.

Arrival of postal items includes the download of packages and the opening of the conclusions by the postal centers or mail in order to delivery.

Delivery of postal item includes delivery to the recipients (Kujačić, M., 2010).

Figure 3. shows the main phases:

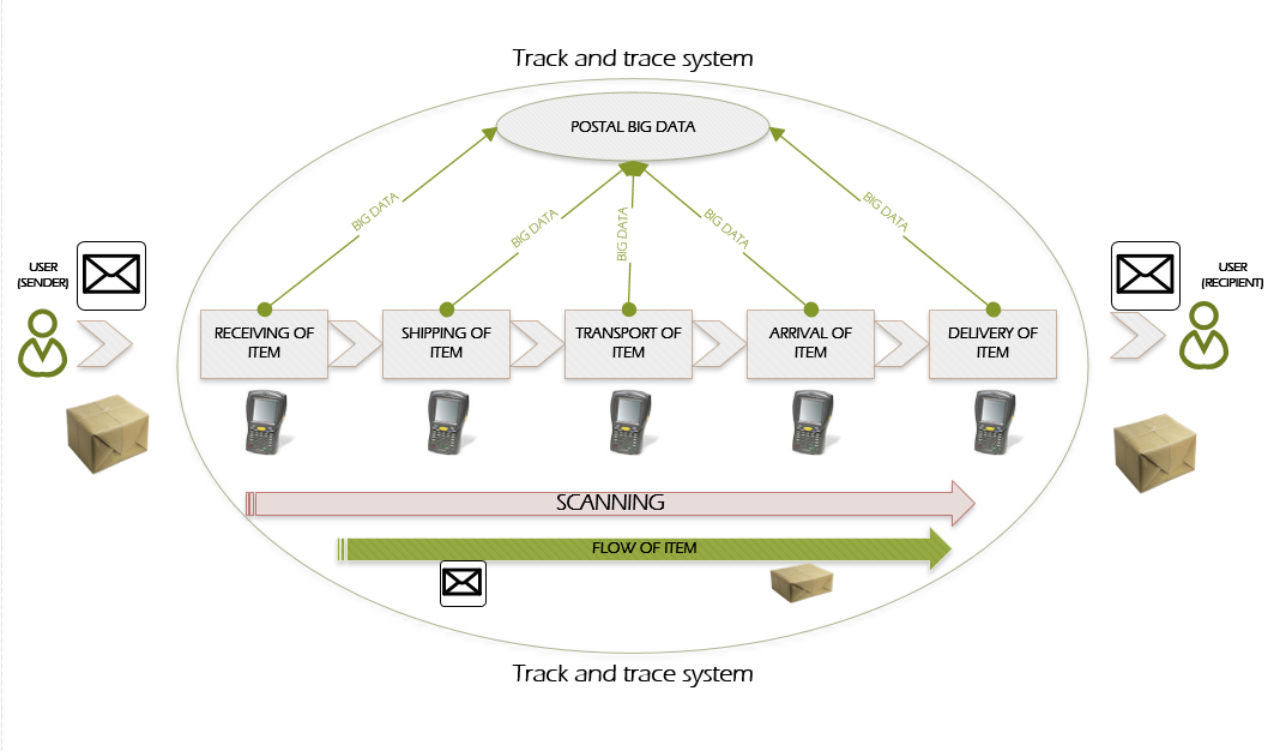

Figure 3: Transfer of postal items and system for tracking

Most of the system for the tracking of parcels and mails (Figure 4) are consisted of the following components (Kujačić, M., 2012):

- Portable Data Terminal (PDT) - handheld computer that is used to scan bar code labels on the items and containers, making sheets of delivery and delivery of item with acceptance of signature and name of the recipient in electronic form
- Workstation for monitoring and control. It consists of computers, printers and printer for bar codes and communication pad
- Host computer system for monitoring and control

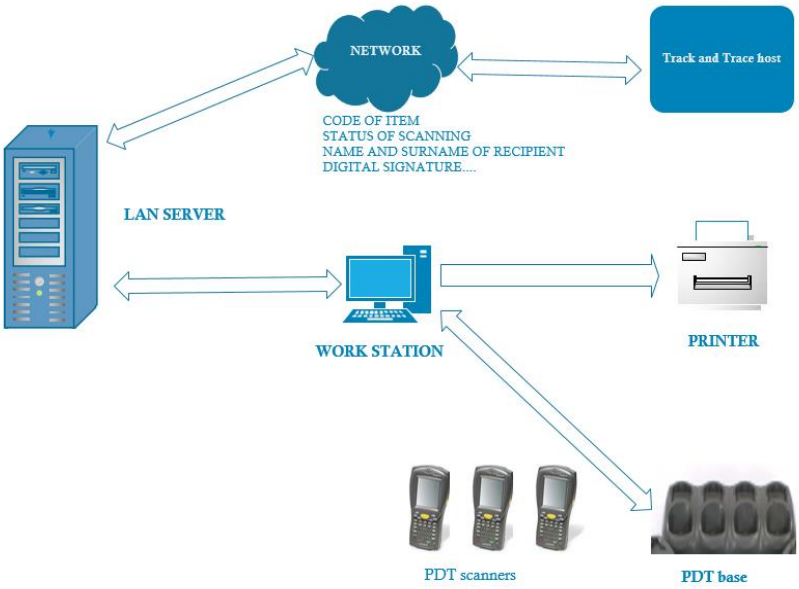

Figure 4: The main components of track and trace system

Items are scanned in all phases of transfer in this system. There is a large amount of postal data such as:

