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E-BUSINESS TECHNOLOGIES

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Foreword to the 1st EBT conference

Dear colleagues, dear friends,

We are glad to welcome you to the very first E-business technologies conference, at FON, University of Belgrade. The goal of the conference is to gather leading professors, scientists, researches and experts in practice, well-established IT companies and PhD students in order to share ideas and use cases from practice in area of e-business.

Interactions and convergence of the advanced information technologies and e-business ecosystems have redefined methods modern business entities and ecosystems generate value, shape roles and activities, while opening new directions, challenges and environments for both academia and practitioners. Digital e-business ecosystems bring plethora of possibilities, opportunities and challenges in different contexts. We see E-business technologies conference as a kind of a platform or environment for strategic networking on both national and international level. In addition, the idea is to foster scientific potentials, skill and knowledge and promote and empower the ideas of digital society, competencies, citizen science, crowds, etc.

EBT 2021 accepted 49 regular papers from 15 countries. In addition to a large number of researchers and experts from Serbia, the conference will include researchers from abroad: Russia, USA, France, Iran, India, Portugal, Bosnia and Herzegovina, Croatia, Romania, Libya, Eritrea and Turkey. Keynote lectures will be given by two eminent experts: prof.dr Miodrag Mihaljević, research professor, Mathematical institute SANU and Borko Kovačević, Director of Marketing & Operations at Microsoft Singapore.

Further, the conference includes many sessions, a workshop: Azure Synapse Analytics, handson series: IoT Python programming and Microservices technologies. Finally, the round table: 20 years of teaching e-business in Serbia will be organized within the conference program

We thank all the volunteers and other members of the organizational team for the huge effort, help and support

Welcome to EBT 2021 in Belgrade

Marijana Despotović-Zrakić
Zorica Bogdanović
Aleksandra Labus
Dušan Barać
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EBT 2021 Keynote speakers

Prof. dr Miodrag Mihaljević
Research Professor at Mathematical Institute, Serbian Academy of Sciences and Arts, Belgrade, Serbia

Borko Kovačević
Director, Marketing & Operations, Microsoft Singapore

EBT 2021 - Open ceremonies speakears

Prof. dr Sanja Marinković
Vice Dean for international cooperation, Faculty of Organizational Science, University of Belgrade

Prof. dr Zorica Bogdanović
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Informatics Association of Serbia

EBT 2021 - Workshop speakears

Veljko Vasić
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Ivan Vujić
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EBT 2021 - Partners

University of Belgrade, http://bg.ac.rs/

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IEEE Chapter Computer Science CO-16, https://elab.fon.bg.ac.rs/ieee-chapter-computer-science-co-16/

EBT 2021

KEYNOTE LECTURE

Towards secured digital business ecosystems: From threats to opportunities

Miodrag Mihaljević

Research Professor

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Abstract: Further deployment of blockchain technology requires advances in techniques which provide efficiency and security of blockchain based systems. A particular challenge is development blockchain consensus protocols which provide reduction of the energy required in comparison with the traditional Proof-of-Work approach, and at the same time provide the same security level. The challenges also include requirement for advances in encryption and authentication techniques in order to achieve implementation lightweightness and cryptographic security. Finally, in a number of scenarios, the blockchain based system should be dedicated to the addressed application. Consequently this talk points out to certain recent results on advanced techniques for blockchain technology and employment of these results in some illustrative applications.

EBT 2021

KEYNOTE LECTURE

Digital strategy: Igniting digital transformation

Borko Kovačević

Chief Operating Officer
Microsoft Singapore
Singapore

Abstract: Today's pace of change is exponential, and large organizations struggle to spot new and radical ideas quickly, unable to move fast enough to develop their potential. CHANGE, and the rate at which change is happening continues to accelerate. Business, society, and the ways in which people relate to and are shaped by technology are evolving at an exponential rate. It's a time of enormous opportunity, rich with possibilities, but it is also an anxious time. How do we avoid being left behind? How can an organization encourage innovation? How much risk can we tolerate, and how do we harness our current strengths to drive future transformation?

In a world of exponential innovation it is easy to be taken by surprise. Organizations trapped by linear thinking may not notice the steepening exponential curve until it's too late, and they're left behind by more nimble competitors. We need to speed up our innovation processes and be ready to respond to rapid change. Incorporating 'Day After Tomorrow' thinking into our business models is the key to developing agility. Companies should spend 70% of their time, talent, and investments on today, 20% on tomorrow, and 10% on the Day After Tomorrow. Ten percent might not seem like much, but devoting even a small amount of time and energy to the long view can generate enormous long term value. Successful companies don't wait until they are in decline to start thinking about the next big thing. When your competitors overtake you, riding the exponential curve of disruption, it's already too late. It may seem counterintuitive, but the right time to begin this process of risk[1]taking and long-term radical thinking is now, when the revenue is flowing, growth is rapid, and you're crushing your competition. That's when you have the time and the money to shift gears, and you're going to need to shift them because big changes are coming.

In this presentation we will be going through the concept of "Day After Tomorrow" coined by Peter Hinsenn, as well as some examples of how Microsoft is helping it's customers and partners think about the "Day After Tomorrow".

EBT 2021

DIGITAL BUSINESS ECOSYSTEMS

Towards secured digital business ecosystems: From threats to opportunities
Vesna Tornjanski, Snežana Knežević, Dejan Ljubanić, Vladimir Glišić, Danijela Žižić, Jovan Travica

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Aleksa Trivan, Dušan Barać

Development of a web shop based on augmented reality
Ljubica Ljubisavljević, Dimitrije Milačić, Miloš Ninković

Towards secured digital business ecosystems: From threats to opportunities

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Abstract— This study aims at shedding more light on values of the security landscape in the age of rapid digital businesses ecosystems development. The purpose of the paper is to enrich existing theoretical funds by providing a deeper and extended perspective on building secured digital business ecosystems, based on secondary data collection. The paper illuminates security gaps and emphasizes opportunities to effectively shift threats to sustainable value creation. Future research and management framework rely heavily on a switch from push-based to pull-based security ecosystem, protection strategies development, adoption of AI against cyber risks, and security culture development. The transformative journey towards long-term wellbeing to stakeholders included in the secured digital business ecosystems significantly lies in the multidisciplinary knowledge, simultaneous effectiveness of strategic change, and security management on one hand, and efficiency of IT and organizational capabilities, on the other. The article may contribute to academics, business owners, shareholders, strategic change, security, innovation, and IT management.

Keywords—Secured digital business ecosystem, pull-based security landscape, AI, security culture, effective strategic change and security management, efficient IT and organizational capabilities..

I. INTRODUCTION

Worldwide phenomena characterized by undergoing Industry 4.0 and forthcoming Industry 5.0 fashions significantly yield and reshape concepts, principles, models, methods, practices, products, services, and habits worldwide with the ultimate goal to enable and achieve a sustainable future for the long-term wellbeing and prosperity of businesses and societies at a global scale [1], [2].

The ever-present phenomenon of Industry 4.0 drives strategic change and digitalization in a thrilling way [3], creates valuable opportunities, and accelerates various challenges in a business ecosystem, at the same time. Digitalization breaks down organizational, industry, country, and regional boundaries and sets new rules at the open market [4]. The advancements of digital technologies have built a strong foundation for the development of a digital business ecosystem (hereafter: DBE) [5]. DBE creates a significant shift from traditional to innovative business and operating models, consisting of various entities that jointly create values for all involved stakeholders through information and communication technologies (hereafter: ICT) [6]. DBE exceeds traditional horizons to spark open and flexible competition and strengthen partnerships with involved stakeholders in a digital business ecosystem. Many organizations have recognized DBE as a valuable innovative approach to leverage resources (e.g. technology, specialized services) in cross-industries to adequately respond to and satisfy customers and market needs [6].

Despite various valuable opportunities and exchange dynamics capabilities that the digital business ecosystem may provide, interconnected heterogeneous partners in new forms of networks founded on digital infrastructure signify challenges required to be revealed and further analyzed to prevent the entire ecosystem from potential threats. To maximize potentials from the digital business ecosystem in terms of sustainable value creation, security gaps need to be narrowed and all entities secured in a digital long-term journey [7]. With the rapid development of IoT, Big Data, Smart grid, Blockchain, 5G, Cloud Computing, and other digital innovations that enable societies and businesses to be worldwide connected, the effectiveness of cyber security comes to the flour. Cyber security, aiming at simultaneously protecting organizations from threats and ensuring business continuity without interruptions, represents one of the hottest topics for both private and public organizations globally [8], [9].

With that in mind, this paper seeks to holistically understand and integrate security risks that may disturb the digital business ecosystem and shed light on the future perspectives towards sustainable value creation, based on secondary data collection.

II. RESEARCH METHODS

The paper opted for a systematic literature review as a research method. The research method that consists of a five-stage systematic literature review process is followed by Senyo, Liu, and Effah (2019) [6] and is depicted in Table 1.

TABLE 1. A FIVE-STAGE RESEARCH METHOD PROCESS

No.	**The systematic literature review process**	
	Stage description	***Sub-stage description***
Stage 1	Research criteria definition	Relevant sources are taken into account only
Stage 2	Literature search	Kobson database and Google academic
Stage 3	Literature refinement	Manual filtering of downloaded articles
Stage 4	Analysis of selected articles	Reading and selecting the content
Stage 5	Presentation of key research results and implications	Advances analytics of raw and processed data

III. RESEARCH RESULTS AND IMPLICATIONS

Based on the systematic literature review, research results show that a secured digital business ecosystem represents a shift from threats to opportunities by integrating all security aspects. Integrated security aspects refer to all security components required to be holistically viewed and embedded into an entire digital business ecosystem to effectively achieve business continuity, sustainable value creation, and long-term wellbeing and prosperity for societies and businesses [1], [2].

In other words, as the world becomes more connected and smaller accordingly, cyber is getting stronger and bigger [3]. To transform threats into a valuable sustainable digital environment, in the long run, research findings indicate that integrated hard and soft security components should be incorporated into a digital business ecosystem. Hard and soft components of the security landscape towards sustainability are as follows:

- Multidisciplinary knowledge continuous development
- Strategic change management on the top of the transformative journey [3]
- Strategic change leadership knowledge and skills on the top of driving change [3]
- Cyber expertise development [3]
- Security strategy development using a shift from push-based to pull-based security ecosystem approach [10]
- Security culture development and adoption [11], [12]
  - Information security culture and information protection culture development and adoption [13], [14], [15], [16], [17]
  - Cyber security culture development to influence behavior of employees [18]
- Security of digital services chains services [19]
- Shift from virtualization security issues to cloud protection opportunities [20], [21]
- Network protection [22]
- IoT and SIoT security [23], [24]
- Blockchain technology security [25]
- Big data security [26], [27]
- 5G security and privacy [28]
- Cyber security on smart grid solutions [29]
- Artificial intelligence (AI) and machine learning against cyber risks [30], [31], [32], [33]

The transformative journey towards long-term wellbeing for stakeholders included in the secured digital business ecosystems implies effective strategic change and security management on one hand, and efficient IT and organizational capabilities, on the other.

IV. CONTRIBUTIONS

The article may contribute to academics, business owners, shareholders, strategic change, security, innovation, and IT management.

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The role of warehouse in e-business

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Abstract— The expansion of the application in modern information technologies has significantly contributed to the intensification of electronic business in all areas of modern life. Nowadays, the terms e-payment, e-commerce, e-scheduling, etc. are increasingly applied. E-business is based on the use of the internet in connecting companies with their suppliers, warehouses, customers, and other entities. The basic application of solutions based on e-business involves the integration and coordination of information, goods, and energy flows, including the implementation of new business models. Observed in this new context, the warehouse as an essential component of supply chains faces new challenges. Therefore, the main goal of this paper is to review/redefine the role of the warehouse in e-business. Some forms of e-business and their impact on the warehouse are especially explained. For the identified requirements, which e-business makes towards the warehouse, corresponding concepts/solutions of such warehouses applied in practice have been analyzed.

Keywords - business, warehouse, information technology, warehouse management system

I. INTRODUCTION

For a long time, modern business involves the application of the Internet and new information technologies. E-business replaces traditional business, which involves the use of a large number of paper documents. As a comprehensive term, it refers to any method of using digital information and communication technologies to support or simplify business processes. However, it can refer more precisely to business processes related to e-commerce. The above interpretations lead to the problem that a precise definition of e-business does not exist. This term is most often identified with e-commerce. E-commerce means to trade in products and services via the Internet, which is only one part of e-business [3].

Through one of the most common definitions of e-business, it can be concluded that it is a general term that refers to all forms of using digital information and communication technologies to support and optimize business processes. In contrast, e-commerce represents only the sale and purchase of products and services over the Internet, which represents only one segment of e-business [1].

E-business has an important impact on supply chain management. The faster flow of information significantly facilitates and improves the management of supply chains in all its segments. Therefore, it also affects the warehouse business.

Previously, warehouses were places that generated additional costs. however, they are now seen as points where the value of goods is added. Relocation of production to countries where production costs are lower and intensifying e-commerce lead to changes in the warehouse business. As a result, warehouses are becoming very important segments of the entire supply chain [3].

In the domain of warehousing processes, modern technologies are used to speed up the flow of goods through the warehouse, better control of receipt and shipment, reduce the cost of warehouse operations… As a term, the warehouse implies a function, logistics activity, and system that realizes the storage of goods. It is an integral part of every logistics system and has an irreplaceable role in connecting production, transport, and consumption. A typical warehouse was seen as a place to store goods, however, today the movement of goods is the dominant activity in the warehouse [2]. Modern warehouse is a very complex system in which different processes are implemented. Therefore, the aim of the paper is related to the optimization of some processes in the warehouse, using various forms of e-business.

In the basic processes in the warehouse related to the receipt/dispatch, processing, and storage of goods, e-business can be applied in various forms. In the process of receiving and shipping goods, process automation contributes to speeding up the realization of these processes and reducing errors. Within the processing of goods, e-business is most pronounced in commissioning processes. The effects of the application of e-business in this process are the same as in the previous ones: faster realization of the process, increase of accuracy, i.e. minimization of errors, which will be specially analyzed in the paper.

II. METHODOLOGY

The paper is divided into several sections. After the introduction, the third section deals with e-business. Within that, the basic concepts and places of possible application are mentioned. The fourth section deals in more detail with the impact of e-business on supply chain management. The fifth section builds on the previous one and describes in more detail the impact of e-business on one segment of the supply chain - the warehouse. In the sixth section, concrete examples of electronic business in certain processes in the warehouse will be presented. In addition, the effects of their application will be discussed, that is, how modern technologies affect the realization of these processes. In the conclusion, the previous observations will be summarized and the possibilities of further research will be considered too.

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Development of a dental tourism management system: Rent A Dent

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Abstract— The popular term that defines the act of traveling abroad to obtain desired dental care is called dental tourism. The following problems that arise with this occurrence are transparency in dental processes, data confidentiality, insurance problems and credibility of dental clinics. With technology getting more advanced every day, it became easier for patients to find appropriate dental care with numerous platforms that connect patients with desired dental care professionals. Rent A Dent represents a platform that allows patients to explore dental clinics abroad, giving them all the information they need. When the desired clinic is chosen by the patient, Rent a Dent platform acts as an intermediary between them to assure that both parties are satisfied and that the agreed dental services have been rendered.

Keywords - dental tourism, web platform, dental digitalization

I. INTRODUCTION

The first recognition and worldwide market adaptation of sharing services through the internet, as a proven business model has arisen straight from the United States by companies like Vrbo, Airbnb, and Uber[1]. The sharing service concept is based on the owner, provider, and user. The owner of the goods, services, or property provides value to the end-user by using the service of the provider. The provider is usually a company that owes an app or a platform that connects both parties for goods or services to be shared. A company that provides services takes a one-time fee or monthly subscription from the end-user. Income is generated by the end-user from one-time fees or monthly subscriptions. In the sharing economy, ecosystem provider must take a fee to control and protect both parties.

In almost every country around the globe, people live longer because of the improved lifestyle, better education and easier access to better healthcare. In the global trend of digitalization, medical services are also getting digitized and technology slowly reshapes the relationship between patients, healthcare providers and health systems[2]. The main focus of today's startups is to resolve problems with: hospital workflow, AI and Big Data, medication adherence, sensors and wearables, telemedicine and care management, mental health, VR and AR, 3D printing and chronic disease management. With digitalization, health services are much more closer to the patient especially with wide usage of smartphone devices. Smartphone devices with proper infrastructure will play a crucial role in changing doctor-patient communication. By providing access to such private and sensitive medical data, individuals startups were dealing with security issues storing such confidential information. Those problems are going to be overcome with blockchain technology. The transformation of the healthcare industry is taking a place because society is strongly empowered to use digital tools. Patients demand more professional and personalized services in every industry and healthcare is no exception. The main reason is low-cost dental care abroad. Dental care can be expensive, even with insurance. Price differentiation between well-developed countries and developing countries is big and this happens mostly because of the following factors: lower labor cost, insurance cost, government intervention, lower material cost and education tuition fees.

Dental tourism is defined by the American Dental Association (Resolution 28H-2008) as the act of traveling to another county to obtain dental treatment. Reasons for people to travel abroad: lower costs, certain procedures may only be available abroad, privacy and opportunity to explore another country alone or with their family. Dental care tourism is widely accepted between cross-border countries like the USA and Mexico or Austria and Hungary[3]. Patients seek dental care abroad particularly because of the affordable and timely prosthetic treatments that are not covered by their domestic insurance. Safety of dental tourism abroad might be enhanced through better information about choices with available treatment options, continuous follow-up care and exchange of providers across countries.

The biggest pain points in seeking dental treatments abroad are different dental standards based on a country, language barriers, continuity of care, ability to find reliable and reputable dentists, communication, trip planning and arrangement and plan of post-appointment care. One of the problems that stand out when it comes to dental care abroad is the possibility to take legal actions for the interventions that went bad for the patient.

Rent A Dent is a platform that connects people who seek dental services abroad with professional dental clinics. Using web and mobile technologies, the platform solves many of above mentions problems for both sides, patients and dental clinics.

II. LITERATURE OVERVIEW

Nowadays, dental services are inseparable from other digital processes associated with patient's care and their health. According to the authors of this paper[4], the most used technologies and tactics are: live video which represents real-time video communication between health care providers and patient; reserve and forward where health information (e.g., a patient's digital impressions, radiographs, photographs, etc.) are transmitted via a reliable communications system to the provider of healthcare; distant patient monitoring and ambulatory health where providers of public health practice and education are using mobile communication devices such as smartphones, and tablet computers to help patients outside of medical institutions.

The introduction of new technologies in travel and tourism introduces new consumer-centric tools and the impact of digitalization on dental healthcare has numerous advantages in the following areas: significant savings, shared knowledge, personalized patient data, and improved results[5].

Among the problems that occur in medical tourism and also in dental tourism, the most concerning problems are data privacy, transparency, disintermediation, digitization and interoperability. According to the authors of paper[5], blockchain has become a promising technology to solve these problems.

III. MODEL OF DENTAL TOURISM MANAGEMENT SYSTEM

In this research, web platform and mobile application for dental tourism were developed. Web platform consists of four key elements: 1) Presentation area, 2) Client portal, 3) Clinic portal, 4) Dentist portal.

The presentation area offers useful information to the end-users who come to the platform. Once end-user registers and chooses the clinic and procedure, he becomes a client and has access to a client portal that allows users to communicate and chat directly with the clinic and after that with an assigned dentist. To make it easier for clients to describe the problem, a 3D view of the jaw is enabled, where it is possible to easily select teeth and describe necessary procedures for each one. Users via the client portal have many options, which include uploading ortophan and other important documents, insight into clinic's offers, 24/7 support and live chat with an assigned dentist. The clinic portal allows clinics to manage all their employees, which includes personal information and their professional documentation, as well as assigning clients (end users) to specified dentists. Dentist's on their own portal have options to chat with users in real-time, check their uploaded ortophan and other important documents. All elements of the system have implemented a real-time notification system, both on the platform and via email. This allows all participants of the system to be up to date.

The infrastructure of the web platform consists of four different applications which communicate with RESTful API and through API with Database as shown in Fig. 1. Each of four applications was made using JavaScript and React framework. RESTful API was developed using PHP and Symfony framework which communicate with MySQL database.

On the other hand, a mobile application for client portal has been developed to make it easier for end-users to access the system and to receive notifications in real-time. Mobile application consume directly API to store and receive data. The application was developed using the React Native framework which allows both iOS and Android to access the client portal on their smartphones.

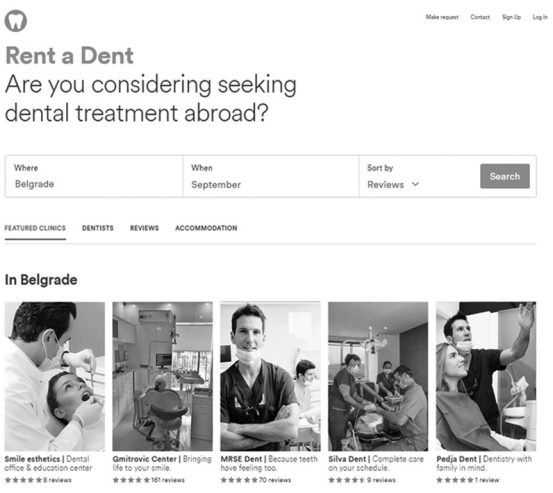

Fig. 1. Web platform

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Introducing a Model for Customer Satisfaction Based Smart Business Systems

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Abstract— In the current era, with the growth of ICT, business systems experience a new form. Due to the variety of products and changing people's tastes, online sales services and platforms should be developed to achieve satisfaction. On the other hand, with the increasing expansion of data in the online business context, the variety of new products, and changing people's tastes, there is a need to run online businesses on a smart platform. This study believes that providing some solutions to the fundamental gaps in online businesses can increase customer satisfaction. In the model prepared in this research, basic factors such as Real-Time Responsiveness are addressed. Thus, more detailed attention has been paid to people's tastes compared to previous studies so that the product offer would seem closer to the people's tastes. As a result, in this study, we tried to prepare an electronic business model based on smart platform to increase the quality of services, achieve satisfaction and establish electronic customer loyalty.

Keywords - Smart City, Smart Business, Real-Time Responsiveness, Satisfaction, E-Loyalty

Fostering digital transformation in the household tools commerce

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Abstract— This paper investigates digital transformation of a company that sells wide corpus of tools. Main goal is to provide a comprehensive overview of the digital transformation process and its elements, such as: technologies, human resources, business models and strategies and cooperation. Further, the role of electronic sales channels with a focus on web sales will be specifically considered. A model of digital transformation of the business system for tool trading will be provided. The B2C web store will be implemented, as well as integrations with the certain components of the e-business ecosystem

Keywords - digital transformation, e-business, e-commerce, subsystem integration

I. INTRODUCTION

The accelerated development of technologies and computer systems greatly affects the business of all companies on the market. Companies that are slow to accept change and that do not take advantage of modern business are in a huge deficit compared to their rivals. The dynamic environment and the growing demands and expectations of customers are another factor that forces companies to advance in terms of technology.

The paper portrays the e-business system of the company Prodavnica alata. This company operates as a wholesaler and retailer, and is engaged in the sale and import of a wide corpus of the tools. It owns two retail stores in Belgrade and internet sales on which this paper will focus.

The research area of this paper is primarily focused on web sale and its integration with all other company subsystems. The goal is acceleration by digitalization and transformation of current parts of the system, and also replacement of the parts which are obsolete. Therefore, this paper will deal with the transformation of a traditional medium-sized company into a company that successfully uses various digital tools and facilities.

II. METHODOLOGY

The paper will define and analyze foundations of digital transformation, e-commerce and e-business and possibilities of application of methods, modules and tools for improving the above. Also, subsystems, their content and possibilities of integration with WEB store will be included. The paper will include the implementation of the proposed methodological approach to the organization and show its results. The paper will contain a detailed analysis of the possibilities and explanations of the decisions made.

III. RESULTS AND IMPLICATIONS

The paper will define and analyze foundations of digital transformation, e-commerce and e-business and possibilities of application of methods, modules and tools for improving the above. Also, subsystems, their content and possibilities of integration with WEB store will be included. The paper will include the implementation of the proposed methodological approach to the organization and show its results. The paper will contain a detailed analysis of the possibilities and explanations of the decisions made.

Results and expectations are reflected in the increase of the sales for selected sale channels. This will be achieved through the application of new sales channels such as Email marketing, Google ads, advertising on social networks and the like. And the improvement of existing sales channels, where the focus is of course on the improvement of sales through the Website.

Acceleration and simplifying the business is one of key goals. All tasks that can be automated and digitalized will be modified or changed. The functionalities will be designed to make it easier and faster for employees to work. The website will give customers better customer experience. Also, the site will be closely related to the company's business program, so it will become a standard part of everyday business within the company.

Integration with systems of other companies will be included in this paper, as wholesale customers and suppliers have big impact on the company's business.

Most important general implications:

- Companies that don't adapt and innovate will be behind their competitors.
- Automation of processes saves employees and managers a lot of time and money.
- Every subsystem that can be digitized should be digitalized.

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Development of a web shop based on augmented reality

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Abstract— The aim of this paper is to develop an electronic store based on augmented reality. In the first part of the paper, augmented reality technologies will be analyzed. The concepts of e-commerce will be described with a focus on the analysis of the possibilities of applying augmented reality (AR-commerce). The possibilities of integrating augmented reality into existing solutions for the development of electronic stores will be analyzed, too. In the practical part of the paper, the development of an web shop using WooCommerce solutions will be presented. The web shop will implement augmented reality-based services that provide support to customers when shopping online. Appropriate tools will be used to monitor the performance of the developed system.

Keywords - e- shop, augmented reality, AR-commerce.

I. INTRODUCTION

One of the basic and currently most common forms of communication is the Internet. With the progress and discovery of new technologies, its use is increasing, so it is used every day in order to find information faster, as well as easier to perform life activities. Its development completely changes the way of doing business and enables the creation of new business models[1]. One of the most current business models are e-shops that focus on the customer. Given that modern age is characterized by rapid change, a large number of products and services that change quickly and become obsolete, the customer tends to spend his time rationally. The development of e-shops enables him to do that. That's a place where customers can shop 24 hours a day without leaving their home or workplace.

The development of the e-commerce is growing every day. E-commerce is the purchase and sale of goods and services that takes place with the significant application of modern information and communication technologies. Its basic components are products, services and participants in the e-commerce process (buyers, sellers, intermediaries and other business partners). Some of its main advantages are: large selection and the ability to quickly search and select specific offers available globally, low costs of placing products on the market, easy and fast entry into the world market and easier communication with customers, modest initial investment and process automation[2].

One of the biggest disadvantages of e-commerce is the lack of a social aspect of classic stores, where the user can see and try out products that interest him and buy them immediately. In order to solve this problem, the application of augmented reality in e-commerce has begun.