- Code of items
- Address of users
- Full name of the recipient
- Digital signatures
- Sending time
- Weight of items

Such data can be used in various applications:

- Optimization of different internal processes in the company
- Identifying bottlenecks in the system
- Workforce optimization
- Identifying key users
- Determination of the most important regions, municipalities and cities depending on the number of sent items
- Prediction number of items and the active fleet
- Reducing the various types of costs etc.

6. CONCLUSION

Bearing in mind all that is mentioned in previous chapters, it is clear that big data occupy an important place in the postal sector. Large companies realized in time the significance of big data and the use of it in various ways, primarily to create a competitive advantage through the creation of various applications. This is firstly related to leading postal organizations. Postal operator of Serbia can, through various partnerships with these companies, gain the necessary experience, modernize its range of services, and therefore much faster launch innovation. In the near future is expected more intensive development of e-commerce and for this reason the development of some of these applications will be a competitive advantage.

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COMPARATIVE OVERVIEW OF JAVASCRIPT FRAMEWORKS USED IN E-BUSINESS APPLICATIONS

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Abstract: *In this paper I presented the current development and experience using JavaScript and pointed particularly to the two additional functionality as improvement of JavaScript, focusing especially on its use as a real, general-purpose programming language. Since 1995 JavaScript gave web browsers the power to do more than just load web documents. Now, JavaScript programming language is the industry standard client-side scripting language that is used in web applications. JavaScript is supported by all major browsers and is increasingly the foundation of new web development technologies such as Ajax and JSON. Two main improvements of JavaScript language are in the form of library and frameworks. Framework is a web application framework written in JavaScript and describes the structure of the application with main goal to make your app more flexible and scalable and JavaScript library which offers a lot of useful predefined functions that you can call to improve and expand your application. In the market they appeared many projects with the aim to create JavaScript libraries and frameworks that would facilitate writing JavaScript code. I will list the most used libraries and frameworks that exist in the market and their main characteristics and benefits as well as the difference between a library and framework. Many developers do not recommend using a JavaScript library, I will try to show that they can still be useful in projects.*

Keywords: *JavaScript, framework, library, programming, WEB, plugin*

1. INTRODUCTION

With the increasing popularity of the World Wide Web, scripting languages and other dynamic languages are currently experiencing a renaissance. A whole new generation of programmers are growing up with languages such as JavaScript, Perl, PHP, Python and Ruby. The attention that dynamic languages are receiving is remarkable, and is something that has not occurred since the early days of personal computers and the BASIC programming language in the late 1970s and early 1980s. At the same time, the web is becoming the de facto target platform for advanced software applications, including social networking systems, games, productivity applications, and so on. Software systems that were conventionally written using static programming languages such as C, C++ or Java, are now built with dynamic languages that were originally designed for scripting rather than full-scale application development.

JavaScript is a scripting language developed in 1995 by Netscape and added to the Netscape Navigator browser in the same year. JavaScript gave web browsers the power to do more than just load web documents. While JavaScript, as first developed by Netscape (and later Mozilla), has long had a presence on the Web for many websites, it gained a particular pitch with the rise of the Web 2.0 era of computing, in which JavaScript became increasingly used for the development of user interfaces for applications, both web-based and desktop-based. The majority of web sites in the world now use JavaScript and other aspects of the internet such as advertising and analytics and widgets almost depend on its existence.

Now, JavaScript programming language is widely used for web programming and, increasingly, for general purpose computing. JavaScript become the industry standard client-side scripting language that is used in web applications. Scripting is easier to learn and use than many other kinds of programming, and provides a convenient way of automating repetitive tasks or extending applications to provide additional tools for other users. As the industry-standard, must-know scripting language, JavaScript is supported by all major browsers and is increasingly the foundation of new web development technologies such as Ajax and JSON. As AJAX applications gain popularity, client-side JavaScript code is becoming increasingly complex. However, few automated vulnerability analysis tools for JavaScript exist (Saxena et al., 2010).

A variety of projects have sprung up to build reusable JS libraries and frameworks — and at this point, a good number of them have matured and shown staying power that they're worth taking a serious look at and relying on in professional projects. The development of object-oriented frameworks and product line architectures was one of the most important technological leaps forward in the field of computation. This led to the implementation of standardized software architecture which can be specialized by application-specific code, and also

considerably decreased the length of the source code. However, one must take account of the extra effort required for framework development, plus the higher cost input. Framework development seems still to be in its infancy, despite significant developments in the tools and technologies, because of a uniformity of efforts and absence of standards. The recent efforts towards standardization of the UML have led to the hope of harnessing it as a notational basis for projects dealing with framework development, but it is not without lacunae in its constructs (Suman, 2014).

A JavaScript framework is a web application framework written in JavaScript and it differs from a JavaScript library. A library offers a lot of useful predefined functions that you can call to improve and expand your application. A framework describes you the structure of the application and gives you a way to organize your code to make your app more flexible and scalable. You can't call a framework, but it is the framework that will call and use your code in some particular way.

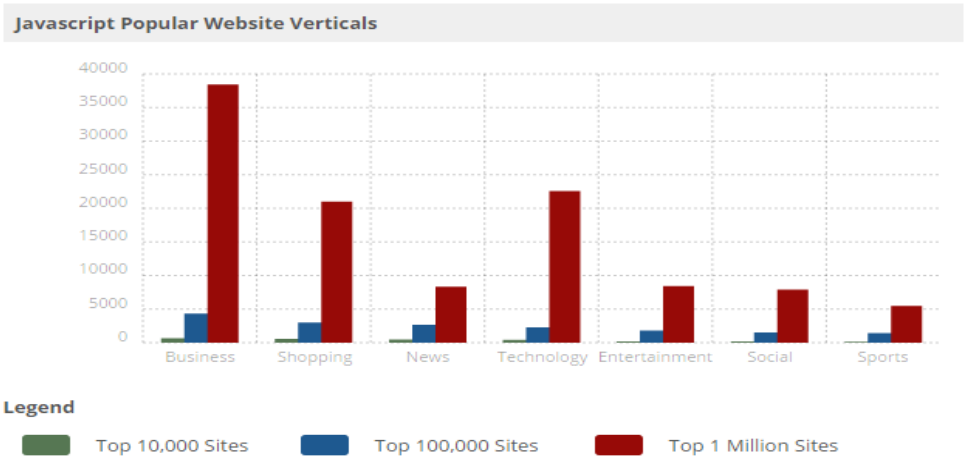

Figure 1: JavaScript popular website

2. JAVASCRIPT LIBRARIES

A JavaScript library is a library of pre-written JavaScript which allows for easier development of JavaScript-based applications, especially for AJAX and other web-centric technologies. With the expanded demands for JavaScript, an easier means for programmers to develop such dynamic interfaces was needed. Thus, JavaScript libraries and JavaScript widget libraries were developed, allowing for developers to concentrate more upon more distinctive applications of Ajax. This has led to other companies and groups, such as Microsoft and Yahoo! developing their own JavaScript-based user interface libraries. Some JavaScript libraries allow for easier integration of JavaScript with other web development technologies, such as CSS, PHP, Ruby, and Java. Many libraries include code to detect differences between runtime environments, and remove the need for applications to allow for such inconsistencies. Almost all JavaScript libraries are released under either a copycenter or copyleft license to ensure license-free distribution, usage, and modification. Some JavaScript libraries, such as YUI, are classified as frameworks since they exhibit full-stack capabilities and properties not found in general JavaScript libraries.

The main arguments against using any JavaScript library have always been speed and size: some say that using a library adds too much download bloat to pages, while others claim that libraries perform poorly compared with leaner custom code.

First, as far as size is concerned, jQuery (for example) is lightweight. The core jQuery library has always had a fairly small footprint—about 19KB for the basics, less than your average JPG image. Any extras your project needs (such as plugins or components from the jQuery UI library) can be added in a modular fashion—so you can easily count your bandwidth calories.

Speed (like size) is becoming a decreasing concern as computer hardware specifications rise and browsers' JavaScript engines grow faster and faster. Of course, this is far from implying that jQuery is slow. Every new release is faster than the last, so any benefit you might derive from rolling your own JavaScript is shrinking every day.

When it comes to competing JavaScript libraries (and there are more than a handful out there), jQuery is the best at doing what jQuery does: manipulating the DOM, adding effects, and making Ajax requests. Still, many of the libraries out there are of excellent quality and excel in other areas, such as complex class-based programming.

jQuery

jQuery is a powerful JavaScript library that can enhance your websites regardless of your background. Creators of the popular jQuery learning resource, share their knowledge, experience, and enthusiasm to make one of the most widely used JavaScript library and to help you to make your web applications shine. For designers, jQuery leverages existing CSS and HTML skills, allowing you to dynamically find and change any aspect of a page. For programmers, jQuery offers an open-source, standards-compliant, unobtrusive approach to writing complex JavaScript applications (Chaffer & Swedberg, 2007). JQuery is the most detected JavaScript library in use on the web. It provides features and functions of JavaScript that not only make JavaScript browser agnostic but also ease the development process.

jQuery makes it easy to play with the DOM, add effects, and execute Ajax requests. In fact, it makes it so easy that you'll often need to pull back from some craziness you just invented, put on your web designer hat, and exercise a little bit of restraint. But there are a multitude of notable factors you should consider if you're going to invest your valuable time in learning a JavaScript library.

Aside from being a joy to use, one of the biggest benefits of jQuery is that it handles a lot of infuriating cross-browser issues for you. Anyone who has written serious JavaScript in the past can attest that cross-browser inconsistencies will drive you mad. For example, a design that renders perfectly in Mozilla Firefox and Internet Explorer 8 just falls apart in Internet Explorer 7, or an interface component you've spent days handcrafting works beautifully in all major browsers except Opera on Linux. Even when cross-browser problems are relatively simple to handle, you always need to maintain a mental knowledge bank of them.