Augmented reality(AR) is defined as "the superposition of virtual objects(computer generated images, texts, sounds etc.) on the real environment of the user"[3]. Represents an upgrade of the real world through digital content, so that it improves the environment in which we currently find ourselves. AR is supposed to be an innovative technique having three key prerequisites: a combination of the real and virtual article/objects in a real environment[4], adjusting real and virtual article/objects[5] with each other, and real-time interaction[6]. The possibilities of applying augmented reality are enormous. AR applications are widespread in industries such as manufacturing, navigation, healthcare, education, communications, military, retail, gambling and e-commerce. Many companies use an AR mirror that enables customers to experience virtual facial makeup. Some of them are Sephora and L'Oréal. Other large companies such as Nike, eBay, Snap, Ikea and Converse have been adopting various forms of AR. This allows their consumers to experience their products more realistically.

AR-commerce is a term that refers to the application of 3D product models during the purchase process. It allows the use of augmented reality in order to observe products in real life at accurate size and scale. In the online shopping context this enriches a consumer's shopping experience by displaying product visualizations on images of consumers' physical features[7].The result is a more informative and interactive shopping experience. That leads to increased consumer confidence in both the product and the retailer.

The aim of this paper is to develop an electronic store based on augmented reality. The development of an web shop using WooCommerce solutions will be presented. Also, the implementation of augmented reality in order to improve the user experience will be shown.

II. METHODOLOGY

In order to get to know the augmented reality in more detail, we are developing an example of an e-shop based on it. For the needs of web shop development, Woocommerce technology and Virtooal Try on plug-in are used.

WooCommerce is one of the most popular open source Wordpress e-commerce plug-ins. Some of the wide range of features provided by this WordPress plug-in are the following: selling any product and / or service through your site in a simple way, easily managing and editing existing products and / or services on your site, inserting new ones products, support for various product varieties (color, size, details, etc.), review and manage all orders of your customers, statistical reports on sales performance, providing various discounts to your customers via electronic coupons, accounting for various taxes, choice of delivery and payment methods, support for social networks, etc. That is why this technology was chosen for the development of our web shop.

Web shop development begins with the installation of the WooCommerce plug-in. After that we create a catalog of our products. Since it is a matter of creating a cosmetics store, we will provide a wide range and a large offer to customers. We group products into categories for easier navigation and the best possible user experience. When adding a product to our catalog, we take care to enable it to be displayed on a separate page with all the detailed information, different product variants and a defined price. From the catalog itself, but also from the product page, we enable adding to the cart.

The cart allows users to see all ordered products, their quantity, price and total order price. It also allows users to modify and delete products and enter coupons that would reduce the overall price. From there, the user can complete their purchase by filling out a form with their details. Depending on where the order is made from, the user has different delivery methods and payment methods available. Available payment methods are Check payments, Cash on delivery, Direct bank transfer and PayPal. Use of PayPal is enabled by using API credentials which we can find on the official paypal website after logging in.

Augmented reality integration is enabled by using the Virtooal Try on plug-in. This plug-in allows us to see for each of the products how it would look on a person. It is used by many well-known brands such as Rossmann, Avon and Dermacol. It allows us to display the so-called Try on mirror, where for the desired product we see how it stands for the person in the picture. Also, the user can add a picture of himself and see how the product would suit him and whether he likes it. Before installing the plug-in, an account was created at https://try.virtooal.com. There we can see our API credentials with which we connect to the store. The store needs to be online in order to be used. After installing the plug-ins and entering the API credentials, we define where we want our virtual mirror to be located. For each of the products, we choose the category to which it belongs and, accordingly, connect it to the mirror that will be on all product pages. That way, before adding the product to the cart, the user will be able to try it out and be sure that it is what he wants.

Google analytics is used to monitor the performance of the developed system. It allows us to track whether a purchase has taken place and how augmented reality has prompted the purchase. In this way, we have an insight into the success of our web shop and the application of augmented reality in order to improve the user experience.

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E-BUSINESS INFRASTRUCTURES, CLOUD AND BIG DATA ANALYTICS

The Challenges of NoSQL Data Warehousing
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The Challenges of NoSQL Data Warehousing

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Abstract— Data warehouses are an important part of decision support systems in business. The volume of data currently being created can at times push the capabilities of relational data warehouses to their limits. A possible step forward is to use NoSQL solutions to model data warehouses, since they were made for the ever-increasing amount of data that various platforms deal with. However, simply deciding a data warehouse should be based on a NoSQL approach does not mean the problem has been solved. The flexibility of NoSQL leads to a host of new problems, such as how to perform various OLAP operations on a data warehouse that does not have a fixed schema or how and when to compute aggregate values. This paper provides an overview of various solutions that have been theorized and presented along with their advantages over relational data warehouses, as well as their drawbacks.

Keywords - NoSQL, data warehouse, OLAP, Big Data

I. INTRODUCTION

Every day more and more data are created: data about orders, sales, shipments, e-commerce website clickstreams, etc., each carrying the potential of improving business practices and providing new insights into current operations. However, the increasing volume of data can cause strain to well-established systems that have been in place for years. Relational data warehouse systems at times cannot cope with Big Data due to their inherent properties: the speed they are created at, their heterogeneity, their sheer amount, etc. A shift to a newer paradigm is tempting and even beneficial in some cases, but not without its own set of problems.

Today's answer to efficient Big Data storage is NoSQL (Not only SQL) databases. Their four most common and well-accepted types are [1]:

- key-value databases (data stored as key-value pairs);
- column-stores (attribute values stored as columns instead of rows);
- document-oriented databases (data stored as documents made up of tagged elements);
- graph databases (data stored as edges and nodes).

Regardless of type, they promise flexibility and scalability, two aspects that can ease the issues connected to Big Data that relational databases can hardly compete with. These aspects have even resulted in more and more companies adopting NoSQL databases as their preferred type of storage. Nevertheless, these capabilities are not enough to start a mass migration of data warehouses from the relational to the NoSQL paradigm. Data warehouses are a part of decision support systems, which need careful planning, as well as require certain capabilities of the technologies used to develop them that NoSQL might not offer.

First of all, best practices (e.g. star schema) and benchmarks have yet to migrate to the NoSQL world. Best practices are often either hard to implement in NoSQL or cannot be implemented due to differences between the approaches [1, 2]. Benchmarks have started a shift towards including NoSQL, albeit a slow one [3, 4]. The current solutions are mature and well established; support is readily available for them, and, unlike NoSQL systems, there are many experts that can use them easily, and develop for them. The lack of NoSQL experts is another issue; NoSQL databases are still relatively new, and they are still in flux. New versions, implementations and approaches to the same NoSQL database are constantly being developed, making them a tough field to gain expertise in [5]. Moreover, since there are more types of database to choose from, selecting the appropriate technology for a task becomes much more complicated.

These are only a small fraction of the reasons a greater adoption of NoSQL systems for data warehousing has not been seen in recent years. This paper aims to highlight the various advantages and drawbacks of switching over to NoSQL technologies.

II. NOSQL ADVANTAGES OVER RELATIONAL DATA WAREHOUSES

Not so long ago, relational data warehouses were more than sufficient for all data analyses companies were eager to conduct. Hardware improvements were promising to speed up calculations and allow more data to be processed. Even though relational data warehouses are still sufficient for various analyses, some cases have surfaced in which

the amount of data to be processed (in real time) exceeds their capabilities.

The data in a relational data warehouse should be structured, because semi-structured or unstructured data can be difficult to process [1, 6–9]. They offer very little flexibility; every change has to be done to the schema directly, and, sometimes, the schema cannot be adjusted or expanded meaningfully [7]. More often than not, using relational data warehouses in a distributed setting leads to data duplication and noticeable increases in query processing times [2, 7–9]. Established solutions can come with high licensing costs [7], and they can be slow to implement due to experts being necessary to do so [1]. Their rigid structure can lead to some tables being heavily populated by NULL values. NULL values become quite problematic if they represent any dimension value or if they are part of a foreign key in any of the fact tables, so much so data warehouse designers try to avoid them by assigning them different values, redefining them or even adding special rows to the dimension tables [8]. Finally, joins can still occur in normalized relational data warehouses, bringing with them a steep price due to needing time and memory resources [8, 9]. This is why denormalized relational data warehouses are more popular.

On the other hand, NoSQL data warehouses are highly scalable and very flexible [1, 6–8, 10]. Any new record can be written onto any disk the database has access to. They do not store NULL values [6, 8]; data that are stored into them do not need to be transformed into a certain format [5–7]; their write operations are considerably faster [1, 5, 6, 11], and they can store substantial amounts of data [1, 6].

III. DIFFERENT THOUGHTS ON NOSQL MODELS, APPROACHES, AND DRAWBACKS

When looking at all the proposed solutions, a clear preference can be seen: authors either use a column-store [3–5, 8, 10, 11] or a document oriented database [1, 2, 6, 9, 10]. Some uses of graph databases have started to surface, but those are mainly applied to social networks [9].

Reference [2] considers how different ways of organizing data in a document-oriented data warehouse impact OLAP queries. They also add OLAP cuboids that were previously only theorized. The authors point out that NoSQL data warehouses require more storage space in comparison with relational data warehouses due to duplicating the names of the attributes in every document. They also find any operation in need of joins is greatly slowed down and any optimization can strictly be done manually. In [3], the authors are mostly concerned with adapting a popular relational data warehouse schema to the NoSQL paradigm. However, they do note that the cost of joins in NoSQL is prohibitively slow and the referential integrity constraint does not exist. The authors of [4] continue the work of [3], but they add that the solutions greatly vary depending on what needs to be processed, mostly due to trying to avoid joins in NoSQL. In [5], the authors once again try to avoid executing joins and calculating aggregates during query execution. They also comment on not being able to use the newest NoSQL technology due to certain incompatibilities within the software. The author of [6] indicates that the schemaless structure of NoSQL only shifts the responsibility of keeping some sort of structure onto the developer. Reference [10] engages in developing an approach that would directly translate a conceptual multidimensional model into a NoSQL logical model that would be part of an OLAP system (such translations usually use a relational logical model as an intermediate step). Even after extensive experimentation, the authors conclude it is difficult to draw detailed recommendations as to when column-oriented or document-oriented databases could be used for OLAP systems. Finally, in [11], the authors experiment with different ways of organizing data in a NoSQL data warehouse and measure the performance of each type of solution. Once again, they evade joins.

Some authors take a more theoretical approach to NoSQL data warehouses, but they still highlight some issues that arise. In [1], they conclude a “best-of-both-worlds” approach may be beneficial because it could mitigate the drawbacks of both methods. The main drawback of NoSQL they identify is that the technologies have immense problems with join operations and aggregate functions due to their loose structure. The author of [7] also proposes a combined approach, adding that NoSQL databases’ query languages are still severely lacking in capabilities as opposed to regular SQL. Reference [8] notes that the existing approaches that lead from a conceptual model to a data warehouse are tailored to relational data warehouses, making them difficult to translate to NoSQL. They propose a new approach that would skip the relational phase of modeling, but the resulting method requires a new table whenever new information is needed from the model. In [9], they propose an approach merging document-oriented databases and graph databases to accurately store the data produced by social networks, but they do mention that the lack of a standardized query language and the differences between NoSQL data models in general make development difficult.

Another problem most of the authors fail to address is that, depending on the chosen NoSQL implementation, joins, aggregate functions or both might not even be supported. HBase [4, 10, 11] and MongoDB [1, 2, 10] are the technologies used in most of the papers due to having some support for the aforementioned functions. Only two of the referenced papers use Cassandra, and one of them openly states that joins and aggregate functions are not supported [5]. The other paper does mention support for some aggregate functions [8], but does not verify the existence of join operations. The disparity is likely due to NoSQL being a fast-evolving field, so some functionalities were most likely added between the writing of the two studies.

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Users Perceived Pricing Model for Big Data

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Abstract— Choosing the appropriate pricing model for big data is a challenging issue. In this research we propose Users perceived pricing model for big data which is based on the feedback from users. We assume that price depends on perceived utility, market environment, users' motivation, provider's reputation, and users' demand. Considering perceived utility covers the most important data characteristics and specific user requirements, it is the main component for price determination in the proposed model. Perceived utility reflects users' satisfaction, and it is tightly related to data quality. One of the data quality factors in the proposed perceived utility function is evaluated using classification based machine learning.

Keywords - big data, price, utility, classification, CNNs

I. INTRODUCTION

The amount of data collected in recent years has been explosively growing due to the large number of new applications and technologies that are being incorporated into our living and working environments on a daily basis. By introducing data as a type of commodity into digital markets, data owners and users can connect, share and further increase the utility of data. However, in order to enable an efficient market for data trading, several challenges need to be considered, such as choosing the appropriate pricing model for big data [1].

In today's big data markets, various pricing models and strategies are proposed and applied [2]. Besides standard pricing mechanisms (e.g. subscription, bundling, and discrimination) various models based on economic principles are proposed, as well as game theory models.

In this paper we propose Users perceived pricing model for big data price determination. This model relies on the perceived utility function for big data users which strongly depends on data quality. With the aim of evaluation perceived utility function, several factors that mainly affect users' utility are considered and determined. One of the perceived utility function factors is evaluated as the accuracy of a classification model trained using data of different quality levels. Also, different well-established training methods are used for model creation.

II. BIG DATA PRICING ISSUES

Pricing digital data, as digital commodities, requires consideration of several specific characteristics, such as diverse data sources, diversity of data, and complexity of data management [1]. Digital data have different types which makes them difficult to classify and evaluate. The variety of devices in new applications and technologies as well as the associated application costs can add to the complexity of estimating collection costs and price determination. Big data creates a huge amount of data that is constantly increasing. Therefore, the way data is managed (analysis, storage, updating, distribution, etc.) is another issue to consider when pricing data. Price evaluation of different datasets with various volumes, precisions, and types remains a challenging issue. Finally, the users' perspective must also be taken into account, because the income for a big data provider will depend on the end users' demand and willingness to pay for digital commodities.

The most common set of pricing models is economic-based pricing, which encompasses pricing models based on economic principles, typically cost based pricing, supply-demand pricing, user perceived pricing, differential pricing, etc. Also, a widely used set of pricing models is game theory-based pricing. In such models, pricing is greatly influenced by competition. Commonly used game theory models for big data pricing are non-cooperative game, bargaining game, and Stackelberg game.

III. USERS PERCEIVED PRICING MODEL

A. Price Determination

Users perceived pricing model assumes that data providers consider the feedback from users. The user perceived price depends on five main factors: perceived utility (*PU*), market environment (*ME*), users' motivation (*UM*), provider's reputation (*PR*), and users' demand (*UD*) [3]. We assume all factors are normalized.

In this model, perceived utility is the key factor for price determination because it covers the most important data characteristics and specific user requirements. Perceived utility is the satisfaction measurement for users, and it is tightly related to data quality [2].

According to [4] quality can be classified in three categories: internal quality, external quality and quality in use. Internal quality refers to a specific configuration for the internal and static properties of a product/service. Another aspect of quality is external quality. It covers the dynamic properties of the product, which is influenced by the internal quality. Quality in use is mainly a subjective category of quality perceived by the final user. Frequently used classification of quality aspects implies network performance, which corresponds to the internal quality, quality of service, which is most similar to the external quality, and quality of experience, which corresponds to the category of quality in use [5]. Hence, perceived utility depends mainly on quality in use, i.e. quality of experience.

We assume that perceived utility for big data user i (*PUi*) is defined as a function of adequacy (*Qad*), accuracy (*Qac*), completeness (*Qc)*, and redundancy (Qr), which have been assigned corresponding weight factors (*a, b, c,* and *d*):

$$PUi = aQac + bQc + cQr + dQad \quad (1)$$

where a ≥ 0, b ≥ 0, c ≥ 0, d ≥ 0, a + b + c + d = 1.

It is assumed that the total perceived utility is the mean value of individual perceived utilities for all observed users in the market. Further, users' satisfaction can be determined as a function of the total perceived utility and expected users' utilities. For the simplicity, in this research our focus is on the perceived utility as the main satisfaction measurement from users' perspective.

Market environment factor depends on the number of competitors in the market. Less competing data providers in the market means that the value of ME is closer to 1, while with increasing competition, this factor is lower and closer to 0, which means a lower price for users.

Users' motivation implies motivations of users to purchase digital commodities. For users who are more motivated, UM will be higher and vice versa.

Provider's reputation represents the recognition of the provider in the market and consequently the main feedback from users. We assume that PR is the same for all users and differs only for the big data provider. Depending on the reputation of big data provider, PR will have a higher or lower value.

Users' demand denotes economic value, which depends on the demand for digital commodities in the market, and it also has an impact on the price. With increasing demand for data UD will be higher and vice versa.

Assuming that the base price is P0, according to the proposed model, price P can be determined as:

$$P = P0 \cdot PU \cdot (ME + UM + PR + UD) \quad (2)$$

B. Perceived Utility Evaluation

Even though, the type and nature of data can vary from structured to semi-structured to unstructured, in this paper we assume that the used dataset can be represented in the form of a table with dimensions N´K where each row corresponds to an item, and the first columns correspond to the property values of the item. Last column in the table represents labels of items.

In order to determine perceived utility function as defined in (1) it is necessary to evaluate significant factors obtained from dataset:

- *Accuracy* - indicates whether the values for cells stored for an item are the correct according to the domain and the source,

  $Q_{ac} = 1 - \frac{N_e}{K(L-1)}$

- *Completeness* - indicates completeness of the cells in a dataset. It means the cells that are not empty and have a meaningful value,

  $Q_c = 1 - \frac{N_i}{K(L-1)}$

- *Redundancy* - expresses the extent of duplicate records in the data source,

  $Q_r = 1 - \frac{N_r}{K}$

- *Adequacy* - indicates whether data is adequate to the purposes of the analysis. In order to determine the adequacy of data in the perceived utility function classification based machine learning is used. Here, we assume that the accuracy of the obtained model represents adequacy of dataset. Accuracy is defined as a fraction of successful prediction for the model.

In the next section we will introduce dataset and different methods used for label prediction.

C. Experimental Evaluation

In order to evaluate adequacy of the perceived utility function, we use a real dataset called CIFAR-10 [7], which contains images that are commonly used to train machine learning and computer vision algorithms. The dataset includes collection of 60,000 32x32 colour images separated into 10 classes. 50000 images are used for training, and 10000 images are used for testing. Here, for the purpose of classification model training we use several well established and documented methods applied on CIFAR-10 dataset. Most of these methods apply some form of Convolutional Neural Networks (CNN) for model training. CNN is a type of deep artificial neural network used in image recognition and processing, specifically designed to process pixel data.

Our goal is to determine how different quality levels of a given data influence perceived utility for user. In this paper, we assume that CIFAR-10 dataset is perfect, meaning that accuracy, completeness and redundancy of dataset are equal to 1.

In order to analyse the effect of different quality levels

on the accuracy of the model we are adding noise to the label data. Also, we are removing appropriate number of cells in the dataset in order to change its completeness. By removing some items and introducing existing items again in dataset we are changing redundancy of dataset.

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Enterprise Business Intelligence Approach With Cloud-Based Analytics

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Abstract— In today's rapidly changing e-business environment enormous amount of heterogeneous and high-velocity data is being generated. A critical component for success of the modern enterprise is its ability to take advantage of all available information. In this paper, business intelligence (BI) system for advanced analytics based on modern cloud-based data warehouse architecture and machine learning models is presented. Its main purpose is to support insights-driven business decision making by integrating relevant data form various sources, and transforming it into usable and accessible information and knowledge. In order to demonstrate the effectiveness and usefulness of the proposed BI system, an experiment with the real-world dataset from the retail industry has been carried out. Data has been integrated into the single multidimensional data warehouse. For advanced analytics several machine learning (ML) models have been created. These ML models complement data warehouse reporting with advanced knowledge that can be used for effective decision making and proactive actions.

Keywords - business intelligence, data science, data warehousing, machine learning, cloud analytics

I. INTRODUCTION

The modern business environment, characterized by high competition growth and great dynamism, puts companies in a situation to struggle to maintain market share and achieve better results, and thus to increasingly take into account the problem of managing large amounts of data.

Business intelligence (BI), data science and big data technologies encompass the collection of platforms, services, and tools, as well as data modelling and analytical methods for efficient data integration, storage, processing, and reporting.

BI is used by retailers to understand customer needs, optimize price alignment with current trends and determine upcoming trends [1]. It is useful for addressing supply chain risks in categories of demand, supply, process and environmental risk in the retail industry, which is crucial for retail companies [2].

Reliance on adequate and relevant data allows businesses to make effective decisions and ultimately achieve a competitive advantage [3]. According to [4] the need for continual analysis and innovation to remain competitive through new opportunities is what sets a lot of successful businesses apart from failing ones.

II. BUSSINESS INTELIGENCE MODEL

The purpose of Business Intelligence is to make it possible to combine data from multiple sources, analyze and systemize information, and then disseminate the information to relevant stakeholders. That way, companies are able to see the big picture and make smarter business decisions.

Due to the growing diffusion of big data in the business context, enterprises increasingly need to redefine their knowledge management systems in order to make them capable of managing the different types of complex data available in a dynamic and transparent way [5].

Traditionally, enterprises have been gathering data in data warehouse which was an on-premises operation and the larger it grew, the more IT infrastructure and resources were required to support it. The traditional enterprise data warehouse has never been designed to support near real-time transactions or event processing, it hasn't been able to keep up with variety of new data sources and explosive volumes of data and has been slowing down the ability to do advanced analytics. According to [6] a cloud-based environment eliminates many common issues with data warehousing and also offers many new opportunities. Since there is desperate need for such elastic capabilities as data warehousing and big data, data warehouse must modernize in order to keep up. The modern data warehouse starts with the ability to handle both relational and non-relational data sources and to rapidly provision and release resources to match what a workload requires.

Recent studies have begun to empirically demonstrate the value that big data and business analytics have on organizational-level outcomes, such as agility [7], innovation [8] and competitive performance [9][10].

According to [11] increasing competition has further contributed to the complexity and made achieving business growth and sustainability very challenging, therefore involvement in work, consistency and mission further enable an organization's members to understand the need for, and the usefulness of, the system and to make efforts to use it effectively.

Those who adopted approaches in business intelligence, besides competitive advantages, have experienced improvement in decision making capabilities, better customer service and increased revenue, as claimed by [12].

III. RESULTS AND DISCUSSION

Machine learning uses well-researched statistical principles to discover patterns in large sets of data. Typically, these patterns cannot be discovered by traditional data exploration because the relationships are too complex or because there is too much data. Applying the machine learning algorithms makes it possible to forecast trends, identify patterns, create rules and recommendations, analyze the sequence of events in complex data sets, and gain new insights.

Dataset that has been used is sourced from multinational manufacturer and seller of bicycles and accessories. The products were classified into five categories: bicycles (mountain, road and tourist), accessories (such as helmets and water bottles), clothing, components and services. There was a huge amount of information of this company in the transaction system, so queries over the transaction database could reveal a lot about the dynamics of business and the nature of data, but in order to obtain better data analysis, a data warehouse and business intelligence were needed.

Therefore, the data warehouse, created by the ETL process, was used, because in that way the data from several sources were stored in tables of dimensions and facts, suitable for OLAP analytical data processing.

For advanced analytics, such as predictions, classifications, and associations, several machine learning (ML) models have been created. These ML models complement data warehouse reporting and could be the basis for making effective decisions.

Besides advanced analytics and knowledge extraction, it is very important to deliver information to decision-makers in a timely manner and in adequate format. Reporting is realized through cloud-based BI service which enable rich visualizations, self-service analysis and collaborative decision-making.

The study has presented business intelligence system for advanced analytics based on data warehousing and machine learning models and its impact on the business performance. Systems like this are essential for managing today's global businesses.

Created machine learning models show that BI tools can help gain the knowledge needed to increase profitability through cross-selling, recommendations, and promotions.

Successful implementation of BI system can help organization to achieve several benefits, such as optimizing organizational efficiency and performance. BI makes it possible for companies to meet emerging business demands that allow them to stay ahead of the competition

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Cloud architecture for analyzing real-time road traffic data

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Abstract— With the expanded usage of IoT sensors in road traffic and an increasing number of vehicles on the road, analyzing road traffic data is something to be considered. Road traffic data is collected using IoT devices and these datasets are massive. Road traffic can be optimized in many ways by making the traffic flow better and ”smarter”. The main goal of this research is to architect a model which will provide a connection between road traffic sensors and traffic participants to build a centralized community where road traffic data can be collected and analyzed in real-time. The goal is to design a cloud architecture that provides an available, scalable, and reliable service that can collect road traffic data, analyze it and provide real-time results.

Keywords - cloud, architecture, real-time, road traffic

I. INTRODUCTION

The current IoT systems are based on simple sensors that collect data to a cloud and actuators controlled by applications in the cloud [1]. The cloud provides access to virtually unlimited resources that can be programmatically provisioned with a pay-as-you-go pricing model, enabling applications to elastically adjust their deployment topology to match their current resource usage and according cost to the current request load. IoT cloud applications therefore must be designed to cope with issues arising from geographic distribution of edge devices, network latency and outages, as well as regulatory requirements, in addition to the traditional design considerations for cloud applications [2].

Internet of things is mainly based on smart objects working in a collaborative manner and interacting instantly with surrounding environment. The emergence of the internet of things and communication technologies allows collecting different types of information from sensors and surrounding systems [3].

IoT sensors are heavily used in road traffic. In some papers, IoT sensors are used for collecting data from roads, in order to prevent road traffic accidents [4]. The IoT cloud system they built is used for private drivers and drivers of critical helpful service such as ambulances. They proved with an experiment that the provided system had acceptable response times to allow drivers to receive alert message in useful time to avoid the risk of possible accidents. In other paper researchers were focused on empowering roads using IoTin order to prevent traffic congestion. They proposed model was divided into following layers: data collection by sensors, data receiving in the cloud, object and pre-processing layer and application layer. Application layer is separated into the performance layer and the prediction layer. In the prediction layer, SVM is used to assess the congestion and the performance layer evaluated the results produced by the prediction layer’s analysis. With the help of RFID sensors, drivers will receive a notification about a congestion point [5].

The goal of this research is to design a cloud architecture that provides an available, scalable, and reliable service that can collect road traffic data.

II. METHODOLOGY

A. Designing an available cloud system

When we talk about cloud systems, the first that we consider is availability. Cloud systems provide availability zones. Availability zone is a unique physical location within a region. Each availability zone is made up of one or more datacenters equipped with independent power, cooling, and networking. To ensure resiliency, there’s a minimum of three separate zones in all enabled regions. The physical separation of Availability Zones within a region protects applications and data from datacenter failures [6]. To ensure best availability several availability zones should be used (one is the main one and others are replications). If one availability zone fails, the other will be accessible.