The jQuery team is keenly aware of cross-browser issues, and more importantly they understand why these issues occur. They have written this knowledge into the library—so jQuery works around the caveats for you. Most of the code you write will run exactly the same on all the major browsers, including everybody's favorite little troublemaker: Internet Explorer 6.

This feature alone will save the average developer a lifetime of headaches. Of course, you should always aim to keep up to date with the latest developments and best practices in our industry—but leaving the task of hunting down obscure browser bugs to the jQuery Team (and they fix more and more with each new version) allows you more time to implement your ideas.

Making today's technologies cross-browser compliant is all well and good, but jQuery also fully supports the upcoming CSS3 selector specification, even in Internet Explorer 6.0. Selecting elements you want to change lies at the heart of jQuery's power, and CSS3 selectors give you even more tools to work with.

Separating script behavior from page presentation is best practice in the web development game—though it does present its share of challenges. jQuery makes it a cinch to completely rid your markup of inline scripting, thanks to its ability to easily hook elements on the page and attach code to them in a natural, CSS-like manner. jQuery lacks a mechanism for adding inline code, so this separation of concerns leads to leaner, cleaner, and more maintainable code. Hence, it's easy to do things the right way, and almost impossible to do them the wrong way (Castledine & Sharkie, 2010).

Also included is an assortment of utility functions that implement common functions useful for writing jQuery: string trimming, the ability to easily extend objects, and more. These functions by themselves are particularly handy, but they help promote a seamless integration between jQuery and JavaScript which results in code that's easier to write and maintain.

One noteworthy utility is the supports function, which tests to see if certain features are available on the current user's browser. Traditionally, developers have resorted to browser sniffing—determining which web browser the end user is using, based on information provided by the browser itself—to work around known issues. This has always been an unsatisfying and error-prone practice. Using the jQuery supports utility function, you can test to see if a certain feature is available to the user, and easily build applications that degrade gracefully on older browsers, or those not standards-compliant.

The jQuery team has taken great care in making the jQuery library extensible. By including only a core set of features while providing a framework for extending the library, they've made it easy to create plugins that you can reuse in all your jQuery projects, as well as share with other developers. A lot of fairly common functionality

has been omitted from the jQuery core library, and relegated to the realm of the plugin. Any additional required functionality can be included easily on a page-by-page basis to keep bandwidth and code bloat to a minimum. Thankfully, a lot of people have taken advantage of jQuery's extensibility, so there are already hundreds of excellent, downloadable plugins available from the jQuery plugin repository, with new ones added all the time. Whenever you're presented with a task or problem, it's worth checking first to see if there's a plugin that might suit your needs. That's because almost any functionality you might require has likely already been turned into a plugin, and is available and ready for you to start using. Even if it turns out that you need to do some work yourself, the plugin repository is often the best place to steer you in the right direction.

jQueryUI
jQuery has already been used to make some impressive widgets and effects, some of which were useful enough to justify inclusion in the core jQuery library itself. However, the jQuery team wisely decided that in order to keep the core library focused, they'd separate out higher-level constructs and package them into a neat library that sits on top of jQuery.

That library is called jQuery User Interface (generally abbreviated to just jQueryUI), and it comprises a menagerie of useful effects and advanced widgets that are accessible and highly customizable through the use of themes. jQueryUI is a collection of GUI widgets, animated visual effects, and themes implemented with jQuery (a JavaScript library), Cascading Style Sheets, and HTML. jQueryUI is used on over 197,000 of the top one million websites, making it the second most popular JavaScript library.

Accordions, sliders, dialog boxes, date pickers, and more—all ready to be used. You could spend a bunch of time creating them yourself in jQuery but the jQueryUI controls are configurable and sophisticated enough that your time would be better spent elsewhere—namely implementing your unique project requirements rather than ensuring your custom date picker appears correctly across different browsers.

3. JAVASCRIPT FRAMEWORKS

In computer programming, a software framework is an abstraction in which software providing generic functionality can be selectively changed by additional user-written code, thus providing application-specific software. A software framework is a universal, reusable software environment that provides particular functionality as part of a larger software platform to facilitate development of software applications, products and solutions. Software frameworks may include support programs, compilers, code libraries, tool sets, and application programming interfaces (APIs) that bring together all the different components to enable development of a project or solution. Frameworks contain key distinguishing features that separate them from normal libraries. In a framework, unlike in libraries or normal user applications, the overall program's flow of control is not dictated by the caller, but by the framework. A framework has a default behavior. This default behavior must be some useful behavior and not a series of no-ops. A framework can be extended by the user usually by selective overriding or specialized by user code to provide specific functionality. The framework code, in general, is not supposed to be modified, while accepting user-implemented extensions. In other words, users can extend the framework, but should not modify its code. Frameworks and tools have been built to make using JavaScript easier or to provide specific functionality for other website functions. However, since JavaScript is such a flexible and dynamic language, each framework can present very different approaches to the problems of web development — each with its own pros and cons. As such, improving the correctness, security and performance of JavaScript applications has been the driving force for research in type systems, static analysis and compiler techniques for this language (Richards et al., 2010).