B. Designing a scalable cloud system

Scalability is the core of each cloud system. In the cloud systems it is very convenient to scale both horizontally and vertically. Vertical scaling is also called scale up and down and it is considering when the size of the virtual machine is increased/decreased. Horizontal scaling is when number of virtual machines is increased/decreased and they are working together. It is considered for horizontal scaling to be more flexible, since it can easily spin hundreds of virtual machines. All popular cloud provides autoscaling option, which can be configured. Auto scaling is always using horizontal scaling and it can trigger automatically, based on the defined measures (CPU, RAM usage and similar).

C. Desigining a reliable cloud system

The probability that a system is operational in a time interval without any failures is represented as the system reliability. Cloud systems use fast and real-time failure detection to identify or predict a failure in the early stages is one of the most important principles to achieving high availability and reliability in cloud systems. A service level agreement is often defined between a company that builds a service and the owner of the service. It is simply defined as a part of a standardized service contract where a service is formally defined. It is an agreement about the quality of a provided service. This is referring to system reliability [7].

D. Design a system that can collect traffic data

Traffic data consists of a large amount of data that comes in streams directly from IoT sensors. Various sensors can be used, but they all provide large number of data points which are used. For accepting streaming data, normal REST API is not something that is recommended. This can easily become a bottleneck. When designing a system that should take large amount of data that is being sent simultaneously it is always first thing to consider data streams.

Many relevant IoT applications can take advantage of streaming data, as i) those based on distributed monitoring systems using embedded devices with limited processing capacity (e.g., environmental analysis), and ii) real-time data stream analytics, processing a large volume of data (e.g., e-health and driving assistance systems) [8].

Largest cloud providers have included services that can process hundreds of thousands records per second. These records are looked as data streams. Benefit of data stream is that it can analyze data on the fly and it allows real-time insights from the sensor data to look for patterns and take actions on them. Cloud providers do allow writing queries directly on the real-time data that is streamed. This data can also be visualized [9]. “Table I” shows the list of actions that could be done against the streaming data in the cloud.

TABLE I. ACTIONS AGAINST THE STREAMING DATA IN THE CLOUD

Action name	Description
Real-time analysis	Streaming data is processed real time
Batch processing data	Grouping data before processing with short latency intervals
Visualize data	Real-time data is populated to a visualization service
Data analytics	Advances analytics of raw and processed data

Both real-time data and batch processed data can be used for analytics and visualization. “Table II” shows what is the difference between batch and real-time processing in the cloud.

TABLE II. COMPARISON BETWEEN BATCH AND STREAM PROCESSING

Batch processing	Stream processing
Processing over all the data in the dataset	Processing over the most recent data records
Large batches of data	Micro batches consisting of a few records
Latencies in minutes to hours	Latency in the order of seconds or milliseconds
Complicated analytics	Simple aggregates and rolling metrics

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Enterprise Business Intelligence Approach With Cloud-Based Analytics

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Abstract— In our work presented here, we take a position that Software Defined Networking (SDN) in the narrow sense as conceived in the seminal papers of Casado, Nick McKeown and Koponen, has to be extended to the SDN in a wider sense, covering not only programmability of the network basic and minimized Traffic Processor (TP) firmware. The approach taken advocates the extension of the programmability and configurability of the SDN higher level engines, to the levels which include dynamic partitioning of the SDN engine, its distribution and migration down to the virtual or physical switch levels. In addition, with intentions of enhancing overall man-software-machine communication system performance, reliability and security, we investigate potential of the SDN technologies application to the L8, user layer, layer of human presence and social networking. In order to achieve elevated security, we propose SDN based dynamic access control protocol implemented within the interface between L7 and L8 layers of the ISO-OSI network model.

Keywords - SDN, Enterprise business intelligence, cloud analytics.

BIM - Modeling of Transport Infrastructure Objects

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Abstract— The article analyzes the geographic information system (GIS) of the Avtodor state company (developer "Indor-Soft", Tomsk). The implementation of the project through BIM modeling is described, on the example of construction of transport infrastructure facilities of the Far Western bypass of Krasnodar project (FWBK). Issues of standardization and database creation of information models in urban planning and road construction are currently priority areas in the Russian Federation. Evidence-based reasoning is given that it is optimal to use GIS at the operational stage of a complete BIM model of the road. Are revealed the main functionality and examples of using of the Avtodor state company IndorRoad GIS for data entry, accounting and analysis, to solve practical problems of road maintenance.

Keywords - BIM for road constructing and maintenance, road information model, geographic information system, transport infrastructure component

I. INTRODUCTION

The main components of the digital transformation of the road industry are: mobility; safety; efficiency; use of information modeling when building models of linear-extended road sections [1]. Geographic information systems (GIS) are tools for managing the state of transport infrastructure objects at the operational stage: both Building Information Modeling (BIM-modeling) and GIS are interrelated, since they are based on an information model and a common data environment (CDE).

The article analyzes the geographic information system (GIS) of the Avtodor state company (developer "Indor-Soft", Tomsk). The main tasks assigned to the GIS of the Avtodor are listed on the site https://avtodor-eng.ru/services/arenda-spetstekhniki/geoinformatsionnye-sistemy. The implementation of the project through BIM modeling is described, on the example of construction of transport infrastructure facilities of the Far Western bypass of Krasnodar project (FWBK).

The need for the exchange of 2D and 3D information between computer-aided design (CAD) systems has existed for a long time, as well as in a standard that records changes in an infrastructure object throughout all stages of its life cycle [2], [3]. Issues of standardization and database creation of information models in urban planning and road construction are currently priority areas in the Russian Federation. The international non-profit organization buildingSMART based on the NAICS Association, has been dealing with these tasks since 2017 in Russia. National BIM standards have not yet been fully developed and there is a lack of software compatibility in the road sector, as not only domestic developers say [4]. At the moment, the use of digital models of capital construction objects is regulated by Resolution N 1431 of September 15, 2020 (see https://ipbd.ru/doc/0001202009220002/).

Let's note the differences between the information model of capital construction facilities and linear-extended transport infrastructure facilities. For transport facilities, design and construction are carried out in separate sections, which takes into account different implementation periods, that is, they are simultaneously at different stages of the life cycle (for example, construction, operation and repairs can be carried out on the same road at the same time) and the project itself is usually performed by several contractors. Therefore, it is optimal to use GIS at the operational stage of a complete BIM model of the road [5]. The main functionality and examples of using of the Avtodor state company IndorRoad GIS for data entry, accounting and analysis are disclosed in [6], to solve practical problems of road maintenance. The approach to the formation of GIS of the Avtodor state company serves as an example of interaction between the state and business and will help develop common standards and regulations for information exchange.

II. BIM-MODELING IN RESEARCH AND DESIGN

Currently, the state-owned company Avtodor is implementing a project to build the FVBC highway, which is part of the North-South transport corridor. To justify the investment in the project, a consolidated model of FWBK was created (Project model_2108018_dop_attributes.nwd) in the Autodesk Navisworks environment, using the NWD file format, which is a data exchange format for summary models. This format is static, meaning that the data contained in the file cannot be changed and used to create 2D drawings. The individual models that make up the BIM summary model correspond to different sections of the project and are integrated using different formats (including dwg, dwf and fbx). Not all of these formats allow you to load feature attribute data into a BIM model. The

geometric parameters of the information model elements are completely correct (see Fig.1). The level of detail of objects is very high.

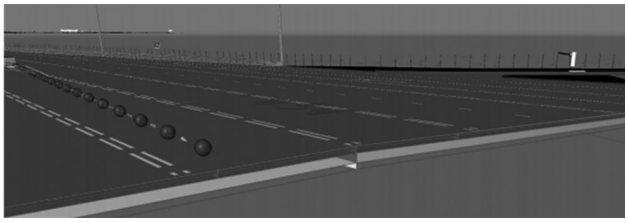

Fig. 1. Section of the BIM model on a road section

When planning a project using the InfraBim [7] tools, you need to define the basic Levels of Development (LOD). The most optimal in this project is the LOD 500. Let's list the LOD results:

- **LOD 100:** territory diagrams with models of existing and planned highways (2-D model)
- **LOD 200:** an area plan with the planned highway in the form of a highway model (number of lanes, configuration of junctions and intersections, etc.)
- **LOD 300**: engineering model of the highway route, structural lines, road surface and roadbed, road markings, artificial structures, construction site development plan, etc
- **LOD 400 - LOD 500**: 1) a Production model with a detailed work schedule, logistics for the supply of products and materials, etc. (including 3D models for automated control systems for road construction machines) 2) Executive model (models of laser scanning of the highway, etc.) 3) Operational model (formed on the basis of the Executive model)

The LOD 500 model has clearer relationships and the most complete data for all elements of the model (see Fig.2).

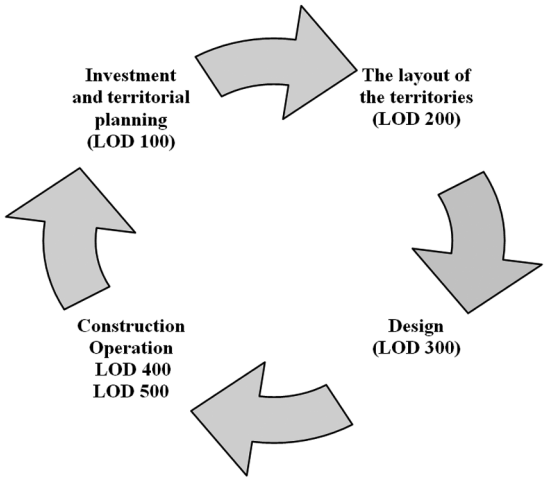

Fig. 2. Road projects life cycle and LOD levels of detail

III. COMMON DATA ENVIRONMENT FOR PROJECT IMPLEMENTATION

CDE and the BIM model at the operational stage are described in [6]. An information model in GIS is generated for roads that are being operated using CDE during surveys, routine diagnostics, and engineering surveys. A BIM model is formed for roads under construction and under design. These processes will continue to develop in parallel for quite a long time due to the significant length of the road network. Thus, only the use of CDE will allow avoiding contradictions and ensuring the reliability of the information model data in both cases. The description of aspects of the organization of CDE is given in the UK BIM standard [8], [9].

In [5], we present evidence – based arguments that the GIS of highways are CDE and BIM model of roads in the operational stage at the same time. The use of the web-based General data environment (geoportal) GIS allows online use of a digital terrain model with subdecimeter accuracy for unmanned vehicles. The development of unmanned vehicles and "convoy" technology for autotransport trains requires interaction between the road infrastructure, on-Board computers and computer vision of cars: Avtodor state company prepares GIS and CDE interfaces for interaction with such vehicles based on V2I (Vehicle to Infrastructure — vehicle to infrastructure) [6].

In 2020, specialists of JSC "Institute Stroyproekt" implemented a BIM model of FWBK in the S-INFO environment (see https://sinfo.tech/ru/portfolio/dalnij-zapadnyj-obhod-krasnodara). Experts determine whether this model is suitable for breaking down construction and installation works into stages and getting a General idea of the implementation of construction and installation works, and also specify to what extent it can be used for the operation and maintenance of infrastructure facilities. In the current state, the BIM model can be used to get an idea of construction and installation works and structures under construction, update data on the volume of earthworks and control geodetic works.

IV. CONCLUSION

The operational InfraBim model of FWBK will provide uniform principles of data storage, access and processing for applied tasks. Avtodor state company implementation of the FWBK project is an example of successful interaction between the state and business. The use of BIM tools in the implementation of transport infrastructure development projects will allow solving the main tasks that are set for the road area – optimizing time and money when planning and implementing activities at the stage of operation of infrastructure facilities.

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DIGITAL MARKETING AND SOCIAL MEDIA

Digital Marketing and Social Media: A Review
Yüksel Akay Ünvan, Yuliya Badlo

Holistic Marketing in Development of Arts and Cultural Institutions in Digital Environment
Leposava Zečević, Olgica Stanojević, Radmila Janičić

Employer Branding Framework Using Social Media For Attracting Talents
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Digital marketing techniques for promotion of "Infrastructure of Serbian Railways"
Danijela Stojanović, Nenad Stanisavljević, Elena Jovičić

Cost-effective way of implementing SMS marketing in small to middle-sized enterprises using Raspberry Pi
Miodrag Šljukić

Digital Marketing and Social Media: A Review

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Abstract— Nowadays it is not possible to foreseen future prospects of business and trade development without realizing the role and importance of platforms that thousands of people use on a daily basis, for both: producers and consumers. Social and digital marketing offers great opportunities for companies to increase their brand awareness and sales. The use of social media has changed customer behaviour and consequently the way companies do business. That is why it remains necessary to further analyse of current state of the existing platforms that determines success of online marketing. It is proposed to overview current and future trends in this field. The content is based on recent literature review. Obtained results state that the communication of the consumer with brands through social media has a positive effect on customer-based brand value. It is considered that it creates a strong connection between customers and the company.

Keywords - digital marketing, social media, marketing

I. INTRODUCTION

Different resources propose different ways of views over the concepts of digital marketing and social media.

Some researchers propose to see social media platforms as a part of digital marketing strategy [1]. According to another opinion, digital and social media marketing is a single concept for carrying out businesses [2]. Others separate social media marketing (SMM) and define it as a functional part of online marketing that has become quite important in recent years [3].

Statistic data shows that digital population as of January 2021 consisted 4.66 billion active Internet users which is 59.5% of the global population (as of January 2020 the number increased on 0.5%). Among them 4.32 billion people are active mobile internet users, 4.2 billion people are active social media users and 4.15 billion are active mobile social media users. At the same time, Northern Europe ranking first with a 96% internet penetration rate among the population (the highest internet penetration rate worldwide are the UAE, Denmark, and Sweden) [4].

It has also become important to realize that modern platforms used to have different value among active users. Referring to [5] users respond differently to social media activities across platforms.

There are numerous of reasons why social media became an essential part of today's commerce activity. Social media enables companies to connect with their customers, improve awareness of their brands, influence consumer's attitudes, receive feedback, help to improve current products and services, and increase sales [6], [7].

Social media and digital marketing are also considered to be useful for predicting the future, doing prevention of crisis, and creating innovations, because by using social media and digital marketing it is becoming possible to track brand's competitors. It also about to know people's opinion on a product and to build up a brand reputation. These are things that conventional marketing hardly achieved effectively [8].

II. METHODOLOGY

Within the scope of the study, various academic articles and related literature on social media were examined. In this sense, the most basic research method of the study was document analysis technique. The data compiled from the current literature were processed based on the characteristics of the subject, such as the way it was written, and the date of writing.

Briefly, in this study, examples of literature related to the subject have been examined in detail. In the results and evaluations section, all the data obtained are interpreted and comments and suggestions regarding the subject are presented.

A. An analysis of recent literature

Actually, the term "social network" was first used back in 1954 by sociologist J. Barnes, and in the modern sense it was implemented in 1995 in the United States in the form of the Classmates website, and since the second half of the twentieth century it has become a central concept in the concept of Web 2.0 and already since 2005 gained great popularity around the world, thanks to Myspace, Facebook, LinkedIn, Twitter, Odnoklassniki.ru, VKontakte, etc. [9].

The task of marketing is to be where there the audience is [10]. The marketing potential of using web resources is extremely high, and the rapid development of the web and its capabilities changes every year and makes more acces-

sible the methods by which companies can contact their target audience [11]. If the majority of customers engage with social media, firms must engage with it as well [12].

By January 2021, the most popular social network worldwide is considered to be Facebook, whose number of active users reached 2.74 billion people, after that is YouTube – 2.29 billion, WhatsApp – 2 billion, Instagram –1.22 billion, Tik Tok – 0.69 billion etc. [13]. All these numbers only confirm the need for marketers to use social media as a key approach to attract attention of new potential customers to their products, or, to increase loyalty of the existing customers.

In the digital landscape, social media offer a great opportunity to reach large audience easily and at a relatively low cost. But, that comes at a price of a weaker control over brand reputation online or what termed to be e-reputation. Consumers can easily become value destroyers instead of value creators for companies [14]. That's where a strong link between customers and the company takes its place.

B. Current state and development prospects of social media marketing

Nowadays, many marketers are wondering about the place of the SMM strategy in the marketing strategy of companies.

The research carried out by Salesforce (May, 2018), demonstrated that 77% of all marketers say their organization uses a form of social media marketing, 64% of marketers are focused on providing a consistent customer experience across all channels [15].

Fig. 1 represents the distribution of SMM benefits in accordance with the data of the report "2021 Social Media Marketing Industry Report" [16].

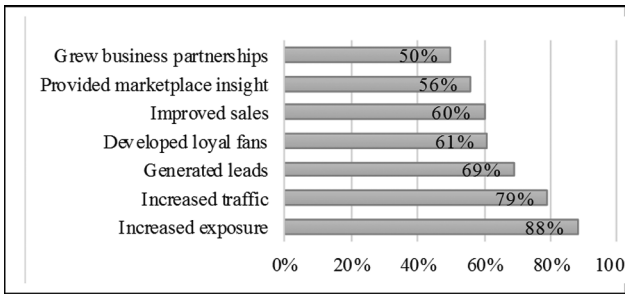

Fig. 1.Benefits of social media marketing

According to information above, it is seen that use of social media product promotion does make a positive impact for companies. Developed loyal fans as one of a positive criteria on the figure comfirms the fact that customers provide loyal brand value for the chosen sellers.

Numbers of social media users are not less important than tendencies that arise among marketers themselves. Platforms, chosen for ellectronic business development, are also having tendencies to changes. Marketers have been diversifying away from Facebook steadily since 2019. When asked to select their single most important platform, only 54% selected Facebook, down from 67% in 2018. 78% of marketers are using Instagram. It's the second most important social platform for marketing (behind Facebook). Short-form video is growing. More than half of all marketers regularly use Instagram and Facebook for video-based stories. A significant 71% of marketers plan on increasing their use of YouTube video and 72% want to learn more about organic video marketing on the platform. TikTok is ignored by most marketers: Only 9% of marketers are using TikTok [16].

Therefore, the implementation of effective marketing communication campaigns in social networks is a significant factor in the effective promotion of a company, brand or product, aimed at increasing the target audience, developing, improving and protecting the company's reputation through the formation of consumer loyalty to the enterprise.

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Holistic Marketing in Development of Arts and Cultural Institutions in Digital Environment

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Abstract— The expansion of the application in modern information techThe paper present theoretical and practical approach of holistic marketing implementation in development of arts and cultural institutions in digital environment. In the paper is analyzed all parts of holistic marketing, internal marketing, integrated marketing, social responsible approach and relationship marketing. Internal marketing present organizational culture that send messages to public audience about arts and cultural institutions. Integrated marketing have to send consistent messages to target groups about artistic and cultural events. Social responsible approach is base in working of arts and cultural institutions. Arts and culture open thoughts, ideas, value that otherwise could be unnoticed. Through arts, social problems could be solved, by raising awareness about that problems. Relationship marketing give opportunity for communication with public audience. Social media are platform for relationship communications. Arts and culture improve values and ideas in digital environment, Arts and cultural institutions accepted digital environment and try to be convenience for public.

Keywords - holistic marketing, arts and cultural institutions, digital environment

I. INTRODUCTION

Holistic marketing approach is a platform for development of arts and cultural institutions in digital environment, based on internal marketing, integrated marketing, social responsible approach and relationship marketing, as well as, strategic planning, strategic marketing analysis, implementation of strategies, evaluation and control. The goal of the paper is to encourage work of arts and cultural institutions in a digital environment, based on a platform of holistic marketing. Specific goal of the paper is to enlighten marketing strategies in development of arts and cultural institutions positioning and reputation in digital environment. [7]

Holistic marketing approach has challenge in the development of arts and cultural institutions in digital environment. All parts of holistic marketing approaches are important, internal marketing, integrated marketing, relationship marketing and social responsible marketing. [1]

Internal marketing strategies improve digital employee's communication in arts and cultural institutions in digital environment. Strategies of integrated marketing improve consistent messages of arts and cultural institutions in digital environment, as well as, development of communications with target audiences and development of reputation in digital environment.

Social responsible approach is base for every arts and cultural institutions. It is important to improve social responsible approach in arts and culture and awareness about social problems in the world. [7]

Strategies of relationship marketing make platforms for clear and direct communications with target audiences of arts and cultural institutions in digital environment. [3]

In all these ways holistic marketing is one of the key platform for realization of development of arts and cultural institutions in digital environment. [1]

II. METHODOLOGY

In empirical research the paper will present results about vision, mission, strategic goals, strategic marketing analysis, strategic implementation and strategic control of arts and cultural institutions in a digital environment.

The empirical research include focus group with managers of arts and cultural institutions in traditional and digital environment. The focus group is prepared with six managers from chosen institutions. Their opinions are presented in the paper.

In the paper is used survey, as qualitative research method for analysis of satisfaction of public with arts and cultural events in digital environment. Special focus is put on positioning and reputation of arts and cultural institutions in digital environment.

The paper has research part focus on observation of positioning of these institutions in digital environment. The data was analyzed in program SPSS and presented in the paper.

The focus group results are presented by description method. In the paper is used cases study methods, also.

In the paper are described case studies of arts and cultural institutions, which are excellent positioning in digital environment. In the paper is described case studies, such as, The House of Beautiful Business, Greek National The-

atre, Museum Tate Modern and Museum of Cycladic Art

Authors of this paper had opportunity to make focus group with managers of arts and cultural institutions in digital environment and professors of marketing in art and culture at business faculties.

Managers and professors of these organizations concluded that implementation of holistic marketing approach and experience marketing approach have impact on development of arts and cultural institutions in digital environment. Interesting is that they enlighten role of care about target groups, in the way that they feel that organizations care about them and their experiences. All these institutions develop new management approach in traditional and digital environment, and in that way give brilliant experiences to public. They emphasized that in implementation of marketing strategies in development of arts and cultural institutions in digital environment, it is important to be passionate about arts and culture, be kind, respectful and sophisticate with audience. Members of focus group, managers in digital environment and professors at faculties, emphasized that it is important that offline and online media write in good way about arts and cultural institutions in digital environment.[3]

They concluded that media contents about arts and cultural digital institutions, organizational culture of digital institutions and development of new professions have impact on development of arts and cultural institutions in digital environment. Managers of these institutions and professors at faculties, as members of focus group, emphasized that it is important to improve knowledge in fields of management in arts and culture, information systems, leader's skills, financial management and marketing management, in classroom, as well in online educational platform.

Also, members of focus group noticed that it is important to improve knowledge in arts, culture, history, in order that young people have opportunity to introduce new cultures, to live and work in beautiful intercultural environment, to have communications with people through modern media, multimedia and digital, interactive platforms, to improve cosmopolitan spirit in young people. They said that in future every arts and cultural institutions will be partly offline and partly online, but some arts and cultural institutions will be fully online, in digital environment. [4]

Results of the research about public satisfaction would be important for further research of development of arts and cultural institutions in digital environments. Digital environment is a new place for development. It is very important to improve arts projects in order to prepare arts people for new business opportunities and new business knowledge and skills that are important in global jobs market places.

Results present that holistic marketing approach has impact on development of arts and cultural institutions in digital environment.

Holistic marketing have integrated marketing communication with target audiences of these institutions, which present opportunities for research needs and wants of public, both in offline and online environment. It is very important that integrated marketing communications have consistent storytelling with target audiences of purpose of arts institutions. [1]

Strategies of relationship marketing develop and improve communications between arts institutions and their target groups. Social responsible approach gives platform for development of arts based on truth, honest base, as well as, purpose and message to target groups. Strategies of relationship marketing have specific impact in leading of arts and cultural institutions in digital environment, because relationship marketing gives opportunities for interactive communications with public, strategic partners and target audiences.

They give opportunities of interactive communications with public, through traditional ways of communication and modern, social media platforms. Two way communications give opportunities for listening of wants and needs of public, that shows ways for furture arts and cultual development.

The paper is focus on academic and scientific research field. Today, new business knowledge and skills are for artistic and cultural new professions, such as arts management, arts marketing, social media developer in arts and culture, managers of music and arts festival in digital environment. The paper has implications for development of arts and cultural institutions in digital environment. It is very important to implement marketing strategies of experiences. These strategies are regarded as key concepts in marketing today. There are different views and interpretations about the content of terms. There are two connected concept of experience and experiential marketing.

Based on the literature review the authors found that experience marketing is a strategic and a broader term than experiential marketing. Definition of experience marketing is that it is a strategic and holistic marketing of relevant and meaningful experiences, and experiential marketing as a tactical tool that helps to do marketing experientially.

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Employer branding framework using social media for attracting talents

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Abstract— In contemporary dynamic environment having an attractive employer brand is pivotal to achieve competitive advantage of hiring and retaining the best talents. This paper suggests a framework for employer branding, and emphasizes social media as a significant channel of employer's brand communication, particularly in targeting young generation. In addition, we propose the principles of commmunication via social media that should be followed in order to create employer image and attractivness. The outcomes of this study can be used by companies in the process of recruitment of talented young people looking for jobs opportunities.

Keywords—*Employer branding, Framework, Communication principles, Social media, Young talents.*

I. INTRODUCTION

The digital age calls for digital Human Resource Management (HRM) approaches, as the "digitized" workforce changes requirements regarding HR practices [1]. It follows the trend of greater expectations for more open access to companies' information.

The power and convenience of social media in the domain of HR can serve to various purposes. As social media are widely used, particulary by young generation, they offer a myriad of possibilities for direct communication. Thus, they bring powerful tools for communication employer brand, as well.

Being firstly conceptualized by Ambler and Barrow in 1996, the concept of employer brand has recently become a notable topic in HRM [2]. As Backhaus and Tikoo [3] explain, it refers to the unique characteristics of the company's employment offering, the package of functional, economic and psychological benefits provided by employment - employer value proposition, that differentiates it from competitors, by attracting and retaining potential employees [4]. Employer branding is a set of specific strategies and activities that company applies in order to convey the message to future and existing employees that it is a desirable place to work [5]. Thus, the concept has appeared as an outcome of the application of marketing and branding principles to HRM, and provides the possibility for HR professionals to strategically promote the company as desirable employer in the process of recruitment [4].

Shabanabi and Kesavaraj [2] elaborate that the essential part of employer branding process is to communicate an employer brand in the marketplace. Furthermore, social media is seen as a significant channel of employer brand communication, particularly in targeting young generation, in order to raise awareness, strengthen an employer image as a good place to work, and consequently, attract talented candidates [4]. In this paper, we are focusing on social media, peculiarly on company-controlled social networking sites which give potential applicants the opportunity to aquire a large quantity of information about the company (not only about job offers, but more - about organizational culture as well)[6].

The paper aims to integrate existing theoretical and empirical approaches and create a clear view of employer branding framework, as well as principles of employer branding communication via company-owned social media. In adittion, we proposed the principles of commmunication via social media, that companies can use in order to effectively attract talents.