In the times of rapid app development, we need better ways to quickly develop interactive web applications and that is where JavaScript frameworks come to the rescue. JavaScript frameworks are the backbone of single page web applications development and provide superpowers to plain HTML and JavaScript. Use of JavaScript frameworks give you space to focus on developing interactive elements of the user interface without worrying too much about code structure and code maintenance. All JavaScript frameworks can be written in an accessible way with graceful degradation, frameworks seen here which imply out-of-the-box accessibility have made a special effort to document best practices for their particular framework. In web application development, framework is a collection of technologies for building dynamic web pages on the client side. Most of the JavaScript frameworks work on MVC design paradigm and enforce structure to ensure more scalable, reusable, maintainable JavaScript code. It however is not necessary that all frameworks ride on MVC pattern.

These are some JavaScript frameworks that are most advanced, feature rich, popular among developer community and make it possible to build complex and feature rich single page interactive web applications.

Prototype
Prototype was one of the first JavaScript libraries to gain prominence during the Web 2.0 resurgence. When the term AJAX was first coined in 2005, making cross - browser XMLHttpRequests was a minefield of browser - specific code. Prototype assists you in your quest for cross - browser compatibility by smoothing out the rough edges of event handling by providing a common method for binding events to their respective handlers and providing a common interface for creating AJAX requests that work in all browsers. It also gives you a cross - browser way to manipulate the DOM, by handling the special cases in all browsers, and allowing you to focus on just writing code without cluttering up your code with browser - specific " if - else " statements. Prototype extends the JavaScript language as well as the elements. The native JavaScript object is extended to include methods for determining the type of data the object represents as well as helpful serialization methods. The enumerable class allows you to easily traverse and manipulate your arrays of both JavaScript objects and DOM elements by providing useful methods such as each() and map() directly on your arrays. The native function object is also extended with useful methods, such as wrap(), which let you write interceptors for your methods that provide useful features like logging. Prototype eases inheritance with the class object. You can easily extend your objects and create hierarchies without the headaches associated with normal inheritance in statically typed languages.

All of these features make Prototype the best choice for writing logic in JavaScript, and it provides you with an excellent base for writing your own JavaScript library. Since Prototype does all of the heavy lifting for you, you can focus on the fun parts of library development — creating new widgets and data structures. Prototype is an excellent framework to use either as your main JavaScript library or as the foundation of another library.

Part of the magic of Prototype is the extension of DOM elements by the framework. By adding new methods to elements, Prototype makes it easier to write cross - browser code in a more eloquent manner. It is easier to write unobtrusive JavaScript by taking advantage of helper methods such as getElementsByClassName and getElementsBySelectors, making it easy to apply styling or events to groups of elements with something in common. By extending the elements you are working on, Prototype is able to centralize all of the cross - browser hacks that make JavaScript programming such a chore. Prototype keeps its extension methods for all elements in the Element.Methods and Element.Methods.Simulated object. If the element is an input, select, or textarea tag, the methods in Form.Element.Methods are also included. Form elements themselves are extended with the methods in Form.Methods. Most of these methods return the original element, so you can chain together methods like so: $(myElement).update("updated").show();. It is important to note that not only is the element you choose extended, but all of the child elements of that element are also extended. In browsers that support modification of the HTMLElement.prototype, Prototype adds the methods to HTMLElement for you. That means you don't have to call Element.extends() on any element you create by hand. The easiest way to extend a DOM element is to use the $() function to get a reference to the element rather than using document.getElementById or some other method.

Prototype was one of the first major JavaScript libraries to make cross - browser AJAX calls less painful. It can automatically interpret JavaScript and JSON responses from your server. It makes it easier to update your user interface with data requested from your server at periodic intervals and controls how often requests are made to your server. With Prototype, your form elements are extended the same way your other HTML elements are, but with a few specific methods. Using the $F() method, you can quickly get the value of any form element on your page. The Form.Elements object contains methods that Prototype uses to extend your form elements. You can easily serialize all of your form elements into an object literal or a string suitable for passing into an AJAX call (Orchard et al., 2009).

AngularJS
It was first released in 2009 and made available as open source framework under MIT license. Ever since its release, Angular ecosystem has grown beyond imagination. It currently boasts the biggest community of developers and is the most used JavaScript framework for developing Single Page Web Applications.

AngularJS framework gives a set of functionality to HTML by adding all the necessary features required to build dynamic views (interactive user interface). It gives option to extend HTML attributes by the use of Angular directives. Extending HTML with AngularJS is very simple, one can use standard AngularJS directive or develop a custom directive and mount it on any div. When AngularJS compiler compiles and renders the HTML on user interface, it does the DOM manipulation and attaches all features provided by the directive used. Of course, this is just one aspect of how AngularJS can be used to empower web applications. When user interacts with the interface and provides an input, the view and the model (JavaScript objects) are synchronized, the logic in the model is executed and the DOM gets updated. The reverse is true as well, if model gets updated, view is re-rendered. This essentially takes away all the problems of writing manual code for DOM manipulation.

Recently released Framework ReactJS is giving tough competition to AngularJS but AngularJS is holding the ground tight and growing in demand as ever before. The main reason behind Angular's continuous growth is the improvements and advancements it brings in with every new release.