II. METHODOLOGY

In this study, we used a conceptual research by observing and analyzing already available both research and case studies on employer branding and its communication via social media. We used both scholarly and practitioner researches and articles from the fields of HRM, branding, and social media communication. Based on extant rosurces, we comprehensively systematized employer branding framework, with special attention given to social media communication for creating employer image and attractivness.

III. EMPLOYER BRANDING FRAMEWORK

As Aldousari et al. [7] explain, there is a difference between external and internal employer brands. The external employer brand refers to the attractivness to job applicants, whilst the internal employer brand refers to an image that an employer has among the actual employees. This study will focus on building the external employer brand, particulary via company-controlled social media, such as LinkedIn, Facebook, Youtube, Twitter and Instagram.

By integrating existing theoretical and empirical approaches, we propose the employer branding framework, shown in Fig. 1. The determinants relavant for understanding the external employer branding and what should be communicated via social media are briefly explained below.

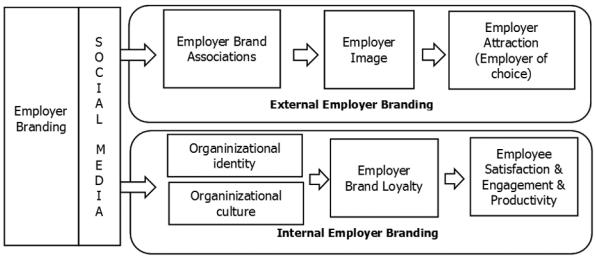

Fig. 1. Employer Branding Framework (based on [2])

An employer image refers to how potential employees receive and perceive the employer brand [2], and it reflects their beliefs [8], and types of associations [4]. Lievens [9] proposed that employer attractiveness assumes not only intstumental aspects of the job, what a company offers (such as a job salary), but also the symbolic attributes, as intangible and subjective aspects of a job. Thus, these symbolic attributes should be used in communication via social media [10]. To summarize, employer branding activities are related to positioning employer brand and targeting potential employees with attractive job offering, that should be communicated through various channels, but also via social media. Consequently, together with other employer branding activities, communication via social media can make an impact on what job applicants think, feel and do [4].

A plethora of companies has been recognized and leveraged the potential of digital and social media (such as LinkedIn, YouTube, Facebook, Twitter, Instagram), to communicate employer brand and attract talents. Additionally, the rise of "gig economy", as well as COVID-19 pandemic, have created an increasing need for online organisational support in the context of employer branding and becoming the employer of choice for young talents[11].

The advantages of using company-controlled social media in the first phases of recruitment are numerous, from possibility to post more in-depth information at almost no cost, over widening visibility through transcending geographical and cultural boundaries, to offering various conveniences for job applicants who can come across and use relevant information whenever they want [12].

IV. COMMUNICATION PRINCPILES AND BUILDING EMPLOYER BRAND WITH SOCIAL MEDIA EMPLOYER BRANDING FRAMEWORK

The paper suggests that an essential part of the communication in employer branding should be conveying effective and powerfull massages. Here we had to consider not only marketing and communication strategies that are pivotal for conveying the purposeful message, but also the unique characteristics of socal media as the tool and the medium of spreading desired reflection (representation). To create the effective and powerfull messages, the main communication principles regarding the content of the messages are proposed:

- Content should be relevant for presenting the genuine and desirable values of the companies [12] and in accordance with the potential employees' interests. The information given in the content should target the right audience, showing that an employer's values are fit to the candidates ones [13]. Finally, information has to be genuine and consistent with the real workplace experience [14].
- The amount of relevant information should be proper, according to good ergonomic practices when posting information online [15]. The quality, diversity, as well as the quantity of information are of great importance [13]. Diversity and the quality of information are covered by the specific content, but the capacity to receive the information and form the impression toward the company could be undermined by the amount of information given in one frame of time.
- The information should be well visually structured [12]. The well structured information might provide the clues for better understanding and visibility of key points, eleciting the right cognitive reception.
- Striking the emotions as well as providing information – provoking positive emotions (positive emotional experience) leading toward positive emotional evaluation of the company [1]. Kashive et al. [16] have great expectations from understanding the sentiments of employees.

Bearing in mind these principles, we would like to provide guidelines for effective communication of an employer brand via social media, based not only on theoretical considerations, but also on empirical evidence. Thus, we believe that it is possible to overcome potential pitfalls of building employer brand in virtual setting, that can be used for attracting young talents

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Problems of Algorithmic Censorship and Personal Branding

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Abstract— In this paper we present systematic model of censorship in the cyber space as related to the modern day marketing of variety of important elements from tangible commercial products over political ideas, to personal public presentation to which we refer to as personal branding. Faced with the dominant presence of the multimedia promotional material in the cyberspace, and the necessity of having an individual be enabled to project her or his presence in the public cyber agora, we analyze modern trends to formalize and restrict style and the content of such public projections. Besides identifying personal strengths, and professional skills, an individual must device strategy and content to attract attention of the targeted population of digital residents of the cyber space. We find that modern algorithmic censorship significantly threatens to, and does impede the most effective attention grabbing vehicles. In our work, we dedicate particular attention to the commercial consequences upon e-commerce platforms that is being super-scaled and globalized, leaving ethical, philosophical, political, cultural, and other aspects for future considerations.

Keywords - censorship, brending, digital marketing, e-commerce

Interactive content on Instagram business profiles

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Abstract— The further growth of popularity and influence of social media have left their mark in the last decade. Social media based on multimedia content exchange getting bigger and bigger users attention. According to the number of active users, Instagram today ranks 5th among global social media and it is the main promotion channel for all types of business. User behaviors research on Instagram shows that interactivity is one of the most significant social and psychological motives. This paper presents various forms of interactivity that are implemented in posts within the most popular Instagram formats - Stories, standard Feed posts and Live events. Next to that, the exposed interactive contents are analyzed from the aspect of achieving business goals, such as: e-shop sales; product promotion; raising brand awareness; generating potential buyers; collecting followers' feedback and keeping customers

Keywords - Instagram, social media, user engagement, e-marketing, e-business

I. INTRODUCTION

The number of global, regional and national social media on the Internet continues to grow. Compared to 2019, in 2020, the growth of users on social media was 13%. It is estimated that 53.2% of the world's population uses social media today [1]. The crisis caused by the pandemic has increased the popularity of social media, messengers and e-shops. Today, a social media user spends an average of 2 hours and 25 minutes a day in various activities [2].

The popularity of social media has certainly been contributed by the easiness of use and functionality of the client application. No additional tools integrated in commercial applications are required to create a multimedia post [3].

Instagram was designed in 2010 as a social medium for sharing photos and videos. With the acquisition in 2012, Instagram became part of the Facebook company. The application is constantly being improved and a new format will soon be added - video with sound. The biggest changes in functionality were made in 2016, when the format Instagram Story was introduced [4]. Then, in 2018, Video Live is introduced as a possibility of live broadcast of the events that are interesting for followers. Instagram users today can exchange instant messages, share multimedia files of the appropriate format and size, or communicate using the option for video and audio streaming. Finally, in 2018, a special application for mobile devices was published - IGTV Instagram format, which is intended for sharing quality video content. This content includes 2K video density, up to 60 minutes recording time, and full screen display in landscape orientation [5].

The influence and popularity of Instagram as a global social media is constantly growing. It jumped from the seventh place in 2018 to the fifth place in 2020 in terms of the number of active users [6]. According to statistics from 2021, in Serbia, Instagram has 2 million and 593 thousand active users [7].

Different entities (production, services and organizations that base their business on spreading ideas) have an interest in being well represented on Instagram, because Instagram users are their potential clients. Today, Instagram is an unavoidable channel of promotion for all types of business, using Internet marketing technologies [8]. However, Instagram is constantly changing and updating its functionalities. Therefore, the problem of using Instagram as a digital marketing channel has not been sufficiently studied in existing papers. In particular, there is a lack of papers that shed light on the impact of the use of interactive content on the decisions of potential clients.

The aim of the paper is to analyze various forms of interactivity that are implemented in posts within the most popular Instagram formats - Stories, Feed and Instagram Live. The following procedure analyzes the application of identified interactive content in relation to business objectives: e-shop sales; product promotion; raising brand awareness; generating potential buyers; collecting followers' feedback and keeping customers.

According to Pareto's Principle and Rule 80/20 [9]. users use only 20% of functionalities implemented in digital product for various reasons and most often out of ignorance. The purpose of this paper is to increase the use of interactive functionalities in designing posts for business users on Instagram, in order to achieve the satisfaction of business entities and customers.

II. METHODOLOGY

The research methodology used in the paper includes various scientific methods, such as: content analysis, comparative method and webometric analysis.

Content analysis was applied to two groups of collection: classification and data processing. Please note sections below for more information. First, the Instagram app was analyzed. The focus is on the implementation of interactive content in Feed, Story and Live formats. Further, the available professional and scientific literature relevant to the research was analyzed. The comparative method compares the collected data and valorizes their significance in posts for business profiles on Instagram. Webometric analysis [10] includes research and analysis of web articles relevant to the research, websites of institutions and organizations that are stable and enjoy a good reputation for a long time, as well as their business profiles on Instagram.

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Digital marketing techniques for promotion of "Infrastructure of Serbian Railways"

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Abstract— This paper explores and analyses the presentation of "Infrastructure of Serbian Railways", a state-owned railway company, on the Internet and social media in 2020, as well as the effects achieved in the media and the public. The aim of the research is to determine the extent to which the business of "Infrastructure of Serbian Railways" can be presented on the Internet and social media by company's activities and shared information.

Keywords - railway, social media, internet

I. INTRODUCTION

According to the volume and type of investments in the railway infrastructure in 2020, it can be concluded that large modernization projects were realized in the region.

At the same time, the Covid-19 pandemic shaped almost the entire 2020, which significantly affected not only the functioning and business of "Infrastructure of Serbian Railways" (hereinafter: company), but also the implementation of railway infrastructure modernization projects in our country.

In these conditions, the results of this research should describe the extent to which the company responded to the challenges of 2020 via the Internet and social media and influenced by its activities public opinion and created a media and public attitudes on important topics of the company operation and business in the last year.

In this paper, we investigate how company was presented in 2020 on the Internet (company presentation) and social media (Facebook, Instagram, Twitter), by topics and areas, then by forms of presentation, as well as by the dynamics of activities.

In addition, the paper analyses the public's comments on the Internet announcements and the company's presentations, as well as the interest they have shown in other topics related to the business and functioning of this railway company.

The paper states in a theoretical sense the importance of presentation and PR activities for the successful presentation of the company to the public, as well as other target groups.

Also, the paper analyses the indicators of media reporting based on the Internet activities of the company, including quantitative and qualitative analysis. In particular, certain media (electronic editions) were analyzed from the point of view of their internet traffic and impact, with the aim of determining the "coverage" of users and target groups with information and activities of the company.

The research is aimed at determining the extent to which the company can present its business and functioning to target groups and the public by its activities on the Internet and social media so influencing their attitudes, on which making and implementation of appropriate strategic and financial decisions depend.

II. METHODOLOGY

Based on the conducted quantitative research, the paper establishes a qualitative causal link between the company's presentation on the Internet and social media and informing the public through the media, as well as certain target groups (Government of the Republic of Serbia, Ministries, Local self-government).

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Cost-effective way of implementing SMS marketing in small to middle-sized enterprises using Raspberry Pi

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Abstract— Among other specificities of SME (Small and middle-sized enterprises) is their lack of financial, human and technical resources. This important barrier forces SMEs to optimize their market advent and put it in line with their capabilities, without losing competitiveness in their market niche. One important marketing channel is SMS (Short Text Message). Although technologically very old, it still has it's marketing value and potential to bring competitive advantage to enterprise. This paper proposes sustainable and cost-effective model for sending short marketing messages using the combination of Raspberry Pi device and mobile technology. Conceptual model has been developed, as well as a prototype of programming solution, a list of use cases and brief financial analysis of effects of this kind of solution. The results show that using the proposed system, SMEs can achieve significant reduction in marketing campaign cost without losing its quality.

Keywords - SMS marketing, SME, Raspberry Pi, m-marketing, web service, IoT

I. INTRODUCTION

One of the most challenging aspects which SMEs face are the lack of human, technical and financial resources. This affects various aspects of business, including marketing efforts as well. Mobile marketing can be used as a channel to access existing customers and keep them loyal to the firm. SMS is a simple form of communication between two persons which enable transfer of text message between mobile telephones.[1] Although very old, SMS is very popular service with 3.2 trillion business messages in 2019 and estimated 3.7 trillion in 2020. [2] Beside being widely available and with faster response rate than e-mail, SMS marketing is 99% legitimate, with only 1% of spam. [3] SMS marketing is a part of mobile marketing where messages are sent by companies as a part of advertising or promotional campaign and paid by the company.[4] SME can reduce the cost of SMS marketing using low-cost solutions.

Raspberry Pi is low-cost, small and portable computer board which can be used to plug-in to computer monitor, television, keyboard, mouse etc.[5] Its technical features provide additional benefit in view of it's adaptation for application in other context within organization's domain. Using such solution can be proven to be more cost-efficient than using existing web services which are cloud-based and often offer complete solution for SMS marketing under relatively high price.

II. METHODOLOGY

The main goal of the research is to create a prototype of software and hardware configuration which will provide flexible framework for low-cost SMS marketing campaign ready to be easily adopted by SMEs. The research should answer the following questions:

- Is there a low-cost alternative to the existing web services for SMS marketing?
- Is it possible to develop such a solution and integrate it with SMEs' existing information system?
- What are use cases and possible benefits for such a solution?

Preliminary literature review didn't point out similar research, which indicated the research gap.

In order to answer these questions a two step analysis has been conducted. In the first step, literature review was conducted with the goal of finding appropriate hardware devices capable of doing the job. Also, market research was conducted with the goal of finding business and pricing models already available.

In the second step, a conceptual model of the solution was developed, together with a prototype of software solution which implements the goal of sending SMS messages.

III. RESULT AND IMPLICATIONS

A. Cost analysis

Before creating a model for the solution, brief cost/benefit analysis was conducted. Looking at available cloud solutions, it is evident that there exists a number of cloud solutions which differ in terms of usage and price. Some providers charge on monthly basis, while others charge on pay-as-you-go basis. While most of them give free trial period of usage, the limits which are set are quite narrow for the purpose set in this paper. Pricing models for top five providers found on Google Search are summarized in table I.

TABLE I. SMS SERVICES PRICING

Pricing model	Min. price	Max. price
Monthly Basis	$49 per user	1000 EUR unlimited
Pay-as-you-go	$0.0075 per SMS	$0.079 per SMS

On the other hand, mobile networks offer different packages with different level of services included. Prices of packages with limitless SMS included from two Serbian mobile operators are shown In table II.

TABLE II. MOBILE OPERATORS PACKAGES

Stakeholder	Price
Telenor	1.199 din.
mts	1.650 din

Based on this data, break-even point can be calculated where the benefits of proposed solution become greater than costs, compared to the alternatives. This point comes at approximately 1600 messages. After that number of SMS is sent, enterprise is better off buying mobile operator package then using some of the available SMS services. This short analysis doesn't take into account the cost of the Raspberry Pi device itself, since it is a multi-purpose device and it is hard to allocate the cost of this particular service.

B. Proposed technical solution

In the proposed solution, Raspberry Pi is treated as another node in the network architecture of SME. Raspberry Pi device can be programmed to run scripts either at scheduled time or on demand. It can be easily extended with modem with SIM card jacket and hence capable of accessing mobile network. Due to it's strong technical capabilities, depending on the architecture of existing ERP solution of enterprise, it can be programmed to offer user interface for managing entire SMS marketing campaign. Alternatively, it can be equipped with only necessary parts of the software solution used for sending SMS.

Solution architecture in its simplest form, assuming pre-existence of marketing programming module in ERP where the message is defined and a database of clients is maintained, is presented at the figure 1.

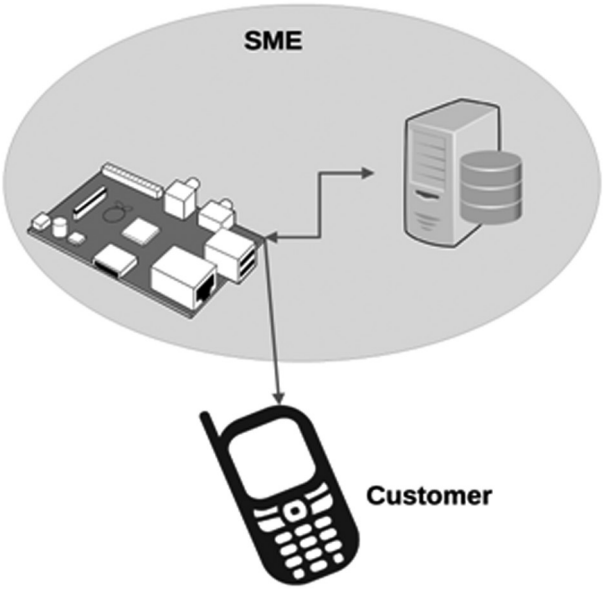

Fig. 1.Architecture of the proposed solutioin

From this figure it can be seen that Raspberry Pi device is acting as a client of enterprise's web server. Software requires the telephone numbers and the marketing message from the web server and then translates this data to the mobile modem software which is responsible for sending message out of enterprise. High-level pseudo-code for this kind of solution is presented at pseudo-code for the proposed solution:

```
get_data_from_ERP
foreach customer
    assemble_personalized_message
    send_message
```

C. Use cases for the solution

Flexibility of the proposed solution provides opportunities for the marketing managers to plan it's use in different scenarios. Some of possible use cases include:

- flash sales
- order tracking
- reminder with calendar or event organizers
- two-step authentication process
- new products or services notification etc.

IV. DISCUSSION

The research presented is aimed to find technical and business solution for SMS marketing scaled to SMEs' financial and technical reach. Although this solution is also applicable for large enterprises or banks, it is more probable that they will pay more attention to the quality of the hardware in view of durability and speed. For example, large banks can have millions of simultaneous requests for token, which can be impossible task for the solution this simple.

The main stakeholders and their benefits of using the proposed solution are shown in the table III.

TABLE III. STAKEHOLDER BENEFITS

Stakeholder	**Benefit**
Customer	Getting relevant information in the convenient way
SME	Lower costs of marketing capaign
	Closer communication to customers
	One more channel to access customers
	Offering additional services to customers
	Simple solution which doesn't require a lot of technical skills or expensive hardware

V. CONCLUSION

This paper proposes a technical solution to SMS marketing in SME using Raspberry Pi. The main benefit of this solution for SME is its cost-effectiveness compared to other identified solution. The prototype has been made which proves the feasibility of the solution. Flexibility of the solution allows it to be applied in different mobile marketing scenarios.

The main constraint which prevents the solution from being more usable in other context is related to the scale of campaign measured by the number of messages sent. On the other side, the solution has numerous advantages to the enterprises whose needs for speed and scale are moderate. Besides the lower price per message, SME can benefit of having Raspberry Pi as a powerfull multi-functional smart device capable of executing different enterprise tasks.

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E-EDUCATION

Contribution to the training of students in Digital Transformation in postgraduate education
Jose Luis Reis, José Paulo Marques dos Santos, Felope Sampaio Rodrigues

Assessing the Significance of Emotional Intelligence In E-Learning
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Automated grading assignments in programming - advantages, problems and effects on learning
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An application of TikTok in higher education
Katarina Draganić, Maša Marić, Dejana Lukač

Contribution to the students training on Digital Transformation in postgraduate education

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Abstract - Digital Transformation (DT) has become vital for many organizations. Although it is not a recent strategy, in recent years, greater importance has begun to be given to the way in which organizations have to manage their processes, creating conditions for their digitalization. This work intends to create a body of knowledge, to support proposals for postgraduate courses in DT, considering the need to train more students in DT. Taking into consideration the needs of companies, business associations, consultancies and other public and private sector organizations, higher education organizations are starting to make training offers explicitly in DT. The development of DT students' knowledge is related to the skills associated with management and technologies, namely those related to strategies for digital business, leadership and innovation, digital economy and markets, technologies and information systems accelerating DT.

Keywords - Digital transformation, digital business, education, training, skills.

I. INTRODUCTION

Digital Transformation (DT) has become vital for many organizations. Although it is not a recent strategy, in recent years, greater importance has begun to be given to the way organizations have to manage their processes, creating conditions for their digitalization.

This work aims to create a knowledge base, to support proposals for postgraduate courses in DT, ensuring that the need to train more students in this field of knowledge is adequate.

The paper begins by providing a framework on DT, followed by a section on the impact of DT, and finally a proposal for strategy and curriculum content for courses in DT is presented.

II. FRAMEWORK

Corporate governance and governing bodies have paid more attention to DT strategies, for example the Portuguese government has created a Secretary of State for Digital Transition and European Union bodies set strategies for Digital Transformation as one of their top priorities.

The phenomenon of DT has been assuming a growing importance in recent years, in scientific and academic circles [1,] [2], in the industry [2], [3] and more recently, for the public administration, having been created instruments and action plans to support DT, which is assumed as one of the drivers of transformation of the countries [4] [5], in this context, in Portugal was created the Action Plan for Digital Transition [5].

Today, organizations operate in an incrementally complex competitive environment. ICT (Information and Communication Technologies) generate, store, and distribute data and information in proportions and scales never seen before and exponentially increasing. Providing them, at the same time, with immense opportunities to innovate and improve their performance and, at the same time, exposing them, weakening their ability to remain competitive [6]. In the field of education, there is a need to develop curricula that are more focused on understanding about transforming business models transformation, especially in the context of DT [7].

III. DIGITAL TRANSFORMATION IMPACT

DT will have to be seen as a highly complex undertaking that involves the whole organization [8], [7], [9], [10], and not as a mere technological or IT industry issue, with DT having to be seen as a process that generates structural changes that triggers strategic responses that changes, the way to create value [6]. The European Commission argues that "digital technologies, however advanced, are only a tool" [4], and [9] argue that while ICT strategies tend to focus on the management of ICT infrastructure, this approach limits the possible benefits of DT that can be achieved when the approach focuses on the customer and the value creation framework [9].

A 2018 study by Tabrizi, Lam, Girard & Irvin (2019), based on a survey of directors, CEO, and senior executives concluded that the risk inherent in DT was their number one concern in 2019. In that same study, the researchers found that 70% of all DT initiatives fail to meet their objectives. Of the $1.3 trillion that was spent on DT in 2018, an estimated $900 billion was wasted. The authors of the study pose the question, "Why do some DT efforts succeed, and others fail?" [11]. The answer may lie in the lack of professionals prepared to manage DT, fundamentally, because most digital technologies offer possibilities for

efficiency gains and better customer relations but forgetting effectiveness. On the other hand, if managers do not have the right mindset to change and current organisational practices are imperfect, DT will simply amplify these failures [11], with the consequences being very serious for organisations.

Consultants from McKinsey & Company (2020), report that a DMEXCO trend survey of over 800 corporate DT decision-makers, 527 from Germany, Austria, and Switzerland and 305 from other countries, conducted in April 2020, concluded that the pandemic caused by COVID-19 is a driver for DT, as 70% of respondents consider that the effects of COVID-19 is likely to accelerate the pace of their DT [12].

IV. DIGITAL TRANSFORMATION TRAINING AND EDUCATION

When we deal with DT we are facing a multidimensional phenomenon that is transversal to various areas of knowledge, so it will be difficult to address it in any other way than multidisciplinary, which forces postgraduate courses to approach DT centred on management and strongly complemented by computer sciences.

The courses in DT must be built on a solid conceptual and theoretical basis, based on an informed perspective focused on the management of DT, inspired by the definition of DT as "a process that aims to improve an entity by triggering significant changes in its properties through combinations of information, computing, communication and connectivity technologies" [6], aiming to develop skills to manage, in a holistic way, DT based on value creation, in order to contribute to the development of professionals able to manage DT, exploiting technologies, maximizing the benefit for organizations (and society), taking into account that digital transformers, digital masters, must cultivate "two capabilities: the digital capability, which allows them to use innovative technologies to improve elements of the business, and the leadership capability, which allows them to predict and drive organisational change in a systematic and cost-effective way. Together, these two capabilities enable a company to turn digital technology into a business advantage" [13].

The proposed DT courses must aim at preparing students to be the digital agents and transformers that society and organizations need, empowering them with skills that allow balancing the strategic management of traditional and digital businesses, in the aspects that allow relating organizations and people, using ICT supported by digital machines and platforms, aligned with their institutional strategy of training offer. The programmatic contents must enable its students with the necessary competences to manage DT comprising the 4 dimensions: strategy [1], [9], organizational change [14], processes [15], and culture [16]. Throughout the training process, students must acquire competences for the use of technologies, the changes in value creation, and the structural changes [9].

The postgraduate courses in DT should be oriented towards a practical application component, whose focus should be the dimension of applying contribute to the development of DT, where the student knows, understands, and develops skills, to be able to build and lead digital transformation projects. Considering these assumptions, the three are fundamental three pillars: technologies, tools, strategy and innovation and transformation of organisations and business.

DT students should acquire knowledge associated with organisational innovation strategies and the application of methodologies that use digital technologies and tools in the management of DT-related processes. Students must acquire knowledge leading to skills to apply strategies, lead, create, analyse, and build operational plans, as well as implement and monitor DT projects focused on value creation and results at the level of efficiency, effectiveness, and economy.

V. CONCLUSIONS

Considering that this document is a preliminary approach, which needs to be complemented with more information, we can conclude that the development of DT students' knowledge is related to the skills associated with management and technologies, namely those related to strategies for digital business, leadership and innovation, digital economy and markets, technologies and information systems accelerating DT.

It is crucial that academia recognises the importance of DT, and that all institutions involved in the decision-making process on DT training are aligned, as investment in DT training is an opportunity for students and company workers to update their knowledge, to suit the market of the future.

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Assessing the Significance of Emotional Intelligence In E-Learning

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Abstract— Emotional Intelligence (EI) has been viewed as a critical factor influencing work productivity, leadership, ability to work in diverse environments, business growth, academic performance and a potential to succeed in an extraordinary way. Despite this fact, relatively little research have been done to boldly demonstrate the significance of EI in e-learning settings. This research assesses the significance of EI in e-learning environments by learning lessons from Business-to-Consumer (B2C) digital marketing experiences, where EI is applied. Although there are a number of tools used to measure EI, in this research we have applied the Trait Emotional Intelligence Questionnaire (TEIQue) along with Academic Emotions Questionnaire (AEQ) to assess the significance of EI in online academic settings. The contributions of this study are (1) to assess and then help students be aware of the significance of EI in e-education (2) to recommend students with personalized information for better academic performance.

Keywords - Digital Emotional Intelligence, e-learning, academic performance

I. INTRODUCTION

Emotional intelligence is the ability to monitor one's own and others feelings and emotions, to discriminate among them and to use this information to guide one's own thinking and action [1].

Today emotional competency and mastery of related digital tools and techniques have been shown to have a greater performance influence in education especially in understanding learner behavior and dynamic changes in student needs. In a broader sense emotional Intelligence encompasses varieties of human qualities including: empathy, decision making, the ability to convey and decipher verbal and nonverbal messages, conflict solving skills, self-awareness in coping with a variety of emotions in real time, the ability to analyze emotional functioning by identifying the emotion involved, defining and expressing it as well as understanding the actions and behaviors that might stem from it, expertise in processing the emotion by applying meta-cognition and a capacity for ethical and moral conduct and behavior. These qualities have indispensable implication both on the traditional teaching-learning setup and on the rapid growing online education methodology.

As stated in [2], emotions underpin all human actions, even our most rational and logical decisions are influenced by our emotions be it in the digital market or digital education environments. Therefore understanding how students' emotions affect their academic performance while they are utilizing digital technologies for learning purposes is of potentially enormous value to all types and sizes of e-education services. Any kind of e-business cannot survive without a carefully designed digital marketing strategy where emotions are considered. E-learning users are in no way different when it comes to utilization of emotions [3].

In this research, we carefully study how EI is applied in various fields and propose the best of these practices for enhancing e-learning service delivery. As acknowledged by [4], owing to the speed of digital content and digital communications, digital emotional expressions are more contagious than physical emotions. On the other hand, while the global e-learning market is expected to grow continuously, the self-paced e-learning market will decline. This shows the lack of emotional interactivity between learners, learning content and teachers [5]. In this section we summarize the literature on EI as a lesson for empowering e-learning environment for students' success.

A number of researches into the brain, human behavior, educational performance and medicine have identified new findings and evidences proving cognitive intelligence (I.Q.) is not, in and of itself, sufficient and that in order to lead a more effective, holistic, abundant and ethical life, one needs to develop and apply an additional dimension of knowledge. This dimension of knowledge is the EI also called as emotional quotient (EQ), a dimension of life that enriches the rational one by providing emotion related information.

According the study made in [6], using EQ skills and techniques, an educator and the educational system at large will be better able to achieve their educational objectives with the students as individuals and as a group. In an attempt to investigate the psychometric aspects of students' preparedness for online learning, students' EQ has been examined in [7], as a determinant indicator. In another study conducted in [8], although not directly related to EQ, the researchers used emotion detection technologies from biophysical signals to explore how emotion evolves during learning process and how emotion feedback could be used to improve learning experiences. EQ curriculum

for students in higher education has also been developed as in [9], that can be used as a therapy to emotionally challenged students with skills to manage these emotions.

The above stated studies have done tremendous work in evaluating the implication of EQ in education in general and in academic performance in particular. However, little work has been done to investigate the significance of EQ in an e-learning settings with the purpose to provide students and teachers with personalized information to empower their emotional competency for better academic performance. Moreover, most of the EQ measurement tools used are based on the ability EI model which refers to the actual abilities to attend to, process, and utilize affect-laden information. It is argued that ability EI model cannot be operationalized along typical cognitive ability lines because it is not possible to devise items with objectively correct responses. Also this model is not based on known scientific theory. On the other hand, 'Trait EI', utilized in this study, refers to a collection of emotion-related dispositions and self-perceived abilities and is assessed with self-report measures – making it more subjective and aligned to personality theory. Our approach is unique in that (1) it focuses specifically on e-learning environment; (2) we have applied a combination of the trait EI model and Academic Emotions Questionnaire (AEQ) along with students' activities and performances history obtained from self-reported scores and an e-learning service. The goal of this research is therefore to assess the significance of EQ on e-learning environment in specific courses of the Department of E-business, Faculty of Organizational Sciences, University of Belgrade and then to develop tools and methods that promote the academic performance of students based on the findings.

II. METHODOLOGY

In this research we are using two measurement instruments to assess the significance of EQ in e-learning. These instruments are Trait Emotional Intelligence Questionnaire (TEIQue) which is based on the trait emotional intelligence theory and the Achievement Emotions Questionnaire (AEQ). Moreover students' academic records and virtual learning logs will be used for correlational analysis purposes. The experiment will be designed in line with an online educational settings using Moodle in studying specific courses. In the first phase of the experiment, we will assess students' EQ while studying the course Internet Marketing and in a second attempt we will assess students EQ while studying the course Internet of Things. Each instrument is briefly discussed below.

A.Trait Emotional Intelligence Questionnaire (TEIQue)

The TEIQue is an integral part of the academic research program on trait emotional intelligence (trait EI) [10]. Trait EI, alternatively called as trait emotional self-efficacy can be formally defined as a constellation of emotional perceptions assessed through the TEIQue instrument and rating scales. The instrument contains a number of versions including TEIQue (full form), TEIQue-SF (short form) and many other forms and translations. The TEIQue full form is a self-report inventory that covers the sampling domain of trait EI comprehensively. Individuals indicate their level of agreement on a 1-7 Likert scale (1 'disagree completely' to 7 'agree completely') with 153 unique items. The instrument measures 15 emotional traits (facets) concerning four factors (Well-Being, Self-Control, Emotionality and Sociability) and a global trait EI score. The TEIQue-SF is a 30-item questionnaire designed to measure global trait emotional intelligence (trait EI) used in performing short term researches. In this initial research, we have used the TEIQue-SF to get an insight on how EQ matters. In the future we have the plan to use the full form.

B.Achievement Emotions Questionnaire (AEQ)

The AEQ is a multidimensional self-report instrument designed to assess college students' achievement emotions. It is based on a program of quantitative and qualitative research that examines students' emotions experienced in academic achievement situations that is, attending class, studying, and writing tests and exams [11]. The class-related and learning-related emotion scales include 80 and 75 items respectively. Both scales measure eight emotions: enjoyment, hope, pride, anger, anxiety, shame, hopelessness, and boredom. While the test-related scale include 77 items and measures eight test emotions pertaining to enjoyment, hope, pride, anger, relief, anxiety, shame, and hopelessness. In this study, due to time limitation, we have considered only the learning-related emotion scales ordered in three blocks of experiences which are before, during, and after learning.

In the initial phase of the study, about 100 students taking the online course Internet Marketing using the e-learning platform Moodle are expected to participate in the study. Two questionnaires have been designed using Microsoft Forms and shared with the students for response. Once obtained, the data will be analyzed and results will be discussed.

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Automated grading assignments in programming – advantages, problems and effects on learning

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Abstract— E-education is having great growth in the last few years. It is obvious that the need for e-learning software is growing. In the process of learning, grading assignments is one of the most important activities in this process. Grading, programming languages, and environments are not standard across different educational facilities, that's why many tools for grading are made especially for one or a set of courses. While there are several tools that are made for universal use, often they don't support all features that are needed for different courses. In this paper, reasons for automatization of grading activity will be presented, but also problems and considerations which must be resolved while developing such a system. Also, a model for grading complex programming assignments will be presented, which should provide the necessary flexibility for most of the courses.

Keywords - e-education, e-learning, automated grading, programming assignments

I. INTRODUCTION

E-learning is one of the fastest-growing industries. The global e-learning market was projected at USD 144 Billion in 2019 and is estimated to reach USD 374.3 Billion by 2026 [1]. Demand for online courses is growing as many schools and universities had to adjust their courses to be online, since the start of the pandemic. Numerous online courses and e-learning platforms have been used for gaining knowledge not only for beginners but also for developers learning new technologies and expanding their knowledge. Tools for automatization of processes in learning are needed. One of the most important activities of learning is the evaluation of knowledge. This encompasses defining tests, their assessments, grading and providing feedback. The idea of automatization of some of these activities has existed since the 60s, since then many tools have been implemented and widely used – tools for creating forms, questionnaires, collaboration, online lectures, grading assignments etc. In this paper, we will present problems that one must resolve while implementing this kind of system and the advantages of its use. Also, we will present the effects on this process, which includes all activities of evaluation.

II. REASONS AND ADVANTAGES

Reasons for automatization of grading are [2]:

1. ime-consuming: grading implemented programs take a lot of time since they must be tested with many test inputs
2. Error-prone: usually, while grading an assignment teacher is, instead of testing inputs, analyzing code line by line, which can lead to more errors.
3. Subjectivity: while grading code inspecting code line by line, teachers usually have a model solution and can be biased when students have different solutions.
4. Plagiarism[3]: software can be used to compare as-signments and detect plagiarism, while when sev-eral people are grading assignments, plagiarism can remain undetected.

These are the most important reasons for using this kind of software. Some tools are created for universal use but often they don't provide all the needed features. That's why there are many implementations of these systems. [4]

One system for grading should be flexible in term of defin-ing a test, evaluating partially correct answers, generating feedback for students, and being easy to use and adapt to the specificity of a course.

III. PROBLEMS AND CONSIDERATIONS

Here are identified problems that must be resolved when designing the system for grading[5][6]:

1. Syntax – beginners can often have problems in syntax while programming. When this error should occur these assignments cannot be tested, but feedback about this can be provided.
2. Trying to trick a software – in a lack of knowledge or solution students may try to implement a solution that is true for only a subset of inputs. This can be resolved by using a large set of test inputs. Also, sometimes students are requested to implement a function that is available in the standard library. Use of those functions must be prevented.

3. Endless loops – Often, while learning, students may make an endless loop. This kind of error can cause a problem in a grading program. The time or number of loop iteration must be limited.
4. Runtime errors – while testing a program runtime errors must be expected. This kind of error must be expected and graded. The grading of an assignment or a test that created such an error should not impact the system.
5. Memory leaks – in an environment that has a garbage collector this is not an issue, but in an environment where a student must free memory when necessary, this also must be put into consideration. When testing these systems, memory leaks, should not have a big impact on the system, but in implementation mocking and determining if there is a memory leak should be provided.
6. Potentially malicious code – Program must be tested in a safe environment because a student can intentionally or unintentionally submit a malicious code.
7. Feedback – Providing useful feedback is necessary. Students need to be able to know what they did wrong, and also to lower a need for complaints.
8. Defining a test – when using automated grading, when defining assignments they must be clear and not ambiguous.

IV. MODEL

In this section, a model for designing this system will be described. It is shown in Figure 1.

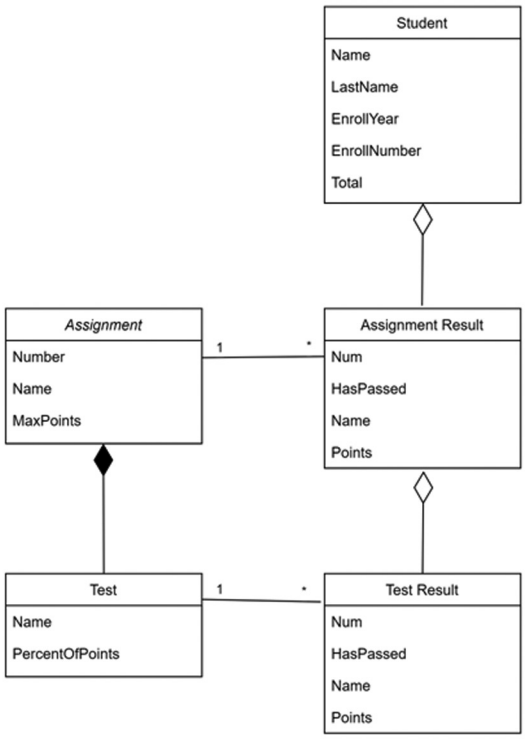

Fig. 1 Model of automated grading system

Usually, a test is created with an idea of connecting several topics and assignments which are part of the test. A test is consisted of implementing different functions to be able to resolve one assignment. Sometimes function implemented for one assignment can be reused in resolving another one. This is done to let students recognize where they can reuse a function and to connect different topics. Hence, a separation between a function and an assignment has been made. This also enables a program to implement a partially implemented assignment. Also, the presented system is flexible and can be customized to suit any task.

When defining a test, a student must be given a function prototype based on which it will implement necessary functions.

V. CONCLUSION

As the online learning business is growing, also interest in learning to program is rising. While the interests are rising quickly, the teaching staff has been facing a large number of assignments for grading. Luckily, this activity can be automated. In this paper, it is discussed what problems must be considered when designing a system for grading programming assignments.

Designing software for automated grading of assignments in programing must allow quick and correct behaviour in a safe environment, without a risk of failure or corrupting data. It is important enabling grading partially correct solutions while providing meaningful feedback on error.

Also, the flexibility of software to be adjusted to different types of exams is needed.

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Microservice architecture in E-learning

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Abstract— Microservice architecture has found its application in the design and implementation of systems used in e-learning. Multiple cases of applying microservice architecture in e-education were considered and it is determined that there is a place to further investigate integration of the custom e-learning microservices with some existing LMS (Learning Management System). The aim of this paper is to present a possible solution of a custom microservice architecture that is based on integration with some existing LMS. The approach that was used to identify microservices is Domain Driven Design. Integration of the Cloud Data Platform into this architecture is also considered.

Keywords - microservices, microservice architecture, e-learning, Cloud Data Platform, LMS, Domain Driven Design

I. INTRODUCTION

There are different definitions of microservices in literature. One of them is given by Sam Newman [1], who defines microservices as autonomous services that work together [1]. Thus, the microservice architecture can be viewed as an approach in the development of applications that are organized as a set of independent and small services that communicate using a mechanism, mainly the HTTP protocol [2]. The deployment of such services is performed independently of the others, and the centralized management of these services also stands out as a separate service [2].

As microservice architecture is used to implement different solutions due to its nature to provide more flexibility and reusability of existing parts (microservices) of the system, the purpose of this paper is to further investigate possible scenarios of integrating microservice architecture in e-learning environments.

Multiple cases of applying microservice architecture in e-education were considered. Some solutions investigate the migration of custom Learning Management Systems (LMS) to microservice architecture [3]. The others consider improvement of the existing microservice architecture of the e-learning platform [4] or VLE (Virtual Learning Environment) [5] or developing their own educational platform for remote access using microservices [6].

Based on the considered existing cases, it is determined that the integration of the custom microservices with some existing LMS is lacking. The goal of this paper is to provide a possible solution of the custom microservice architecture that will be part of the e-learning flow and that is based on integration with some existing LMS (e.g. Moodle). Also, possible design of Cloud Data Platform and its place in microservice architecture is presented.

In order to identify microservices Domain Driven Design should be considered [5] and strategic concepts characteristic of this type of design, the so-called Bounded Contexts, must be defined first [5]. Concepts such as The API Gateway and Message Broker that are commonly used in the implementation of this type of architecture are illustrated. The solution gives presentation of microservice architecture which consists of e-learning microservices and their communication.

II. METHODOLOGY

In order to create custom microservice architecture and to identify the microservices that make up the system, Domain Driven Design approach and the Bounded Contexts are used. In this case, it is necessary to identify microservices whose integration is done with the Moodle platform. Identified contexts are: authentication, resource search, learning through play, communication, analytics and reporting. A microservice corresponds to each identified context (Fig. 1):

- Authentication service,
- Teaching materials search service – searches for teaching materials by certain criteria
- Education games service – implementation of an educational quiz,
- Communication service – chat add-on,
- Analytics and reporting service – generating reports on student activities.

The API Gateway routes the requests that customers send to microservices and thus calls microservices and aggregates the results [7]. In [8], the use of this pattern in microservice architecture is compared with the Facade object-oriented design pattern. Message Broker works on the principle of publish / subscribe message system which is a form of asynchronous communication between services

[9]. In this model, every message sent to a particular topic will be received by all services that have subscribed to that topic [9].

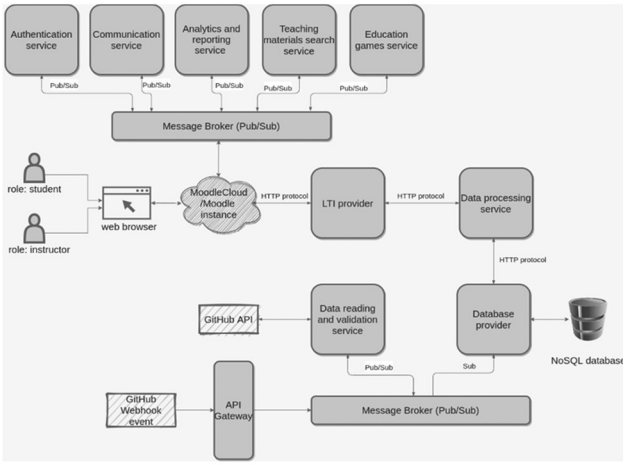

Fig. 1.Microservice architecture diagram

The second part of the architecture is the Cloud Data Platform with application in e-learning. As this is a data management platform, context identification is facilitated and relies on the layers identified in the universal architecture of the Cloud Data Platform [10]. Contexts i.e. the layers are as follows: Ingest, Storage, Processing and Serving. Each of these layers corresponds to a microservice, respectively (Fig. 1): Data reading and validation microservice, Database provider microservice, Data processing microservice and finally microservice LTI provider.

After the GitHub webhook [11] event occurs, the call is forwarded to the API Gateway which further determines which event needs to be generated and sends it to the Message Broker.

The Message Broker forwards this event to the appropriate service. The Data reading and validation service was launched by this event. It processes the data and validates it. This service further sends an event triggering the Database provider service through the Message Broker. This service stores data obtained through the events in a NoSQL database, and is also in charge of generating an endpoint for reading and modifying data in this database. The Data processing service communicates with the previous service via the HTTP protocol. In this way, it obtains data from the database and transforms it. Finally, the service that uses the data generated in this way is the LTI provider that requests it via the HTTP protocol, as shown in the figure (Fig. 1).

In order for the LTI (Learning Tools Interoperability) provider service to successfully connect to the Moodle platform, it is necessary to use the LTI protocol [12]. Three components stand out in this part of the architecture [12]: web browser, provider (microservice LTI provider) and user (Moodle).

The web browser is in charge of displaying the module that the user (e.g. an instance of the external Moodle website) requests from the provider. At the time of the request, the user (Moodle) sends data (payload) to the service address by HTTP POST method [12], and in response receives data from the LTI provider in HTML format and thus displays the given module on the page where it is referenced in the settings. Since the user can have different roles and since the role data can be obtained from the predefined data sent by Moodle [12], if the call comes from a student, the display may differ from the one coming from the lecturer.

III. RESULTS AND IMPLICATIONS

Exploring literature that dealt with implementing microservice architecture in e-learning environments led to a conclusion that integrating this type of arhitecture with existing LMS solution is lacking in practice.

In search for possible ways of integration, a proposal of microservice architecture with application in e-education is given. In addition to the general presentation of microservices and their communication, the patterns used in the implementation of this type of architecture are illustrated.

Asynchronous communication is performed between certain services according to the Pub / Sub pattern principle, and thus better performance is achieved. Message Broker is used for communication between microservices. As in paper [5], Kafka can be used for implementation of this pattern.

Microservices whose integration is done with the Moodle platform were identified. They are an extension of the LMS solution. They use data available to Moodle, which is externally available through the Moodle API. A possible design of Cloud Data Platform is also considered to be integrated with this type of arhitecture.

In conclusion, it is important to state that, as given microservice solution suggests, there is a possible way to implement microservice architecture which is based on integration with existing LMS system. This solution can be used as a starting point for further consideration of this idea. The main goal of implementing this kind of arhitecture is to achieve flexibility and reusability of existing parts of the system, that being the basic characteristic of microservices.

Furthermore, adding new e-learning microservices is facilitated since existing microservices are independent, concerning technology (programming language) and functionality that is provided in each one of them.

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Instagram as a collaborative e-learning tool in higher education

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Abstract— The social network Instagram is used daily by a lot of students. By using Instagram, they share photos and videos, communicate, comment and react to the content of other users. Apart from the current purpose of Instagram, we believe that it can also be used for educational purposes. The aim of this paper is to examine the possibility of using the social network Instagram as a support in the process of collaborative e-learning in higher education. The paper presents the methodological procedure of applying collaborative e-learning activities on Instagram in higher education. Collaborative e-learning activities are organized in the form of challenges and quizzes, with the aim of encouraging creativity and motivation of students to learn, as well as collaboration through mutual interaction in assessing responses to challenges.

Keywords - Instagram, collaborative e-learning, education

I. INTRODUCTION

The influence that social media have in different spheres of society (eg. politics, economics, sports and communication) is also recognized in the educational context. Higher education is undergoing changes due to the influence of social media [1]. Using social media as a mean of communication and learning assistance is recognized as a good practice in higher education [2], [3]. Social media, especially Facebook, and more recently Instagram, have become a useful e-learning tool that allows students to communicate, collaborate, search, and share educational content [4]–[6]. Numerous studies show that learning based on the social media usage has the effect of encouraging joint learning, increasing motivation, as well as achieving better learning outcomes [7], [8].

Higher education institutions use various social media as platforms to promote study programs, improve distance learning processes, communicate in real time, interact with students and to manage student relationships (Student Relationship Management) [2], [3]. A large number of students use social media for informal education [2], [3], [9]–[11]. Different scientific studies have shown that it is possible to use social media in the context of formal education as a personal learning environment [9].

Through social media users are provided with the opportunity to connect based on their interests, sharing and viewing a large amount of multimedia content, experience and knowledge [2], [3]. In addition, social media are used as the main tool in marketing when building a brand on the Internet, attracting new website visitors, as well as interacting with existing users [4].

In recent years, there has been a growing trend of the use of social media as an aid to formal education, although they were not initially created for these purposes. [6], [12]–[14]. The introduction of social media in the learning process offers the possibility of creating such content that will encourage students to communicate, engage and collaborate [8], [15], [16]. Professors establish a direct channel of communication with students, which enables the provision of relevant information related to subjects and exams, and trough social media they can construct encouraging and motivational learning environment for students through various activities [16], [17]. The use of social media as an aid to e-learning in higher education institutions is an important factor in improving the application of acquired knowledge in practice. A sense of belonging to a particular community is an important element for successful e-learning [18].

Research shows that students use social media more often than email or other forms of communication as an e-learning support [15]. The idea behind the use of social media in the educational process is based on research that has shown that teenagers and youth (in their early twenties) use social media more than any other age group. [19]. The Instagram platform is one of the most commonly used platforms for sharing content (photos and videos) in the student population. Based on the results of the conducted studies, it can be concluded that the sharing of content on this platform contributes to a positive learning outcome, especially for students with a visual learning style [20]. The importance of using the Instagram platform as a support to informal education has been the subject of analysis of numerous scientific papers [5], [15], [21].

Social network analysis (SNA) provides both visual and mathematical analysis of human relationships and collects information that help in market analysis, business de-

cision making, research of marketing activities, determining affirmed users of a certain social network, and other similar requests [22].

The term distance learning has produced concepts such as online learning, e-learning, web-based learning, collaborative learning, virtual learning and others, that has defined the way of distributing educational material.

II. METHODOLOGICAL PROCEDURE FOR APPLYING COLLABORATIVE E-LEARNING ON INSTAGRAM

A.Preparation of challenges and rules of participation

The Instagram campaign #UčimoUzElab was conducted on the profile of the Department of Electronic Business (@elab_office). It consisted of three challenges and one quiz. Challenge announcements are posted in the form of posts on the Instagram profile once a week. Students posted the answers to the challenges in the form of stories on their profiles by tagging the profile of the department and setting the appropriate hashtags.

The Elab quiz consists of 5 questions that are published in the form of surveys on the Instagram stories of the Department's profile.

In order for a student to participate in the campaign, I need to follow the Instagram profile of the Department of E-Education and adequately respond to the topics of the challenge by posting an appropriate photo or video as a story or post on the profile. Challenge responses must include the hashtag #ucimouzelab and the @elab_office profile tag.

The motivating factor for students to participate in the campaign are the additional points obtained in the subject of Internet marketing. Points are awarded as follows:

- Each challenge carries one point.
- Collaborative activity carries one point. It is achieved in the form of assessing the response to the challenges of other students by selecting the percentage of fulfillment of the task requirements.
- Answering all five questions of the quiz brings one point.
- Responding to campaign-related posts brings extra points.

B. Setting challenges

Figure 1: Announcements of the challenges

The campaign consists of three challenges on the topics: "Health promotion on social networks", "Application of Crowdsourcing in environmental protection" and "Digital marketing techniques". Challenges were set on Tuesdays and students were able to respond to each of them for 7 days.

C. Responses of students to challenges

Students responded to the challenges by posting Instagram stories on a given topic and tagging the Department's Instagram profile.

D. Mutual evaluation and comments – collaborative activities

Each answer to the challenge that meets the given conditions was shared on the Instagram story of the Department's profile. A slider is placed on each split answer. Using a slider, other students evaluate the percentage of completed answers to a given topic. In addition, students respond to Instagram stories by expressing their opinions, which encourages collaboration.

E. Quiz

After completing all three challenges, a knowledge quiz was published. The quiz was conducted in the form of surveys on Instagram stories, and the questions were on the topics of previously conducted challenges..

F. Survey

After the Instagram campaign, a survey was conducted on the Moodle platform.

G. Analysis of results

The collection of results was done by marking the mutual interaction of all students so that the evaluation of someone else's response, depending on the slider, was evaluated from 0 to 5. After that, using the SNA tools Social Network Visualizer and VOSViewer. Changes in followers, interactions, and user demographics are tracked using Instagram Insights.

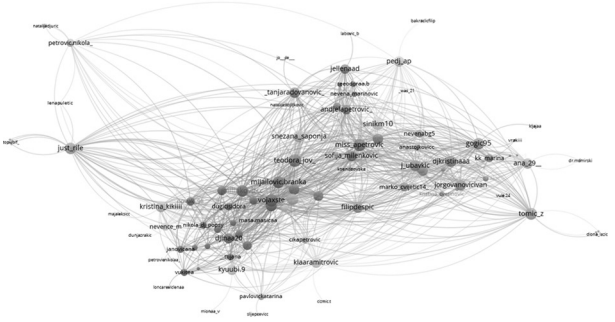

Figure 2: Analysis of results using VOSViewer

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An application of TikTok in higher education

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Abstract— The field of the research of this paper is an application of the social network TikTok in higher education. The introductory part of the paper will describe the concepts of social networks with a focus on the analysis of application in higher education. The research will be conducted in undergraduate studies at the Faculty of Organizational Sciences, University of Belgrade, as a part of the course Internet of Things. Students will participate in e-learning activities on the social network TikTok as a part of the "Learning with Elab" campaign. The campaign will be organized in the form of challenges and short quizes to test students' knowledge. At the end of the campaign, a survey will be conducted. The main aim of the campaign is to test the suitability of the social network TikTok for e-learning, students' level of motivation, creativity, and readiness for e-learning on this social network.