React
React JavaScript framework is behind the user interface of Facebook as well and Instagram. This gives us a quick idea about how powerful is React when it comes to building large scale applications of extreme dynamic nature. React was first released as open source in 2013 under BSD license. The community is growing rapidly ever since its release and probably it is one of the fastest growing JavaScript framework as of today.

React is best at rendering complex user interfaces with high performance. The basic fundamental behind React is the concept of virtual DOM. React utilizes a virtual DOM, which can be rendered either at client side or server side and communicate back and forth. When the data manipulation is much more dynamic and complex, client side DOM manipulations become performance intensive. The React approach to handle this is – render the DOM at server side, the virtual DOM. Update only the selective/changed nodes of browser DOM instead of re-rendering the entire DOM. Another biggest advantage of React is the re-usability it brings on the table in the form of reactive components. React component libraries can be created and used across applications or made available for public use.

MooTools
MooTools (My Object-Oriented Tools) is a lightweight, object-oriented JavaScript framework. It is released under the free, open-source MIT License in September 2006.

MooTools provides the user with a number of advantages over native JavaScript. An extensible and modular framework allowing developers to choose their own customized combination of components. MooTools provides a detailed, coherent application programming interface (API) as well as a custom downloads module allowing developers to download only the modules and dependencies they need for a particular app. An advanced effects component, with optimized transitions such as easing equations used by many Flash developers (Newton, 2008). Enhancements to the DOM, enabling developers to easily add, modify, select, and delete DOM elements. Storing and retrieving information with Element storage is also supported. The framework includes built-in functions for manipulation of CSS, DOM elements, native JavaScript objects, Ajax requests, DOM effects, and more.

Ember.js
Ember.js is another powerful MVC JavaScript framework. Ember.js was initially released in 2011 as open source JavaScript framework by Yehuda Katz under MIT license. It competes with AngularJS and React when it comes to building interactive frontend user interfaces and also has a very active community of developers.
Ember.js also rides on the principal of two way data binding like AngularJS, i.e. update view when model changes and update model when the view changes, keeping both in sync all of the time. It is coming up with Fastboot.js module that allows server side rendering of DOM, the concept similar to what React is already using for better performance in complex UI rendering. Ember.js targets the best of both AngularJS (two way data binding) and React (server side rendering).

Aurelia
Aurelia is the creation of Rob Eisenberg and team who come mostly from the world of AngularJS and Durandal. Aurelia though is an open source product is officially managed by Durandal Inc., a startup company that creates libraries, tools and frameworks to support next generation of web development.

Aurelia is released in January 2015, and is ready for production use. It extends the capabilities of Durandal and is termed as NextGen version of it by Eisenberg. For the existing developers who work in Durandal or Angular1 and 2, Aurelia comes with a clear migration path. It is managed by highly professional community and carries a great legacy.

A power fact about Aurelia is that it is highly modularized and comprises of many independent small libraries. One can use entire framework in the project, use few of the required libraries, or extend the selected libraries to create custom framework. Aurelia is self-contained package and doesn't have any external dependencies except for polyfills.

Meteor
Meteor is the magical full stack platform for building end to end mobile and web applications completely in JavaScript. Meteor is the power player and comes equipped with all the features you need for front-end rendering, back-end development, business logic and database management. It was first released in 2012. by Meteor Development Group as an open source JavaScript framework under MIT license.

The best thing about Meteor is that you use only JavaScript for end to end application development, no need to invest time learning anything else. Meteor is modular and the packages and libraries can be used on demand.

The server side packages run in the Node.js and you do not need anything else but Meteor packages to access the database, all in JavaScript. This makes Meteor applications real time web applications. From performance perspective, any changes in the database are reflected back on the user interface in the real time and vice versa without the handshake between different languages or without major overhead of server response times.

Backbone.js
It was first released in 2010 by Jeremy Ashkenas as open source JavaScript framework under MIT license. The popularity and power of Backbone.js can be judged from the fact that biggies like Pinterest, Foursquare, Walmart, Disqus and Delicious are using Backbone.js. This is just a small subset of Backbone.js users.

The good thing about Backbone.js is that it is simple, small size package and easy to learn. You can get started building apps with Backbone.js JavaScript framework within no time. Backbone.js is very flexible in a way that it comes with just the minimal and you can build anything on top of it, by writing your own code or by using third party JavaScript frameworks. One can even build a fully functional opinionated framework with Backbone.js at the core. It is very useful but more as a side framework rather than the core framework of your web project.

Polymer
Polymer was released by Google back in 2013 Polymer uses the concept of web components to extend HTML capabilities.

Web components is the browser technology released by W3C using which new custom HTML elements can be created. For example <audio> is a standard HTML5 element but with the web components and related technologies you can create your own custom element - like <my-audio>. Polymer gives powers and brings structure in building custom HTML elements using browser based technologies that includes web components.

Knockout
Knockout was initially released by Steve Sanderson in 2010 as open source JavaScript framework under MIT license. Knockout works under the MVVM design paradigm and that makes it a little different from Ember.js and AngularJS.