Keywords - e-learning, social networks, TikTok, collaborative e-learning

I. INTRODUCTION

E-learning is a complex system that includes distance teaching and learning, separated in time and space, as well as teaching materials that can be in various forms, the individual or group learning process, the tutorial, and interactive work [1][2]. Social network sites have been defined as web services that allow individuals to construct public or semi-public profiles, articulate a list of other users with whom they are connected, and view and traverse connections made by others [3]. In their original form, social networks represent virtual spaces for social interaction, maintaining relationships with friends, colleagues, for public affirmation of one's status in the group [2].

Social media usage is one of the most popular online activities. In 2020, over 3.6 billion people were using social media worldwide, a number projected to increase to almost 4.41 billion in 2025 [4]. Facebook is the leading social network with more than 2.6 billion monthly active users[4]. The company also owns four of the biggest social media platforms, all with over 1 billion monthly active users each; WhatsApp, Facebook Messenger, and Instagram [4]. Due to the growing popularity of the use of social networks and their mobile applications, educators have the opportunity to use them for educational purposes [5] [6].

Social networks enable users to create digital content themselves and publish it online, creating the vast resource of user content that students and teachers can benefit from together, also encouraging more active and proactive approaches to learning. They connect students with each other as well as with their teachers, allowing them to share their knowledge and at the same time have access to specific and targeted knowledge in a given area of interest [7].

Short video platforms have become a popular form of social media networks for millennials to share entertainment content. Most platforms are mobile applications, where users can create, edit, share and watch short videos [8]. Short videos have a standardized short duration of a few seconds to a few minutes. The relative convenience of content generation, rapid content transmission, and emphasis on socialization are distinct attributes of short video platforms [8].

One such platform is TikTok a mobile application available on Android and iOS devices for free download that allows "creators" to make short videos (3-60 seconds) set with creative tools and effects. TikTok videos are created on a mobile phone, using the phone camera, and then using the functions in the application to add audio and visual effects. This application not only allows users to express their creativity but also to interact with other users of the platform. One of the main advantages of using TikTok is that the created content can be easily shared in numerous applications and on other social media platforms. Since TikTok videos can be uploaded to any electronic device that has an internet connection, it allows users who don't have a smartphone to also join the application. While TikTok is mainly used by younger groups of audiences and teenagers to create fun, visually interesting, creative, and often funny videos online, there is also the opportunity to create informative, entertaining, and visually interesting learning content [9].

Based on the success of entertainment-oriented short video sharing platforms, knowledge-sharing has also become an important part of their services. The categories of shared knowledge on TikTok vary from creative skills and personal experience to explicit knowledge such as science, technology, and culture [8]. Short videos have become a popular form of learning and sharing creative skills such as cooking, drawing, and crafts. Short videos on social media platforms reshape the experience of learning creative skills through visually engaging materials and communication

characteristics to socialize with other users who have similar interests [8].

Another application of TikTok in e-learning is in the area of science. York University members were interested in exploring the possibilities of TikTok application as a platform for learning chemistry. They set up the TikTok account "The Chemistry Collective", on which they posted videos they created [9]. Their main goal was to use the creativity tools employed by TikTok to contextualize chemistry in a fun and engaging manner and to demonstrate it as a part of everyday life. TikTok can also be applied in medicine as a means of distributing health information, assessing public health literacy and opinions, recruiting clinical trial participants, and disseminating health interventions. Research on social networks has shown that they can positively influence the doctor-patient relationship and cause changes in the patient's behavior [10].

This paper aims to examine the possibility of using the social network TikTok as a support to the e-learning process.

II. METHODOLOGY

The methodology of application of social networks in the context of online education can be gradually applied in the following way:

A. Preparation of e-learning material -

The professors must prepare the educational material in a slightly different way from a classic lecture. It has to be prepared for uploading to social networks, to encourage student collaboration and keep their attention. The process of preparation includes creating audio, video, and text material, which the professors create on their own, and publish it on social networks such as Instagram, Facebook, etc. in form of a post or a story.

B.Conducting e-learning challenges on social networks

The e-learning challenges can be conducted through social networks in form of challenges. The main aim of the challenges is to encourage students to participate, emphasizing collaborative e-learning and creativity. Through several tasks, students will have to find an interesting way to show the answer to the given task through a video. For their answers to be noticed, they will have to use hashtags, and each correctly posted answer will be reposted on the official page of the educational institution. The challenges represent additional activities for bonus points.

C. Collaboration between students

Social networks represent a means of communication between students and professors. It is important to understand that encouraging collaborative e-learning is one of the most important elements in online student engagement. Just as important the communication with the official page of the educational institution is, so is the mutual communication of students. Students will be rewarded with additional points for each liking, grading, and impressions on other students' posts.

D. Testing students' knowledge

To test the students' knowledge and get an insight into how much they have learned and remembered from the campaign and all the challenges, a quiz will be conducted as the final challenge. Students will earn points with each correct answer. The quiz will be posted on the official TikTok account.

E. Survey

Upon completion of all challenges, students will be given a survey to complete. The survey will contain questions that will provide an insight into what their attitudes about this type of learning and online collaboration are. It will provide information about the possibilities and readiness of students to learn via the social network TikTok.

F. Analysis of the results

The collection of the data will take place from the first day of the campaign, collecting students' answers, level of collaboration, etc. The analysis is supposed to present the level of collaboration during e-learning, the increase of students' motivation, the success of promoting such methods of learning, what impact did the campaign have on students' knowledge, etc.

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The Potential for Forecasting Cryptocurrency Price Movements Using the LSTM Method

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Abstract—The Bitcoin (BTC) is a decentralized cryptocurrency that represents a new and unique medium currency, and it is often considered as the currency of the future. Therefore, it is important to understand how Bitcoin is valued and how different factors influence its extreme volatility. Several studies had discussion whether BTC prices are predictable, but the time periods of these studies were limited by data. Therefore, we believe that a current study is necessary when we consider the volume of the BTC price movements in 2021. This research is assessing the potential for forecasting cryptocurrency price movements using machine learning approach of LSTM method and closing price of BTC in five-year period. The results show that it is possible to forecast the BTC price and even potential rise and fall using LSTM.

Keywords—Forecasting, Cryptocurrency, Bitcoin, Machine Learning, LSTM, Google Colab.

I. INTRODUCTION

Transformation of economies and financial systems in digital era is in motion and it is happening at a fast rate. New digital economy size is estimated to be 25% in 2025 which is around 23 trillion USD [1]. Current global development is overflown by Information Technologies (IT) innovations, especially in business and financial sector. The most interesting and controversial technology for creating and spending digital assets is the concept of distributed ledger technology (DLT), popularly known in its most well-recognized applicative form as Bitcoin [2].

Bitcoin (BTC) is the most popular cryptocurrency, a digital currency, that represents the alternative to the real currency. It was created by a cryptologist whose real identity is still unknown and the world knows him only as Satoshi Nakamoto [3]. Bitcoin became a unique digital currency with the potential to change the very nature of the everyday digital transactions, by enabling consumers person to person electronic transaction without the need for any intermediary [4].

An issue about the digital assets, such as cryptocurrencies, is price volatility. BTC price value is formed when the group of buyers and sellers that are exchanging the currency come to an agreed-upon value of traded cryptocurrency [5]. The price of BTC for the five-year period of May 2016, to May 2021, can be seen in Fig. 1. We can see that the value of a BTC in November 2016 was around 750 USD, and, still, the currency was not stable at the time. We can see spikes prices as high as 15,000 USD in 2020, as well as low as 360 USD in 2016. As we can see BTC prices have exhibited extreme volatility in previous five-year period as the price increased 1900% in 2017, after it lost 72% of its value in 2018 [6]. BTC prices exhibit extraordinary and extreme volatility, but BTC as a digital asset shows resilience as it can regain its value even after suffering significant drops, and even during COVID-19 pandemic when the uncertainty is generally high [7]. Therefore, a true concern for consumers is whether to make a purchase of an asset that had so much variation in its value.

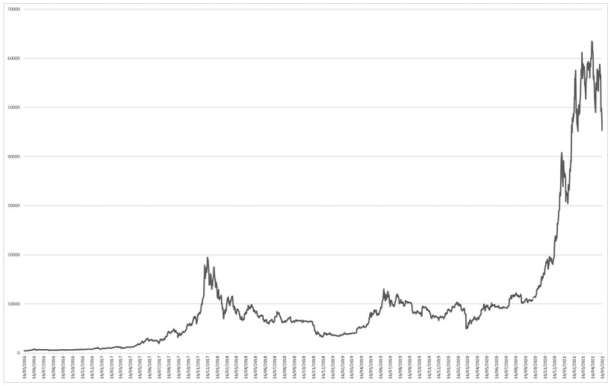

Figure 1: BTC price - May 2016 - May 2021

Regarding its volatility the price of BTC has been an area of interest where researchers have displayed their efforts for price forecast. Studies by Liu [8] and Huang et al. [9] discussed whether BTC prices are predictable and demonstrated significant return predictability. Other studies applied various machine learning methods for end-of-day price forecast and price increase/decrease forecasting [10, 11, 12]. Achieved accuracy ranged from 63% for forecasting of increase or decrease [11] to 98% success rate for daily price forecast [12].

Felizardo et al. [13] presented a comparative study of price prediction performance among several machine learning (ML) models including long short-term memory (LSTM), WaveNet, support vector machine (SVM), and random forest (RF). The results indicated that for time-series data, the LSTM model performs better than other ML models. Tandon et al. [14] came to a similar conclusion.

These studies were all limited by the data that was available. Therefore, considering the price movements in 2021 we believe that this type of study is necessary. Best approach to use for forecasting cryptocurrencies time-series data, according to previous studies is long short-term memory (LSTM).

2021 we believe that this type of study is necessary. Best approach to use for forecasting cryptocurrencies time-series data, according to previous studies is long short-term memory (LSTM).

II. METHODOLOGY

A. LSTM

ML algorithms interpret the data, so there is no need to perform initial decomposition as with classical modeling. The main purpose of our study is to determine the ability of LSTM method to effectively analyze the time series data of cryptocurrencies, in this case the post popular and widely spread BTC, and to identify the patterns that form the basis for the qualitative forecasts. LSTM is an artificial recurrent neural network (RNN) architecture that we can use in the deep learning field, where we can process an entire sequence of data. Unlike the traditional neural network LSTM has a feedback connection that helps it remember preceding information, thus making it the perfect model for time series analysis.

B. Data and Analysis Tools

In this study we will use a BTC prices dataset from Yahoo finance, that contains prices data for last five years, that is from May 16, 2016 to May 16, 2021. The data contains information about the BTC such as High, Low, Open, Close, Adjacent close and Volume. Only the day-wise closing price of the stock has been used for forecasting. We used Google Colab because it is a simple and powerful tool that allows us to write and execute Python. Colab enables us the full power of all popular Python libraries that we used to analyze and visualize the data.

C. Model Building

We initialized our model as a sequential one with 96 units in the output's dimensionality. We used return_sequences=True to make the LSTM layer with three-dimensional input and input_shape to shape our dataset. Making the dropout fraction 0.2 drops 20% of the layers. Also, we added a dense layer with a value of 1 because we want to output one value. After that, we reshaped our feature for the LSTM layer, because it is sequential_3, which is expecting 3 dimensions, not 2. We compiled our model, and we used loss='mean_squared_error' because it is a regression problem, and the adam optimizer to update network weights iteratively based on training data. In data training every epoch referred to one cycle through the full training dataset, and batch size refers to the number of training examples utilized in one iteration.

III. RESULTS AND IMPLICATIONS

In this study LSTM model was used to analyze and understand the mechanics of the BTC market. This research presents a potential way to predict Bitcoin market price. Our results show that it is possible to forecast the BTC price and even potential rise and fall using ML (Fig. 2). The theoretical and practical implications of our research are:

- Modeling results of short-term cryptocurrency dynamics and application using LSTM demonstrated the effectiveness of using ML approach, especially RRN, for forecasting;
- Conducted model simulation have confirmed the feasibility of using the ML for the short-term forecasting of financial time series;
- Constructed models have potential basis for creating algorithms for automated trading systems.
- We recommend combing different ML prediction models to create more accurate cryptocurrencies price forecasts.

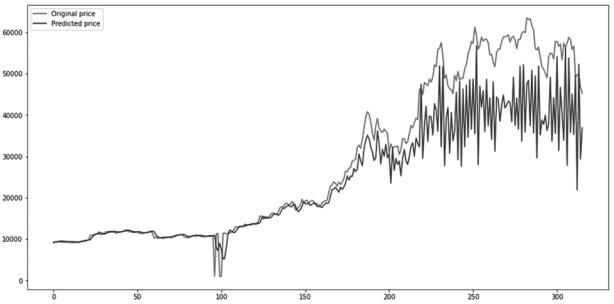

Figure 2. Original vs. predicted BTC price

Future research should investigate the use of artificial intelligence for modeling the price of any cryptocurrency which would enable easier measuring of the risk factor for the justification of financial usage of blockchain technology.

Also, it would be necessary to consider adding external data inputs that are related to global events to detect price anomalies/spikes and to use ML to predict and assess the stability of cryptocurrencies.

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Civic Crowdfunding: Systematic Literature Review and Future Research Agenda

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Abstract: In the last few years, civic crowdfunding has been receiving a growing attention among scholars and practitioners in various fields, ranging from technology to public administration. Civic crowdfunding is a sub-class of crowdfunding in which citizens collaborate with government to (co-)finance public goods or services. Although it is an interesting and promising area for both research and application, only a paucity of attention has been given to broad literature review. The main aim of this paper is to provide a systematic literature review in this worldwide early stage of the development of civic crowdfunding. To address this aim Scopus database was browsed and the total of 71 papers were analyzed. The results indicate a number of opportunities and challenges which were discussed in the Serbian context.

Key words: Civic crowdfunding; Philanthropy; Alternative financing; Literature review

I. INTRODUCTION

Financial services have witnessed some major disruptions in the last few decades. Alongside the proliferation of novel technologies, even the centuries-old financial professions, such as accounting [1] or insurance [2], have been rapidly changing, let alone some more dynamic financial services, including entrepreneurial finance and money lending. These intense-changing services are affected by 'financial democracy' and emergence of crowdfunding as an alternative way of financing new ventures or nonprofit projects [3].

Crowdfunding allows founders of for-profit and nonprofit ventures to 'fund their effort by drawing on relatively small contributions from a relatively large number of individuals using the internet, without standard financial intermediaries' [4]. In the last decade, the popularity of the crowdfunding concept has grown so rapidly that even Serbia as a developing country has been affected by scholarly attention [5]. As the concept of crowdfunding evolves, so do evolve theories, principles, legal frameworks, voting permissions and rights, tech-platforms, donor-attracting strategies etc. Accordingly, crowdfunding as such might not be a novel research topic. Specific niches, sub-classes and genres, however, still attract scholarly radars' attention.

A specific sub-genre of crowdfunding is civic crowdfunding. Civic crowdfunding is an alternative public financial instrument [6] which can contribute to community development [7]. Davis (2015) infers that the term has been used for the first time in 2012, and that, in a grand scheme of things, it refers to 'the use of crowdfunding projects that produce community or quasi-public assets'. This definition is narrow and emphasizes outcome as the only point of differentiation to other crowdfunding schemes. Logically, this difference is easily observable, but superficial. When closely dissected, civic crowdfunding displays a myriad of additional differences and peculiarities. It has been challenged as a contributor to social inequality, as it favors projects in wealthy neighborhoods [9]. Another interrogative expressed in Davies (2015) might be whether civic crowdfunding augments or undermines (local) governments? Also, a number of community or quasi-public projects require ongoing cost coverage which is not supported by civic crowdfunding, at least as currently structured [10]. Finally, any innovation in public financing tends to be slower that the entrepreneurial finance counterpart [11]. A lot of questions still require answers, and civic crowdfunding grows as an interesting field of research.

Even though this sub-class of crowdfunding has been developing for a decade now, we still lack for comprehensive and systematic literature review in the field. This paper aims to fill the lacuna in the present body by systematically analyzing concurrent theoretical and empirical findings in the field of civic crowdfunding. Particular objectives of the paper are:

- to examine the maturity of the field by identifying and analyzing published literature;
- to identify the main challenges and opportunities for the application of civic crowdfunding in the Serbian setting

To the best of authors' knowledge, a systematic literature review on civic crowdfunding has never been conducted before. Evidently, a number of concurrent publications includes overview of the extent body of knowledge to address challenges, opportunities and future agenda in civic crowdfunding [10]. Wenzlaff (2020) conducted a narrative literature review aimed at defining the term and providing four perspectives – project, supporter, owner and platform – of civic crowdfunding.

The remainder of the extended abstract is organized in the following order. Section 2 delineates the methodology used for the state-of-the-art literature review and depict the analytical framework. Section 3 elaborates on the results of the analysis. Section 4 contextualizes the main findings. The last section is reserved for concluding remarks.

II. METHODOLOGY

The aim of this paper is to systematically analyze concurrent literature on civic crowdfunding. For this purpose we created systematic literature review framework as inspired by Keathley-Herring et al. (2016). In particular, we formalized the SLR framework as given in Table 1.

Area	**Action**	**Output**
Search strategy	Selection of database, Definition of Boolean phrases, Definition of l imiters, Exclusion criteria	Search results
Initial exclusion criteria	Identification of relevant papers using meta-data (title & abstract only) by single reviewer	Initial paper set
Final review	Identification of relevant papers using whole text by two reviewers	Final paper set
Data collection	Colletion of bibliometric and paper-specific data	Group discussion
Collection of findings from Serbia	On-desk analysis of main outputs from Serbian civic crowdfunding initiatives	Comparison and report on policy recommendations for Serbia

We selected SCOPUS database to search for relevant literature as it provides prompt access to peer-reviewed articles. Since there are multiple ways to address the term civic crowdfunding we consulted several publications to search for synonyms and closely related terms. The research was constrained to papers whose title or abstract contained following set of Boolean phrases:

"civic crowdfund" OR "civic crowd fund" OR "citizen crowdfund*" OR "citizen crowd fund" OR "donation based crowdfund" OR "donation based crowd fund"

OR

civic AND crowd fund

OR

Civic AND crowdfund

OR

citizen AND crowdfund

OR

citizen and crowd fund

The initial search generated the list of total 140 papers. Then, initial list is filtered by document type to include articles, conference papers, book chapters, reviews and books. After additional filters are applied, total 128 papers remained as starting point for analysis.

Preliminary identification of relevant papers is done by scanning meta-data (title & abstract only) by single reviewer. Out of initially identified 128 papers, 57 were excluded from the analysis due to the following reasons (i) they covered the search terms in combinations that are not related or were not relevant for analysis of civic crowdfunding (ii) they examined civic crowdfunding but not in a way in which citizens collaborate with government (for instance, crowdfunding of medical research or scientific research) (iii) they represented an advice not backed by concrete scientific research methodology.

III. RESULTS AND TENTATIVE IMPLICATIONS

The most important theoretical and practical implications encompass:

- The field of civic crowdfunding is in an infantile phase in scholarly terms.
- The body of knowledge is steadily growing in the last seven years
- A vast majority of the publications use mixed-method approach and report on good practices
- The dominant topic within civic crowdfunding is citizens engagement
- Given the humble efforts in civic crowdfunding initiatives in Serbia, international practices were elaborated against the potentials rather than real national civic crowdfunding projects.

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Applying Deep Reinforcement Learning To Algorithmic Trading

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Abstract: The article presents an algorithm for trading long contracts with one asset in the financial market in the Python programming language using the LSTM neural network using the Keras library. The formalized LSTM model solves the vanishing gradient problem, which can hold the gradient of the objective function relative to the state signal. As applied to our problem, such an improvement in the model allows us to collect data on certain patterns of price changes. Sharpe Ratio is used to determine the optimal strategy and decision making at each time of application. The optimal minimum time period for the model operation has been determined; the signal transmission delay from the moment the market situation changes until the signal is received by the model, which will be infinitely small, and the computing power will be considered infinitely large. These assumptions give the right to say: when the market situation changes, the model is instantly ready to react and make a decision to sell, buy or hold an asset.

Keywords: algorithmic trading, deep learning, reinforcement learning, recurrent neural networks, LSTM model.

I. INTRODUCTION

Trading on the stock exchange is currently gaining momentum and becoming more and more relevant. These issues were considered by both domestic and foreign researchers [1-3]. The introduction of computing systems and the increase in computing power makes it necessary to use deep learning, and it is reflected in a number of studies [4-6]. At the same time, there is a complication of the mathematical base of the work performed, which entails an increase in computing power, due to which machines per unit of time can process more metrics from year to year and give more accurate solutions [7, 8]. The use of deep learning has led to a quantum leap in algorithmic trading [9, 10].

To a certain extent, algorithmic trading can be applied to one degree or another in every financial market where data is not sparse [11, 12]. This criterion is met by the foreign exchange, index markets, blue chips, and the Treasury bond market. As part of this research, we will focus on the blue-chip and indices market.

When making a decision to include an asset or its derivatives in the portfolio, the following are investigated: volatility (risk) and the expected return (mathematical expectation) of the asset [5, 7, 10]. When trading one asset, the trainee agent has 3 options: buy, sell, hold. Generally speaking, there can be much more actions: take a short position, get cash, take an option, and so on, but as part of the work, we will consider a specific task. When solving the problem, we will rely on the supply-demand for the asset. If the difference between supply and demand is significant, that is, demand is less than supply in terms of price, then the market is in equilibrium, the agent expects a sideways trend. If the market is sparse in terms of demand, then this situation is a driver for the sale, since minor fluctuations in the market can trigger the triggering of stop-losses and a sharp decrease in the value of the asset.

II. METHODOLOGY

In the application of reinforcement learning to trading in the financial market, the observation will be the price of the asset, the volume and price of bid and ask, the base rate of the currency in which the asset is traded.

The action is buying / selling / holding an asset. The reward is the change in the Sharpe indicator. The policy of the agent being trained is to maximize the Sharpe exponent. In mathematical terms:

$$\pi^* = \underset{\pi}{argmax}\, E[Sh|\pi] \quad (1)$$

$$Sh = \sum_{t=0}^{\infty} \gamma^t sh_t \quad (2)$$

$$sh_t = \frac{E[R_t - R_0]}{\sqrt{var[R_t - R_0]}} \quad (3)$$

where Rt – is the return on the asset per month t,

R0 – is the return on the risk-free asset for the month t.

γ – discount rate, (γ ϵ [0, 1]).

The parameter determines the importance of future rewards and motivates the agent to take action. The higher this indicator, the more the model is focused on long-term results.

The formalized LSTM model solves the vanishing gradient problem, which can hold the gradient of the objective function relative to the state signal. As applied to our problem, such an improvement in the model allows us to collect data on certain patterns of price changes, that is, when predicting the price of the next step, we rely not only on the data of the previous step, but also on earlier data, when there was a similar state of the environment.

Since we apply the supervised learning method, the input time series are transformed into a sample with one label, the length of the time series is T, the window size is W, the input of the sample is: $s(x_t, x_{t+1}, \dots, x_t + W)$. How we will use the activation function ReLU.

We use MSE as the loss function. We use Adaptive Moment Estimation as the parameter optimization function. To determine the parameter adjustments, we will determine the moving average of the gradients.

The formula for changing the parameters of the model is written as follows:

$$w_p = w_{p-1} - \frac{\eta \cdot \widehat{m_p}}{\sqrt{\widehat{v_p}} + \epsilon} \quad (4)$$

Using the coefficients η and ε, we can adjust the rate of selection of the values of the model parameters.

III. RESULTS AND IMPLICATIONS

To test the model, we used the AAPL ticker data from 03/14/2000 to 03/13/2019, as the risk-free rate was used by the US Federal Reserve System for the same period.

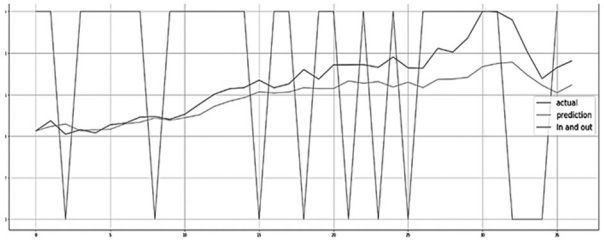

Fig. 1. Model graph for 36 months.

On the graph shown in Figure 1, we can observe that over 36 months the model advises to take 9 long positions of different duration, of which only one with 0 gross profitability. This experiment suggests that the algorithm has a high enough accuracy for planning cash management. We can understand how long over the course of several years the money will be in the asset, and how much it will be inactive.

Figure 2 shows a graph of the deviation of predicted prices from real ones for the next 3 years after the training sample. Predicted prices are plotted on the OX axis, and real prices are plotted on the OY axis.

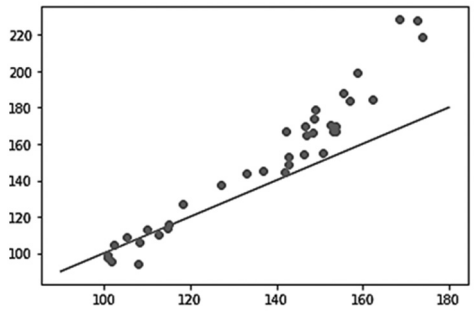

Fig. 2. Graph of the deviation of predicted prices.

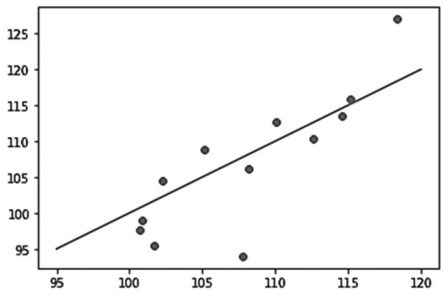

Fig. 3. Graph of the deviation of the predicted price from the real.

The average prediction error was 15.99%, while the asset price increased by 42%, hence the error was 38% of the asset price change. This means that using a model on a three-year horizon, we can predict the general trend of movement and the approximate growth rate of the asset.

Figure 3 shows the deviations of the predicted price from the real one for annual forecasting.

The average prediction error was 5% with an asset price increase of 29%, therefore, the error was 16% of the asset price change. This means that on the annual horizon, the model also predicts the trend and, more accurately, the rate of growth of the asset.

IV. CONCLUSION

The developed model allows you to conduct a monthly trend, based on technical analysis, predict the trend for 3 years, predict the asset growth rate, asset volatility.

Based on this data, we can plan a portfolio in the long term, how often we can transfer from one asset to another.

To improve the quality of prediction, it makes sense to include in the input data the annual and quarterly reports of the company that issued the securities. Using this data, we will be able to calculate such indicators as the level of debt in relation to revenue, the level of operating profit, free cash flow and the dynamics of these indicators over time. Include the most significant indicators in the agent's policy, thereby improving the model. More financial data about the company will provide the model with a larger observational space. Therefore, it is necessary to work

deeper into the methodology of model rewards so that the goal of the algorithm is closer to the goal of the trader - to extract as much profit from the trade as possible. On the other hand, an interesting area of research is to consider the distribution according to which the price of an asset is determined, which will help manage uncertainty.

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Making an Investment/Production Decision in an Uncertain Environment

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Abstract — This article presents the results of scientific research in the field of fuzzy data. Based on the developed methods, a model of making a decision on investment/production in conditions of uncertainty is described. This model includes several auxiliary models: a mathematical model of linear programming of investment project optimization, a model of the parametric α-level method of λ-continuation for the problem of fuzzy linear programming, an improved fuzzy five-factor Altman model. Conclusions and proposals of a scientific, theoretical and practical nature are also formulated.

Keywords — enterprise creditworthiness assessment, Altman models, fuzzy sets, membership function, fuzzy measure, simulation modeling, decision-making under uncertainty, errors in accounting statements, business process optimization, optimal investment, investment under uncertainty.

I. INTRODUCTION

This In real economic conditions, the optimization question differs from standard linear programming problems in that the constraints are not set rigidly, and may be" slightly " violated due to inaccurately defined economic indicators or errors in the calculation. This situation is quite common and occurs when the exact values of the values on the right side of the constraints are unknown, and the lower guaranteed estimates or weighted averages of the input parameters are used instead. Also, if there is a need for strict fulfillment of the conditions, the resulting clear problem can lead to significantly biased point estimates of the found indicators or be unsolvable due to the emptiness of the allowed set. The resulting inaccuracies may be ignored when forecasting profit or loss, but there are areas of economic activity in which such "granules of information" are critical, for example, when evaluating working capital, where revaluation leads to the inability to conduct business, and underestimation – lost profits.

This problem can be solved by formalizing fuzzy concepts using the theory of fuzzy sets, which appeared as a result of generalization and reinterpretation of achievements in multivalued logic, probability theory and mathematical statistics, discrete mathematics, matrix theory, graph theory, and grammar theory. Expert systems built within the framework of this theory have proven themselves well not only in assessing quantitative, but also qualitative (linguistic) uncertainties, increasing the predictive function of models.

Methods for solving problems with fuzzy coefficients are related to the problem of constructing arithmetic operations on fuzzy sets and in linear programming use extended methods with different formal approaches. Currently, there is no general algorithm for solving such problems. The proposed partial approaches suggest performing volumetric calculations with fuzzy numbers, accompanied by the creation of a software package that is specific to each problem being solved.

Information systems that use fuzzy data, on the basis of the structure of the tasks to be solved, can be classified as partially structured, since only a part of their elements and the relationships between them are known. The research work is designed to reduce the developed information systems to structured ones.

Since the parameters of a fuzzy model can vary quite widely, the problem of the stability of the result to changes in the parameters is also extremely relevant.

The theory of solving problems of fuzzy mathematical programming is quite developed today [1]. The task set in this paper is to concretize the results obtained for their application in the conditions of uncertainty of economic indicators.

The solution of problems with fuzzy coefficients uses advanced linear programming methods, giving rise to the problem that the mathematical model under consideration must have an accurately expressed interpretation. But the constraints in the fuzzy form do not generate any clear set of possible values, and the fuzzy function cannot be maximized. Currently, there is no general algorithm for solving such problems. The proposed partial algorithms suggest performing volumetric calculations with fuzzy numbers, accompanied by the creation of a software package that is specific to each problem being solved [2]. Each new method and new representation of fuzzy numbers usually leads to the need to write new modules of software complexes [6]. Since the parameters of a fuzzy model can vary quite widely, the problem of the stability of the result to changes in the parameters is also extremely relevant. [11].

II. METHODOLOGY

We formulate the essence of the solved scientific problem of making a decision on investment/production in conditions of uncertainty, the purpose of which is to obtain models, methods and algorithms for making investment/production decisions and assessing creditworthiness in conditions of uncertainty [10].

It is necessary to solve the problem of modeling.

Given:

S-system (object of research-investment/production decision-making models);

X – multiple input parameters (m, n, $\widetilde{c}_i$; $\widetilde{a}_{ij}$, $\widetilde{u}_j$, $\tilde{b}_j$ (i=1 m), (j=1, n));

Y – multiple output parameters (minimum cost of clay transportation, maximum revenue);

Z – multiple internal system parameters (– amount of clay (investment volume) m3 / p (i=1,m), (j=1,n));

E – a set of environmental parameters (operating conditions-restrictions on investment volumes, volumes of clay for the plant);

Q – a set of indicators of the quality/efficiency of the system (improving the accuracy of calculations in conditions of uncertainty).

Substantive (verbal) statement of the scientific problem: to develop a model of the system S, which establishes the regularity of changes in the set of output parameters Y and the set of indicators of the quality/efficiency of the functioning of the system Q from the set of values of the input parameters X, the set of values of the internal parameters Z, the set of values of the parameters of the operating conditions E. At the same time, the values of the parameters of the sets X, Y, Z E are subject to the conditions of physical feasibility and economic conditions: X Hdop, Y ⊆ Udop, Z ⊆ Zdop, E ⊆ Edop (where the index “dop” means “acceptable”).

Formal statement of the scientific problem: μ : → Y, Q | X ⊆ Xdop, Y ⊆ Ydop, E ⊆ Edop.

The model of optimal production/investment in conditions of uncertainty has the form:

1) if an enterprise considers m different investment projects and after n months it needs to get the maximum income (the enterprise has m quarries and n divisions and it needs to minimize transportation costs),

mathematical model of linear programming for optimizing investment projects is used [4, 5];

2) if it is necessary to solve the problem of improving the efficiency / quality of the system functioning because the input parameters are not clearly defined, for example $\widetilde{c}_i$ – fuzzy revenue from the i project, i=1,m; $\widetilde{a}_{ij}$ – fuzzy income/costs from the i-th project in the j-th year, i=1,m, j = $\overline{1,n}$; $\widetilde{u}_j$ –fuzzy interest rate in the j-th year ($\widetilde{a}_{ij}$ - m³ of clay per day produced in the i-th quarry for the j-th plant, $\tilde{b}_j$ - m³ of clay required by the j-th plant, $\widetilde{c}_i$ – rubles, the cost of transporting one m³ of clay from the i-th quarry (i=1 m) to the j-th plant (j=1, n)),

the model of the parametric α-level method of λ-continuation is used for the problem of fuzzy linear programming [7, 8];

3) if it is necessary to assess the possible risks from the point of view of the bankruptcy of the enterprise,

an improved fuzzy five-factor Altman model is used [9, 10].

III. ACKNOWLEDGMENT

Based on the research conducted in the field of fuzzy data, conclusions and proposals of a scientific, theoretical and practical nature are formulated. The following original results are obtained:

1. As a result of solving the problems of optimal investment of projects by the enterprise, a new mathematical method for modeling optimal financing of investment projects was developed, which allows minimizing initial investments, maximizing the income received by the enterprise at the end of the investment process with an unchanged and periodically replenished investment fund of the enterprise, taking into account the risk index and the average duration of investment, in contrast to the existing one, is applicable for an arbitrary duration of investment [4, 5].

2. The proposed four-sided numerical parametric α-level method for obtaining the final results of the optimization problem is extended to the parametric α-level method λ - the continuation of the fuzzy linear programming problem. It is shown that the use of the algorithm of the parametric α-level method of λ - continuation of the fuzzy linear programming problem allows not only to add a level of uncertainty by expanding the confidence interval at the expense of λ, but also to construct a method of inference for which the set of solutions will not be empty at sensitive coefficients due to the introduced гибкости-flexibility coefficient. The implementation of the proposed algorithm made it possible to eliminate the problem of unprofitability of production and reduce the cost of delivering clay to the Krasnodar Brick Factory by 30% by identifying unprofitable routes (50 thousand rubles instead of 80 thousand rubles per day). The optimal solution allows you to get the developed program in the MathCAD environment. For example, the minimum cost of transporting clay from quarries to factories is 50250 rubles per day. To do this, the first plant needs to deliver 200 m3 of clay from the second

quarry and 250 m3 from the third quarry, and the second plant needs to deliver 300 m3 from the first quarry. At the same time, it is not cost-effective to deliver clay from the first quarry to the first plant, as well as from the second and third quarries to the second plant [7, 8].

3. A simulation model of the problem of fuzzy linear programming with the α-level method of λ–continuation is constructed, which allows us to check the adequacy of the developed mathematical model based on the data of a full-scale experiment (the standard deviation of the left-hand objective function is not more than 5%). This approach has an advantage over the existing one, since it allows you to estimate the probability of bankruptcy of an enterprise by entering fuzzy data, and also offers quantitative ways to formalize the fuzziness, giving the expert more information to make decisions in the conditions of sensitive problems, verifying the model by computational experiment [7, 8].

4. The Altman five-factor model is improved, extended by representing the input data as triangular fuzzy numbers. In the new block, when calculating the main economic indicators based on accounting statements,the incoming values of the coefficients ki (i=1,.., 5) are modeled, represented as fuzzy sets (based on expert opinions of economists). This representation of the coefficients is introduced in order to more fully take into account the fuzzy nature of the initial coefficients of the accounting statements. The implementation of the developed model eliminated the shortcomings of the four-factor Fox Z-model, giving adequate conclusions about the bankruptcy of the enterprise. The evaluation of the enterprise according to the improved Altman model allows even in critical zones of uncertainty (the result obtained is not included in any of the decision-making sets) to refer the enterprise to a well-defined area [7, 8].

5. Using the constructed simulation model, we tested the Altman model for assessing the creditworthiness of an enterprise using modern computer technologies, supplemented with fuzzy ki indicators, which allows us to find the left-hand and right-hand sets of α-levels of the fuzzy set ki and observe how, with small changes in the coefficients, the probability of bankruptcy of the enterprise changes. This simulation shows how much the conclusion about the bankruptcy of the enterprise has not changed with an increase in the degree of uncertainty of the confidence interval. For example, for the Krasnodar brick factory, with an increase in the degree of uncertainty by 0.01, the conclusion about the probability of bankruptcy of the enterprise will not change. The root-mean-square deviation shows a rather small spread of all the main indicators (0.02) in the simulation model, which brings the simulation simulation closer to modeling using deterministic models [9].

6. An effective set of problem-oriented programs for conducting computational experiments based on the developed models, numerical methods and algorithms has been developed [10]:

- Risk-based Investment Portfolio Optimization Program (POIPR);
- Optimization program for the fuzzy linear programming problem of the parametric continuation method (PO-FLPP);
- Program for assessing the creditworthiness of the enterprise (PDMSC new).

The time spent on calculating the optimization problem of fuzzy linear programming with the α-level method of λ–continuation in the MathCad environment was reduced by 0.005 s. In comparison with the four-sided Fiedler problem.

Also, for the purpose of operational access, a mobile application for assessing the bankruptcy of an enterprise in Java in Android Studio has been developed.

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The Risk-Management in Artificial Intelligence

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Abstract— This paper indicates the main distinguishing features of artificial intelligence as a tool for gaining competitive advantages in the field of governmental and international banking. The main techniques for teaching AI and subsequent application in banking are analyzed. The key challenges for specialists in the field of information technology and service are highlighted.

Keywords— risk management, artificial intelligence, banking, ethics, future. economic sphere, learning progress, economics of Russia

I. INTRODUCTION (HEADING 1)

When we read texts, our organs collect information and interact with neural connections. Neural connections, in turn, are based on the results of evaluating a multi-level dataset that contains the experience of our past interactions with fiction and scientific literature. The average reader literally skips most of the text from word to word, because our brains have the ability to make predictions and make relevant guesses. This is one of the features of our incredibly complex thought system. By "average reader" I mean intelligent people who are the carriers of primordial intelligence.

The need to call our intelligence primordial appeared not so long ago - in the 70s of the last century, when a working prototype of AI (artificial intelligence) first appeared on the world stage. At the turn of the 50s of the last century, during the Dartmouth Conference, two decades before the actual creation of the first version, the term "Artificial Intelligence" was used for the first time. Of course, later this technological novelty will be released to ordinary people. Humanity was seriously perplexed by the urgent problem of creating a certain set of practices and techniques that would dispel the fog of uncertainty in the field of rational decision-making. In this article we will look at the use of AI in the banking sector, namely, we would highlight the use of AI in the risk management of a particular banking system. Indeed, artificial intelligence is firmly entrenched in our daily life and has overcome the threshold of performing extremely simple and trivial operations. At the dawn of the formation of the fin-tech industry in Russia and in the world, special attention is paid to the development of high technologies, which can bring the operational and strategic activities of these social institutions to a qualitatively new level of development.

II. MAIN PART

According to current research by WCIOM, 70% of Russian population does not understand the meaning of the term "Artificial Intelligence". From the data, published by Oracle, it is evident that artificial intelligence is "a system or machine that can imitate human behavior in order to perform tasks and gradually learn from the information it collects." As a result, humanity already has a tool that, contrary to the widespread beliefs about job cuts and the enslavement of civilization, is designed to seriously expand the horizons of human capabilities and become a driver in the process of achieving ambitious goals for an advanced society. This technology has been at the service of the practical interests of modern business for many years. It should be emphasized that this developing and modernizing tool is simultaneously becoming one of the priority tasks for advanced R&D centers and AI itself is being built into the arsenal of modern business. Let's move on to considering the problematics of the key task, namely the readiness of AI as a tool for making informed risk decisions in banking.

Currently, the popular expression "information is the new oil" has become widespread. Indeed, the reader can easily draw parallels in the context of the increasing value of data. However, there is many reservations about this thesis. In particular, the number of collected information and the growth of various sensors and sensors indicate the inexhaustibility of the mentioned resource. Nevertheless, the mere fact of possession of information does not mean that the owner will certainly have material well-being. The key caveat is that it is critical to leverage billions of petabytes of personalized information. The main generator of innovations in this area is one of the distinctive features of the modern market economy. At a time when homogeneous products flood the market, leading brands are striving to create a personalized experience for their consumers. Enterprises that specialize in mass production also do not stand aside. Among others, the world-renowned German

automobile concern BMW, at the dawn of the 2000s, introduced the possibility of considering individual options when choosing a vehicle on the corporate website of the same name on the Internet. The work of artificial intelligence is built on the same basis. In the process of learning, the machine analyzes huge amounts of collected information to identify patterns and learn how to make rational decisions.

As a rule, the process of teaching artificial intelligence begins with the formulation of a specific task. Overall, we need to develop computer vision - an outstandingly useful tool in the composite concept of AI. So, experts, among other things, are confounded by doubt of the technological results' success in distinguishing a correctly completed loan application form from an incorrect one. The process begins with the transmission of the plurality of examples to the system. Then, gradually, the presence of a person in the process is leveled by the increasing level of AI competence. Moving on to specialized terms, it can be characterized as "supervised learning" in the process of deep one. This method is one of the most common and it is part of ML (machine learning). Thus, step by step, the elements of the computer's motherboard are getting ready to squeeze out the order managers in one of the central branches of the capital's major banks. As an already existing example, I can cite the fact of the existence and successful functioning of the voice assistant Alice from the domestic fin-tech giant Yandex. It reflects the effectiveness and versatility of the above teaching method. AI in banking is becoming more mature, unlocking the potential for sophisticated solutions that deliver positive ROI across all business segments. The adoption of AI in banking has become more widespread, with most financial services companies claiming to have adopted AI in business areas such as risk management (56%) and generating revenue through new products and processes (52%).

According to a survey of financial services professionals OpenText, most banks (80%) are well aware of the potential benefits of AI and machine learning. Based on the above statistics, it can be assumed that many banks are planning to deploy AI-based solutions. 75% of respondents at banks with over $ 100 billion say they are currently pursuing AI strategies, compared with 46% at banks with assets under $ 100 billion. Certain use cases for AI are already widespread in banking, the most mature of which are chatbots for individuals and countering payment fraud. AI in banking applications is not limited to retail banking. Investment banking and other financial services can also be optimized using AI.

The three main channels through which banks can use artificial intelligence to save costs are conversational banking are the fraud detection, risk management, and back-office. Banks use algorithms in the front-end to simplify customer identification and authentication, simulate live employees with chatbots and voice assistants, deepen customer relationships, and provide personalized insights and recommendations.

AI is also being deployed by banks as part of a framework to assess risk, detect and prevent payment fraud, improve anti-money laundering processes, and perform know-your-customer regulatory audits.

At this point, a sufficient amount of data has been provided to the beginning of a serious discussion of the work of AI as a risk manager in a bank. Undoubtedly, some further empirical data of the current market situation will appear before us. But nowadays it seems logical to independently raise this topical issue. To begin with, the fact that the risk management of the bank is designed to improve the quality and stability of the transactions that this financial institution performs. It is difficult to overestimate the importance of the work of specialists who ensure the sustainable development of their employers. But is AI capable of replacing professionals who can provide a client with several hundred financial and social indicators while deciding whether to satisfy a request. It is important to bear in mind that the financial market is almost at the epicenter of globalization. Many years ago, banks that worked exclusively in their local region lost their positions. Digitalization has erased all physical boundaries and made international financing and other compound deals possible. Consequently, it caused growth of the performed operations exponentially. This means that when using artificial intelligence, you can expect a significant return on investment at the expense of scale. Returning to our question, the shortest answer is: "Yes, AI can potentially cope with this task" and it is doing it right now. In this situation, the banking industry as a whole tends to adhere to the position of Sberbank, which carries out comprehensive work on the development and implementation of high technologies. On December 3, 2020, the head of Sberbank, German Gref, announced the imminent opening of the first Institute of Artificial Intelligence in our country. The strategic investment plans of the said bank include investments in AI in the amount of 150 billion rubles. In addition to the internal transformations of the company and the already mentioned investments in R&D, Sberbank is actively introducing high technologies, from decoding the surviving manuscripts of Peter I and assessing the prospects for the work of young employees, to the risk management that interests us.

"100% of decisions on granting loans to the population in Sberbank will be made by artificial intelligence", - this is how the company's ambitious goal sounds, according to the deputy chairman of the bank's board, Alexander Vedyakhin. Without a doubt, this is impressive enough. However, a few additions are worth making. First, the prospect of digital risk management is in many ways similar to the previously mentioned training of artificial intelligence to work with credit forms. Learning from the examples of decisions already made, having all the necessary information at its disposal, the machine is capable of taking a position that is advantageous for the bank. The second important observation is the ethical side of the issue. For example, Sberbank is the largest bank in our country; it is on it that obligations are historically entrusted to the

often low-income strata of the population of our state. Ethics, in turn, according to the director for the dissemination of digital technologies at Yandex Grigory Bakunov, "... is not algorithmized. The moment we can translate ethics into understandable logical forms, ethics as such will cease to exist in our country. It will just be the law. " Indeed, it is difficult to disagree with this statement. Concepts of morality and ethics densely envelop modern banks, which play a socially significant role in an era of widespread publicity and transparency of business. I propose to consider the second in turn, but far from in importance, part of the ambiguous question of the AI's introduction into the risk management of banking.

It is important to take into account the architecture of decision-making about opening a credit line in our time. Of course, a calculator can cope with such categories as risk appetite and financial indicators of a client. However, socially and environmentally significant indicators also come into play. So, in particular, Raiffeisenbank is very suspicious of applications from brands that specialize in "dirty" production. These brands may include manufacturing enterprises that are involved in the extraction and processing of coal. In the process of deciding on the issuance of funds, the well-known ESG approach for assessing risks can be useful. When applying this methodology, indicators such as environmental, social, and governance are taken into account. Certainly, some of the meanings can be categorized and rationalized. Nevertheless, the question posed again returns the discussion to the area of ethics and "ideological" correspondence between the policies of the potential client and the bank.

Having progressively considered the phenomenon of AI development and the current needs of banking in increasing the stability and quality of the investment portfolio, you should proceed to form your assessment of what is happening. Undoubtedly, artificial intelligence appears to be a promising technology for developing the competencies of the risk management division in banks. Our society can confidently anticipate when this technology will simply become a necessary competitive advantage in the era of an aggressive digital economy. IT specialists together with UX (user experience) employees and other stakeholders, tend to provide an adequate response to the AI challenges discussed earlier.

III. CONCLUSION

In the course of the work, the specificity of the development of artificial intelligence was considered. Emphasis was placed on the current methods of teaching AI, the prospective improvement of the quality of solutions, and application practice. Based on the conclusions of authoritative experts, the result of the work is a formed understanding of the application of these technologies in the risk management of leading banks. In recent years, the intricate abbreviation of fin-tech has become increasingly common. The term known among the broad masses fully reflects the position of modern banks. More specifically, it is these business units that are at the forefront of the modern technologies' development. The desire to invest in promising tools of the digital age is becoming permanently necessary.

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Development of internet marketing model in banking industry based on big data technologies

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Abstract— The subject of this paper is use big data technologies in banking sector. The key issue, which has been presented in the paper, is the research and development of internet marketing models that are based on clients' movements on the bank's digital portals. The goal of the research done is to improve the communication between the bank and its clients and to contribute to portraying particularities in behavior, interests and wishes of clients by developing and applying new models of internet marketing. The aim of the research is to increase the quality and efficiency of marketing and sales strategies of the Bank in order to integrate relevant processes such as data collection and analysis, CRM banking system, with the intention of improving the design and usability of the system when posting content on bank portals.

Keywords—big data, e-banking, internet marketing, CRM

I. INTRODUCTION

With the increase in the number of users, services and channels of communication with clients in banking systems, there is an increase in the amount of data available to banks [1]. The large amount of data allows banks to continuously monitor customer behavior and their habits in the use of banking services, with aim of developing personalized and adaptive services that can be customized to the user in near real time [2]. To implement such systems, it is necessary for banks to provide appropriate infrastructure and services for storage, search, analysis and management of large amounts of data (big data). Big data technologies enable banks to identify and initiate problem solving, as well as to make better business decisions.

Numerous research and experience from banking practice show that establishing long-term relationships with customers is a prerequisite for achieving better business results [3]. The main tool for achieving quality and long-term customer relationships are customer relationship management systems (CRM). CRM systems are one of the main sources of data needed to create personalized banking services as they contain numerous customer data. Except in the CRM system, customer data is located within various portals of the bank, in server logs and other databases. it is possible to analyze the behaviors, characteristics, experiences, needs and expectations of users by integrating this data.

The subject of research described in this paper is the analysis and development of innovative models of internet marketing in banking based on big data technologies. The development of an innovative internet marketing model is based on monitoring the movement of users on banks' digital portals. The result of the research is an innovative model for anticipating the needs of users, planning and implementation of activities, all with the aim of making fast and quality business decisions.

II. METHODOLOGY

The subject of the research is the development of innovative internet marketing models based on big data technologies in the banking sector. The model is based on the analysis of the behavior of users of the bank's digital portals in order to improve existing and develop new bank services. The main goal of research is to define a personalized approach that will respond to the specific requirements of clients and increase satisfaction in the use of banking services.

There are a large number of data management and analytics applications in the banking sector. Banking applications use data in order to better personalize the bank's offer and thus enable real-time offers of products and services tailored to individual users.

Big data solutions for data analysis have led to changes in many sectors in the last few years. These technologies are increasingly used in the financial industry to identify and harness the potential for better collaboration with clients, to better understand and mitigate risks and reduce costs.

A. Big data technologies in banking

In recent decades, the big data concept has been the focus of the modern business world. Due to the increase in the amount of data collected and stored by companies around the world, the ability to access and analyze this data is becoming increasingly important. Big data refers to data sets that are too large or too complex for traditional data processing applications [4]. The importance of the big data concept is not only based on how much data the company has, but how the company uses the collect-

ed data. Different companies use data differently, but the more efficiently a company uses its data, the more potential a company generates will grow [5]. The benefits of a big data concept for one company are [6] :

- Costs reduction
- Saving time
- Responding to market changes in the short term
- Control of the company's image on the Internet
- Increasing the quality and efficiency of client portfolio research
- Detection of malicious behavior
- Better sales conditions

B. Development of internet marketing model in banking based on big data technologies

Business banking portals contain a large amount of data on users of banking services, starting from the number of clients and their visits, the pages they visit, all the way to the keywords they enter when searching the bank's portal.

The implementation of the model was performed in the following steps:

- Data collection and aggregation using Azure EventHubs
- Data storage using HDFS (Hadoop Distributed File System)
- Structuring data using Hive
- Data processing using Spark
- Visualization of the obtained results using SAS Visual Analytics

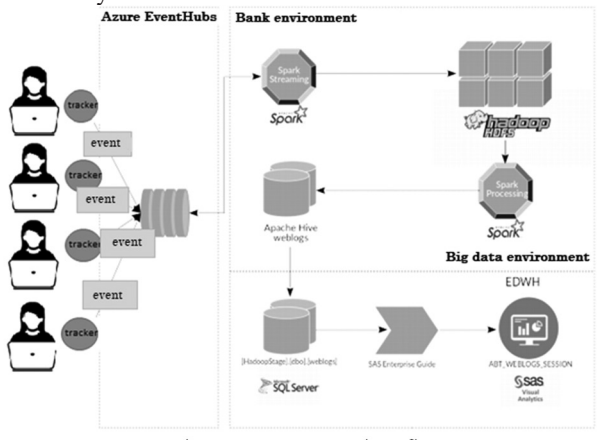

Fig 1. Data processing flow

C. Evaluation of the developed model

For identification and collection of events on digital channels, a component (tracker) was used, implemented as JavaScript Tracker, according to the principles of implementation of Google Anaytics tracker. This component identifies two types of events from the bank's digital portals: pageview - visit the bank's portal and pageevent – invoking an action on a web page that is initiated by selecting a specific button on the page, filling out a form, entering values in certain fields, etc.

Events from the portal are collected and structured as messages in JSON format and forwarded via HTTP protocol to the Azure Event Hubs component of the system. The tracker component uses browser cookies to identify and store information about the user accessing the portal.

Raw events are permanently stored on the HDFS component within the big data environment. Data collected on the HDFS layer is used by analytical applications in order to identify and analyze parameters for monitoring user behavior on the bank's digital portals. The implemented analytical component aggregates user visits and activities at the portal and user session level and calculates various session parameters for analytical needs and visualization of results. The result of data processing is strictly structured data in an appropriate format, in the form of tables.

Aggregate user sessions in the form of final results are entered into the bank's data warehouse environment, from where they can be used for various analytical purposes. Data from the bank's data warehouse environment is used to generate various reports using the SAS Visual Analytics platform.

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SMART HEALTHCARE

Exploring the antecedents of adoption intention of smart healthcare technologies in rehabilitation
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Crowdsourcing models in smart hospital
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Model for digital healthcare ecosystem based on blockchain technology: a pilot study
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Exploring the antecedents of adoption intention of smart healthcare technologies in rehabilitation

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Abstract—The introduction of the Internet of Things and wearable technologies in a healthcare enables measurement of the user's vital parameters. The use of wearable devices in the process of rehabilitation, by doctors or therapists, should enable obtaining information about the psychophysical condition and progress of the patient. By applying the e-health services, the measured data are monitored, stored and analyzed. Based on the analytical results, appropriate methods and biofeedback can be created to improve the implementation of therapy and personalized preventive health messages for users. The main goal of this paper is to examine the antecedents of the adoption of smart healthcare technologies - IoT and wearable computing technology and health services among healthcare employees in the Clinic of rehabilitation Dr Miroslav Zotovic. An integrated adoption model based on TAM and TPB was proposed. The model is planned to be evaluated with about 90 respondents.