Knockout has had its golden time but as of now it is growing at a much slower pace as compared to the earlier competitors like AngularJS, Ember.js or Backbone.js. The slow growth is simply because it lags way behind in terms of improvements and adding more features. Knockout has a great legacy and can definitely make a come back but only if someone else adopts it and starts nurturing it with the latest and greatest of the world of JavaScript technologies.

Vue.js
Vue.js is the creation of Evan You. It was first released in 2014 as open source framework for public use under MIT license. Vue.js is relatively new and is gaining lot of traction among the community of developers. Vue.js works with MVVM design paradigm and has a very simple API. Vue.js demonstrate minimalism to the extreme and allows you to use selective modules, as required. Vue.js is inspired by AngularJS, React and Knockout and updates model and view via two way data binding. While Vue.js is not in the league of AngularJS or Ember.js but conceptually has all the potential to be the JavaScript framework of future and hold respectable market share.

Figure 2 shows the percentages of websites using various JavaScript libraries and frameworks. A website may use more than one JavaScript library or framework. JQuery is used by 70.1% of all the websites, that is a JavaScript library market share of 96.0% and 27% of the websites use none of the JavaScript libraries or frameworks.

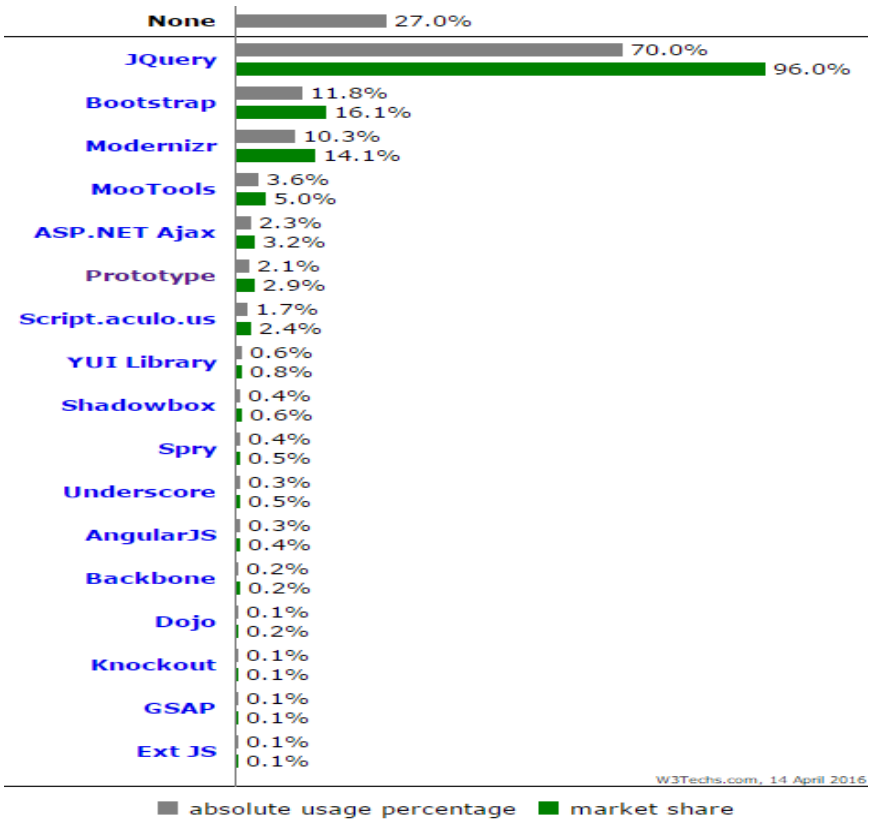

Figure 2: Usage of JavaScript libraries and framework

3.1. Frameworks to build mobile application with HTML, CSS & JavaScript

The emergence of mobile and ubiquitous technologies as important tools to complement formal learning has been accompanied by a growing interest in their educational benefits and applications. Mobile devices can be used to promote learning anywhere and anytime, to foster social learning and knowledge sharing, or to visualize augmented reality applications for learning purposes. However, the development of these applications is difficult for many researchers because it requires understanding many different protocols, dealing with distributed schemas, processes, platforms, and services, learning new programming languages, and interacting with different hardware sensors and drivers. For that reason, the use of frameworks and middleware that encapsulate part of this complexity appears to be fundamental to the further development of mobile learning projects. There been a study to analyze the state of the art of frameworks and middleware devoted to simplifying the development of mobile and ubiquitous learning applications (Martin et al., 2011).

One key advantage of using web technology to build your app is portability. Using a packager/compiler, like PhoneGap, you will be able to port and install your app on many different platforms. There are a number of frameworks that make this possible. They also have done half of the hard work to bridge the gap between web and mobile platforms. PhoneGap provides a set JavaScript APIs that connect to the device's native functions such as camera, compass, contacts, and geolocation. PhoneGap lets us build a mobile application without the native programming language. Instead we can use a framework like jQuery Mobile. It will compile your app using the platform's SDK and will be ready to install on the platform it supports including iOS, Android, Windows Phone, Blackberry and Web OS.

The mobile app development landscape is changing very rapidly with developers moving from native to HTML5 based hybrid app development options. The biggest advantage of hybrid mobile apps is "write once and run everywhere" approach.

JQuery Mobile

jQueryMobile suite is still in the game and holding the ground tight against the feature rich hybrid mobile app development frameworks like Ionic, Onsen UI and Framework 7. The die-hard jQuery fans community has built this minimalist jQueryMobile package on top of solid jQuery and jQueryUI foundation. The focus of jQueryMobile is to empower developers to build web apps and mobile apps that run seamlessly and with unique user experience across mobiles, tablets and desktops. It doesn't focus much on providing native look and feel to apps for individual platforms like iOS or Android. jQueryMobile is a robust mobile development

framework to build cross-mobile-platform app. jQueryMobile support a wide range of different platforms, from a regular desktop, smart phone, tablet, or an e-reader device like Nook or Kindle. Similar to its sibling, jQueryUI, jQueryMobile comprises a number of UIthat, in this case, is optimized for mobile and touch-enabled device**s.**

Mobile Angular UI
This one is for the fans of Bootstrap and AngularJS. With Mobile Angular UI, you get best of both Bootstrap 3 and AngularJS framework to build HTML5 mobile applications. Angular UI is more like an extension to Bootstrap 3 but without any dependencies to bootstrap.js or jQuery. It utilizes Fastclick.js and Overthrow.js for smooth and better mobile experience. Mobile Angular UI provides directives for building UI component like overlays, switches, sidebars, scrollable areas and absolute positioned navbars that don't bounce on scroll. These essentially are the components that you find missing in Bootstrap 3 for building mobile apps. Mobile Angular UI is available as open source and free to use under MIT license.

Sencha Touch
Sencha Touch is a mobile framework powered by HTML5 and CSS3, providing APIs, animations, and components that are compatible with the current mobile platforms and browsers. Sencha Touch supports both Cordova and PhoneGap. You can compile your app, and submit your app to the respective platform's app stores. In addition, Sencha Touch provides a set of themes for iOS, Android, Blackberry, Windows Phone, Tizen, and a variety of other platforms to help your app feel like a native app.

Ratchet
Ratchet was originally used by Twitter as an internal tool to create their mobile app prototype which is then released publicly as an open source project. Ratchet comes with a collection of User Interface and JavaScript plugins for building simple mobile apps, providing reusable HTML classes. In version 2.0, Ratchet is also shipped with its proprietary font icon set named Ratcheticon and two pre-made UI themes for iOS and Android**.**

Ionic
Ionic is an HTML5 mobile framework with focus on performance, by leveraging hardware acceleration, and it requires no third-party JavaScript library. It works best together with AngularJS to build an interactive app. Similar to Ratchet, Ionic is shipped with a nicely crafted font icon set, Ionicons, and a bunch of reusable HTML classes to build the mobile user interface.

Lungo
Lungo is a lightweight mobile framework based on HTML5 and CSS3. It has very nice default styles that you can use as a starting point to design your mobile app. Aside for the mobile user interface components, Lungo brings a number of JavaScript API to control your app. Lungo supports the following platforms: iOS, Android, Blackberry and Firefox OS.

Famo.us
A new mobile framework block, Famo.us promises to eliminate HTML5 performance issue on mobile devices with its lightweight JavaScript engine (only 64k). Famo.us, reportedly, will also launch a cloud-based service to package your app to publish to the AppStore. Famo.us is another powerhouse HTML5 apps development framework and targets to provide near native experience in hybrid apps. The main difference between Famo.us and other hybrid HTML5 frameworks is that it focuses more on graphics rendering, 2d and 3d and hence is more suitable for games development.

4. CONCLUSION

Phenomenon of JavaScript frameworks is not very old but has grown at a very fast pace in the last couple of years. JavaScript frameworks have become the default choice for creating complex user interfaces, specifically for Single Page Web Applications.

Different frameworks offer different concepts and methodology but attempt to solve the common underlying problem of rendering complex user interfaces dynamically and making single page applications much more useful and fast. The frameworks mentioned in this article are among the best and most widely used JavaScript frameworks on the market today. They all help to simplify writing code, but each of them is oriented towards a concrete problem and according to these characteristics the developers use different frameworks in their projects. New frameworks are constantly appear on the market while some disappear from use depending on the support and continuous development that the founders provides. Open source frameworks are more common in usage because they provide the programmer ability to adapt them to himself. It is difficult to allocate some of these frameworks as the best to use because each of them offers its own characteristics which more or less means in different projects so I did not do a comparison of frameworks but only mentioned the most

frequently used and cited their improvements of basic JavaScript. On the programmer is to choose the framework toward its affinities and needs.

At the other side, the main arguments against using any JavaScript library are that using a library adds too much download material to pages, while others claim that libraries perform poorly compared with leaner custom code. I wrote this text from my experience of using JavaScript libraries. In my projects I use jQuery library that gives me all the benefits of writing easier and simpler code with fewer lines. Its producers are trying to continually improve their product and constantly new versions are available to download. Each subsequent enhancement reduces the unnecessary content and adds a new features that are required for use in practice. I do not think it complicates the project and that makes it massive, quite the contrary, it helps in simple programming. I hope that listing type JavaScript library successfully reassure all those who were skeptical of using JavaScript libraries.

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