Keywords—Smart healthcare, wearables, Internet of Things, rehabilitation, technology acceptance model

I. INTRODUCTION

Healthcare services, with intelligent devices and the application of the Internet of Things, open up new possibilities for improving healthcare, forming a new paradigm smart healthcare[1]. Intelligent devices in combination with other smart technologies are represented in all areas of health, but mostly in processes of monitoring vital parameters in real time, well-being, Ambient Assisted Living, in the field stress management, rehabilitation and many other areas.

Wearable computing in healthcare can be a technology for coping with demographic change. This technology can enable people to stay in their homes, with their families and perform daily activities. For the user, this means that he can do everyday routines, walk, socialize, engage in physical activities, study, read, sleep and perform all other activities, while his vital parameters are monitored all the time. Collected, vital parameters are sent to doctors or other relevant health professionals as biofeedback or for further analyses.

There are numerous examples of realization of the Internet of Things and wearable computing in different areas of healthcare[2]. Wearable computing has often been used in physical rehabilitation.

Although wearables for healthcare are not yet widespread and widely used, but in individual examples, it can already be inferred that their use would have positive effects and be beneficial to healthcare professionals, health insurers, healthcare users and individuals[3].

The paper [4] presents a set of smart gloves as a wearable device, which is used for natural interactions with therapeutic serious games for rehabilitation of the upper limbs. The data collected helps the physiotherapist to evaluate the treatment and effect of the therapy. The objectivity of these evaluation is based on measurement of motor activity parameters and especially the function of the upper and lower limbs during rehabilitation period. Patients' motivation is increased according the possibility of adequate feedback.

The study [5] presents ePhysio, a platform to for sensor-assisted physiotherapy and remote management of musculoskeletal diseases. The main goal was to monitor, stimulate, and encourage patient activity performance during self-rehabilitation. Experiment was performed with wearable sensor attached using a textile stripe to the wrist of the arm involved in the exercise. Evaluation proved that system can successfully collect real-time data from the patient and store it in the cloud system. Physiotherapist or doctor can monitor a rehabilitation in real time and have objective information about the patient's activity. Besides that, the evaluation of the solution showed great satisfaction with the project among health workers and users.

The authors of the study [6] propose a SoPhy wearable solution consisting of a pair of socks for the patient, with built-in sensors and a web application for displaying infor-

mation on the movement and orientation of the feet in real time. The measured parameters are monitored by a physiotherapist via a web application, while the patient performs a certain activity on the therapist's order. the results of the evaluation showed that SoPhy increased self-confidence in the exercise process and that less repetition of exercises was required.

Although IoT and wearable technologies are represented in numerous research studies in rehabilitation area and may ultimately improve practice, there is relatively slow their adoption into physiotherapists day-to-day practice.

Barriers to adoption and use of smart healthcare solutions are, mainly, lack of awareness and trust, lack of legislation, or limited access to services.

The aim of this paper is to examine the readiness for adoption of smart healthcare technologies as a part of therapy as well as to monitor traditional methods of therapy among employees in clinic for rehabilitation. In addition, the purpose of this paper is to examine antecedents of adoption intention and the extent of their impact on readiness to embrace of smart healthcare technologies.

II. METHODOLOGY

Given the expansion of wearable technologies in living environment, and especially in the health care area, theories that predict and explain the factors influencing the adoption, acceptance and use of smart healthcare technologies are becoming increasingly important. To understand antecedents of adoption intention and possible barriers, we developed a questionnaire based on the TAM [7] and TPB [8] model. The proposed model is shown on Fig 1.

Behavioral intention [9] or Intention to use (IU) is a factor that leads people to use the smart healthcare technology. The (IU) is influenced by the Attitude (AT) which is the general impression of the technology. Perceived usefulness (PU) is a degree to which a person believes that using a particular system would enhance his or her job performance [9] and is hypothesized to be fundamental determinant of user intention acceptance.

Perceived easy of use (PEU) is the degree to which a person believes that using a particular system would be free of effort [9] and has an independent impact on PU and AT. Attitude towards the use of a smart healthcare technology is based on two main beliefs: PU and PEU. Accordingly, we derive hypotheses: Attitudes have a positive impact on Intention to use/adopt when it comes to use/adopt smart healthcare technology; Perceived ease of use has a positive impact on attitudes towards smart healthcare technology; Perceived ease of use has a positive impact on the Perceived usefulness.

Personal innovativeness (PI) presents the willingness of an individual to try out any new technology, and plays an important role in determining the outcomes of user acceptance of new technology or service. Those who possess inventiveness have the ability to include in their work something that is not already part of the existing system. PI is considered as an antecedent of AT and PEU.

Subjective norm (SN) [10] relates to a person's beliefs about whether people of importance to the person think he or she should engage in the intention behavior. SN is hypothesized to be determinant of user intention acceptance. Finally, in the model, the intention toward using/adoption a smart healthcare technologies is determined by gender, age, experience and education. In its final form, the five point Likert scale will be used to allow the individual to express how much they agree or disagree with a particular statement. The group of the respondents will be drawn from an experts in the Clinic for rehabilitation Dr Miroslav Zotovic, Belgrade, Serbia, that is the most important and valuable clinic of its kind in the country.

To examine the appropriateness of the modified TAM model for our data set, we will use structural equation modeling based on partial least squares (PLS) using SmartPLS software.

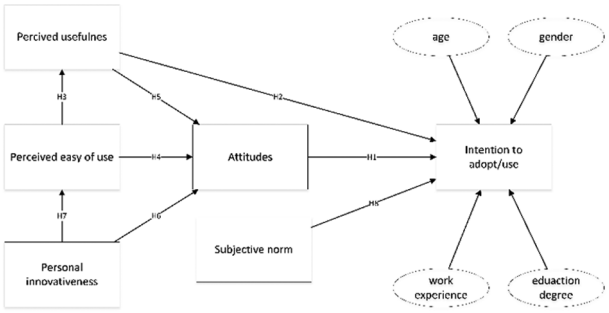

Fig. 1. Hypothesised smart healthcare technology adoption model

The expected results will be a clearer identification of the antecedents and their impact on readiness to embrace smart healthcare technologies. Thus, it will be possible to highlight both barriers and advantages for accepting modern trends in healthcare. The development of a national questionnaire survey would provide exploring these issues in greater depth. The result of this study will be valuable to the researches, educators, rehabilitation practitioners, and smart healthcare vendors.

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Crowdsourcing models in smart hospital

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Abstract - This paper presents research results on patients' readiness to take part in crowdsourcing services of a smart hospital based of digitization, the Internet of Things, the Internet of Services and mobile technologies. The field of research is an examination of the concepts of applying crowdsourcing services in modeling the implementation of regional anesthesia for caesarean section and delivery.

The aim is to investigate the possibilities of applying crowdsourcing services in healthcare and to analyze the factors that are predictors of successful application of this type crowdsourcing for anesthesia possibilities. The results of the research indicate a high degree of knowledge about the usefulness and availability of this type of anesthesia among internal and external stakeholders thanks to the use of crowdsourcing models of internet services implementing in smart hospital. The better communication between employees and users of services (pregnant women and parturients) raises the quality of health services and improves the health status of parturients and newborns.

Keywords—crowdsourcing, Internet of Things, mobile technologies, smart hospital, epidural anesthesia, spinal anesthesia, caesarean section, labor analgesia

I. INTRODUCTION

Most of the platforms based on crowdsourcing are focused on exploration of collective intelligence via web applications. The development of the web application in the service of crowdsourcing helps content management, creation, categorization, publishing, monitoring and promotion [1]. The link between the Web application and crowdsourcing contributes to better business and opens the way to the desired target groups by promoting content. The importance of crowdsourcing in e-health and the web portal as a communication channel for information is the process of building and maintaining relationships with the stakeholders through online activities to facilitate the exchange of ideas, raising the level of health care as products and services that lead to the realization of a common goal [2]. It allows healthcare institutions and internal stakeholders to establish an individual, personalized dialogue with users of their services [3].

In Serbian hospitals, establishing the techniques of regional anesthesia (spinal and epidural) for labor analgesia and cesarean section remains at the low level, despite significant efforts internal stakeholders have made through courses and education. Therefore, the percentage of labor analgesia is less than 10%, while the participation of regional anesthesia for cesarean section is less than 50% [4]. It is assumed that insufficient amount and quality of information of the participants in childbirth (patient, obstetrician, anesthesiologist and midwives) about the benefits of regional anesthesia for delivery and caesarean section (CS) are the main reasons for the extremely low number of births in regional anesthesia [5, 6].

On the other hand, in the last five years, there has been a significant increase in the number of mobile phones and Internet connections in the population in developing countries. In Serbia, 94.1% of the population in 2020 used a mobile phone and 80.8% had an internet connection [7]. The key idea has come from the fact that smart phones and modern technology can be used via smart hospital models in order to improve knowledge of stakeholders and increase the number of safe deliveries in regional anesthesia.

Individual patients participations, using infrastructure and services based on Internet of Things (IOT) and mobile technologies, could contribute to overcoming difficulties and high-quality improvement of the knowledge level in pregnant women who are preparing for delivery or caesarean section. The goal of applying crowdsourcing in a smart hospital is to encourage internal and external stakeholders (parturients and employees) in maternity ward to team work accomplishing common goals by applying their collective intelligence and establishing an organized interactive online community [8]. The applications of crowdsourcing in the functioning of digital services in smart hospital Sremska Mitrovica is realized through the following business models: crowd wisdom, crowdvoting, crowdfunding, crowdsensing.

In smart hospital, which integrates crowdsourcing, its applications are fulfilled through an interactive platform as a targeted initiative and creation of collective intelligence and creative work of the participants. When we introduced mobile technologies into the crowdsourcing concept, sensor-generated data were collected, which contributed to the expansion of the crowdsourcing functionality.

II. METHODOLOGY

In order to fulfill the primary goal of this paper - to improve the awareness of the stakeholders to the modern methods of delivering anesthesia for labor and cesarean section, corporate portal "Smart hospital Sremska Mitrovica" was created. The portal has scheduled campaign regarding childbirth, with the series of useful information for expecting mothers on weekly basis. Furthermore we use it to gather information from stakeholders. Within the smart hospital site, we have implemented a crowdsourcing platform and performed a survey on important issues regarding anesthetic techniques for labor and cesarean section. The survey on stakeholders' readiness to implement crowdsourcing services to the smart hospital was conducted in April 2021, on a sample of 60 pregnant women and 30 anesthesiologists, obstetricians and midwives. The pregnant women were aged 25 – 35 years. The stakeholders were asked to vote for or against following issues: interest for using electronic services, experience in that and readiness to accept various models of crowdsourcing in a smart hospital.

Furthermore, a Crowd Wisdom model was implemented using a forum for sharing knowledge and experience of parturients who were former patients. They shared their testimonials named "My story" about their experience with the regional anesthesia for spontaneous labor and cesarean section. Regarding Crowd Funding, users were asked about their readiness to donate 1.000 RSD for new medical equipment – electronic fetal heart rate monitor for the maternity ward.

III. RESULTS

Crowdvoting was used to promote novel methods of labor analgesia and anesthesia in Smart hospital Sremska Mitrovica and it was proved as a simple and functional tool for end users, such as doctors, nurses, midwives and patients. Out of 90 participants in the poll, 73 voted for their readiness to give their opinion about painless childbirth in this way of communication. Five participants 5 voted against, and 12 were neither for nor against.

Of the 90 participants, 87 were in favor, 3 were against cesarean section under spinal anesthesia. This confirms that use of Crowd wisdom model can help in order to implement these world-wide recognized methods of obstetric anesthesia as the gold standard in the health care system of Serbia. Pregnant women can contribute significantly to the promotion of health and informing the public about new technologies in this field of health especially through their testimonials. Regarding Crowd funding, only 23% showed interest to donate for new medical equipment.

Crowdsensing model were investigated in order to create synergies between doctors, experts in certain fields of medicine, health professionals, patients and other stakeholders in solving health problems. The question was, are you ready to communicate with the maternity hospital and other smart hospital services via a mobile phone via the appropriate application? Sixty eight respondents were for, 5 were against, and 17 were neither for nor against.

The combination of corporate portal and crowdvoting opens the way to the desired target groups by promoting specific content. It helps making our institution recognizable and creates the image of the service and institution to which users of services can rely.

This paper presents how pregnant women as service users and interested healthcare workers can gather information, using the concepts of electronic health through crowdsourcing trends, by web portals as communication channels and how it can raise the level of health services by improving the quality of health care.

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Model for digital healthcare ecosystem based on blockchain technology: a pilot study

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Abstract— The aim of this study is to identify crucial factors that influence the acceptance of a digital healthcare ecosystem based on blockchain technology. Theoretical framework for the proposed model relies on the theory of stakeholders, TAM theory, and concept of readiness for changes. Statistical analysis was performed on the basis of Structural Equation Modeling (SEM). The proposed model may facilitate the use adoption of the healthcare ecosystem based on blockchain technology.

Keywords— blockchain technology, acceptance factors, digital ecosystem, healthcare

I. INTRODUCTION

Blockchain technology is one of the most significant technological innovation in the recent years in the field of digitization of secure ownership of assets. The technology is founded upon the concept of a distributed ledger, a way of decentralized cataloging, and for accounting of large volumes of data [1]. Blockchain is disruptive technology that will revolutionize business and redefine companies and economies [2]. Many sectors, like finance, medicine, manufacturing, and education, use blockchain applications to profit from the unique bundle of characteristics of this technology [3]. Over the past decade, the practical implementation and integration of eHealth systems have been scaled drastically. Many developed nations utilize eHealth technologies, which makes a real difference in improving patient care and provision of efficient and effective healthcare services [4]. The future development in healthcare sector will be based on blockchain technology because [5]:

- by decentralizing data, securely encrypted, we avoid single points of failure,
- by making the data broadcasting permissionless, anyone can contribute to the democracy,
- by demanding consensus, the most probable version of the truth may be created,
- by time stamping, a fully transparent, auditable chain of events is ensured,
- by cryptographic hashing and crypto-economics, the record censorship is made free and it incentivize good behavior.

Literature review revealed some of the most important influential factors for adoption of blockchain technology in the healthcare sector [6]: data security, patient privacy, recognition of technological benefits, relative advantages, perceived low risk, trust factors, etc.

TAM (Technology Acceptance Model) is one of the most popular and widely used models to study the social mechanisms of technology adoption, which has been modified from time to time [7].

However, it is necessary to emphasize the importance of the concept of readiness for changes because of its possible influence on the acceptance of technological novelties. The concept of readiness for changes consists of at least two factors: individual readiness to change and the organizational readiness for changes [8].

The main aim of this study is to identify crucial factors for acceptance of a digital healthcare ecosystem based on blockchain technology. Model for digital healthcare ecosystem based on blockchain technology is proposed.

II. METHODOLOGY

A. Study design

The study presents a discussion of the factors that may influence implementation and acceptance of a digital healthcare ecosystem among stakeholders. The key stakeholders in healthcare are: patients, physicians, medical technicians, non-medical staff, management staff, suppliers, pharmacies, and health insurance companies.

The proposed model is based on the TAM theory and on the construct of readiness for changes. For the construction of the model we used the literature review, the method of exploring the possible factors among stakeholders in the healthcare sector, with a structured Likert type question-

naire for assessment of the readiness for changes, along with the questions about the blockchain technology and acceptance of digital healthcare ecosystem based on it.

The total number of participants in this pilot study was 70, involving the stakeholders in the healthcare sector. The statistical analysis was performed on the basis of Structural Equation Modeling (SEM), using AMOS.

III. RESULTS

Out of the total of ten tested relationships in the final SEM model, seven of them were found to be statistically significant ($p \leq 0.05$). These findings indicate that the independent constructs explained 65.7% of the variance in the behavioral intention of use ($R2 = 0.647$). The results revealed importance of all the tested factors, and the possible influence of the proposed digital healthcare ecosystem based on blockchain technology among stakeholders on the potential use in the health sector in Serbia (Table 1):

- Knowledge about blockchain (1),
- Awareness of cybersecurity (2),
- Perceived ease of use (3),
- Perceived credibility (4),
- Compatibility (5),
- Social influence (6),
- Readiness for changes (7).

TABLE I. RESULTS OF EQUATION – DEPENDENT VARIABLE: USE

Factor	SEM analysis	
	beta coef.	t-statistics
1	0.498	5.71
2	0.384	4.54
3	0.381	3.11
4	0.329	2.64
5	0.293	3.72
6	0.317	3.98
7	0.526	6.27

significance level: $p \leq 0.05$

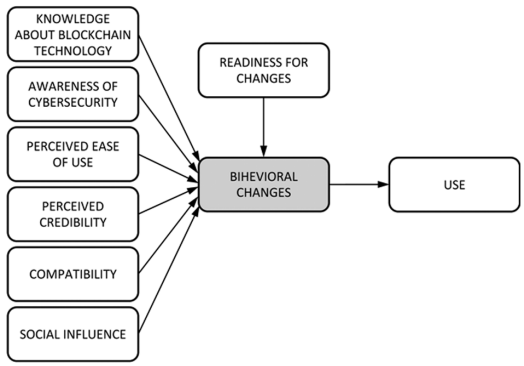

Fig. 1. Model for implementing a digital healthcare ecosystem based on blockchain technology

The most important factors in the model are: knowledge about blockchain technology, awareness of cybersecurity and the construct of readiness for changes. On the basis of the presented model, the implementation of the proposed digital healthcare ecosystem based on blockchain technology may be introduced into the e-business of the healthcare facilities in Serbia. Each identified factor should be more explored for the well-tailored strategy of implementation process.

IV. CONCLUSION

The blockchain technology is the future of modern data transfer technology in healthcare systems. The qualitative issues of the blockchain technology enhances flexibility, security issues, and data transfer processing due to its convincing advantages. But, the process of adoption of this novel technology and influencing factors still remain under investigation. We pointed out that the following factors: knowledge about blockchain, awareness of cybersecurity, perceived ease of use, perceived credibility, compatibility, social influence, and readiness for changes may influence the process of development of a digital healthcare ecosystem based on blockchain technology.

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EBT 2021

BLOCKCHAIN

An analysis of consensus algorithms for transactions validation in blockchain system
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Importance of Blockchain technology for supply chain management
Mladen Božić, Svetlana Dabić-Miletić, Nikola Pavlov

Loyalty system development based on blockchain technology
Sara Petrović, Daniel Bjelica, Božidar Radenković

An analysis of consensus algorithms for transactions validation in blockchain system

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Abstract—Block chain systems and their implementation are in the focus of the it business community. In order to promote and combat technological and economical challenges Blockchain systems adopted different ways to validate effects of the system members. This work will analyze Proof of Work (PoW), Proof of Stake (PoS) and Proof of Burn (PoB) in top blockchain systems.

Keywords—Block chain, Proof of Work (PoW), Proof of Stake (PoS) and Proof of Burn (PoB)

I. INTRODUCTION

Creating secure ledger system, without third party control over data stored in same, is in the focus of economical, mathematical and computer technologies research. Development of Blockchain technology provided one possible answer for this problem and bonded all those scientific disciplines.

Blockchain technology provided decentralized transaction system for keeping ledger inputs. New inputs in the block chain ledger are possible only after confirmation from majority of network members. Public ledger is accessible to all computers of the network or nodes. Simultaneously nodes are anonymous and system provides higher level of security in process of confirmation of transaction then traditional ledger systems [1].

Transactions in Blockchain system are grouped in blocks. Security of block creation and validation process are based on cryptographic hash function. Hash functions are special class of mathematical function with certain properties suitable for use in cryptography. Hashing is a mathematical algorithm that maps data of arbitrary size to a array of fixed size bits size (a hash). This algorithm is a one-way function, that is, a function which is infeasible to invert.

The only way to recreate the input data from an ideal cryptographic hash function's output is to attempt a brute-force search of possible inputs to see if they produce a match, or use a rainbow table of matched hashes [2].

New block reference older block by solution of hash function and this solution is header of older block. Speed of the calculation of the proper solution is important issue in Blockchain implementation. If we can provide more possible solutions of hash functions in time period provide better chances for acquiring exact solution.

Blockchain systems require also consensus for validation of transaction, as additional level of security. Only after majority validates transaction change in data within Blockchain systems is approved. This consensus is provided by the majority of the machines interconnected in P2P networks. These machines solve hash functions and submit solution to network until successful solution is calculated. Creation of new block into block chain, need considerable calculation power of the computers interconnected in (P2P) network [3].

Several different approaches are proposed for vslidation of the calculation in Blockchain systems. Thre most noticable are Proof of Work (PoW), Proof of Stake (PoS) and Proof of Burn (PoB). We will nalyse adoption measure and energy efficence in the blockchain sytems with highest market capitalisation in the moment of preparing this research.

II. METHODOLOGY

We will define three important proof which are used in top Blockchain systems. first is Proof of work (PoW) which a system that requires a not-insignificant but feasible amount of effort in order to deter frivolous or malicious uses of computing power, such as sending spam emails or launching denial of service attacks. The concept was subsequently adapted to securing digital money by Hal Finney in 2004 through the idea of "reusable proof of work" using the SHA-256 hashing algorithm. Second is Proof of Stake (PoS) concept that states that a person can mine or validate block transactions according to how many coins they hold. This means that the more coins owned by a miner, the more mining power they have. And finally Proof of Burn (PoB) is one of the several consensus mechanism algorithms implemented by a blockchain network to ensure that all participating nodes come to an agreement about the true and valid state of the blockchain network. This algorithm is implementing in order to avoid the possibility of any cryptocurrency coin double-spending. Proof of burn follows the principle of "burning" the coins held by the miners that grant them mining rights.

Than we will analyze top twenty Blockchain systems based on their market capitalization, and which type of the validation systems they support. Also we will analyze energy efficiency of implemented validation systems.

III. CONSENSUS AGLORITHMS

Oldest, and first anticipated consensus protocol was proof of Work protocol presented in Bitcoin whitepaper [4]. Consensus protocol is based on scanning values which when hashed have as result hash starting with zero bits. In order to achieve this we add a nonce to the original value, until we receive hash witch start with requested number of zero bits. Once the nonce is found and PoW satisfied, block cannot be changed without redoing work for that block and all consequential blocks. In this system all blocks are based on first genesis block, they all except first have hash which consist from all previous blocks hashes and nonce required to create zero bits. Genesis block hash have all zero value [5].

Other important consensus algorithm is proof of Stake (PoS). This algorithm was proposed in 2012 as hybrid system [6]. In order to fully implement PoS, initial coin must be created using PoW, and then system is upgraded to PoS. Within PoS coin age is defined as Coin-days. So if someone hold 10 coins per 100 days he have 1000 Coin-days. When coin is used in transaction age of coins is reseted to value zero. In PoW systems chin with most work delivered to system is main chain, in PoS this is system with highest consumed coin age.

Finally Proof-of-burn (PoB) is algorithm in which we can destroy cryptocurrency in a verifiable manner. Despite its well known use, the mechanism has not been previously formally studied as a primitive. It consists of two functions: First, a function which generates a cryptocurrency address. When a user sends money to this address, the money is irrevocably destroyed. Second, a verification function which checks that an address is really unspendable.

Important issue is energy consumption of blockchain systems, since they use huge amount of calculation power. Exact nature of saving are hard to calculate since we have different computational machines energy efficiency. Design of the validating algorithm provide information that PoW require most energy. Proof PoB, is variation of PoW without energy vaste. Miners who decide to burn coins are in the game for acquiring new one without additional calculation. And PoS is comparable with this two highly energy efficient [8].

IV. RESULTS AND DISCUSSION

From analysis we expect clear overview of the level of acceptance and dominance of the validation methods in the top 12 Blockchain systems. We will analyze different implementation of PoW, PoS and PoB. Especially we will analyze trends in the systems which changed validation method. We will analyses Hash rate change and impact on market capitalization. Exemplar model will be Ethereum network since usage of this system is basis for DeFi systems and smart contract implementation. Etherum network change validation system from PoW toward PoS.

First we will present overview of the validating algorithms in the Blockchain systems with highest market capitalization.

Ethereum	PoW - PoS
Cardano	PoS
Binance Coin	PoS
XRP	RPCA
Dogecoin	PoW
Polkadot	PoS
Uniswap	PoS
Bitcoin Cash	PoW
Monero	PoW
Litecoin	PoW
Stellar	SCP
SlimCoin	PoB

It is obviously that more and more leading Blockchain systems use PoS over PoW algorithm. We will overview presented algorithms in terms of security, scalability and power consumption.

Security of blockchain depend on the number of calculating power or stake holders level in order to successfully attack Blockchain system. Different attack modes are well researched for the PoW systems. Most common is 51% attack were compromising party achieve majority calculating power in system. While this type of attack is feasible in early stage of Blockchain implementation, after some period of time this type of attack become overly expensive.

Ways to compromise are based on generating a block in PoS. In other words, in order to maximize the benefits, validators could generate conflicting blocks on all possible forks with nothing at stake. This problem is commonly referred to as the nothing at stake attack. This attack slows down the consensus time in the network and thus reduces the efficiency of the system. Moreover, it results in blockchain forks which weaken the ability of the blockchain to resolve double spending attacks and other threats.

The “Long Range” Attack Long range attacks on PoS (also known as history attacks) refer to the case where an attacker tries to alter the blockchain history by creating a fork from an already generated block. While this attack in theory requires an attacker that controls the majority of stake in the network, long range attacks can be practically instantiated if the attacker controls/compromises accounts that have no stake at the moment, but have a large stake at some past block height. For example, an account that had 30% stake at block height and no stake at block height+ 1

can still use his 30% stake to re-generate another block at height. This allows an attacker to create forks from past blocks that can overtake the current chain with (past) majority stake.

maximal number of transaction per second is important issue in usability of Blockchain systems. Transactions within PoW systems are limited by block size. Measuring TPS are limited, we do not have verifiable sources for this, and only way to presume exact value of TPS is from tests and whitepapers. Author of this resources are usually form creators of cryptocurrencies.

Other important issue for Blockchain systems is energy efficiency, since well established Blockchain systems like Bitcoin based on PoW demand extremely high calculation power. This demand increased low energy efficiency and high power consumption. We will compare energy efficiency of the PoW, PoS and PoB system and try to put in line for future implementation.

V. PRELIMINARY CONCLUSION

Preliminary analysis showed that PoW algorithm which is most popular consensus algorithm, slowly showed sings of age and list of different limitation. Most promising validating algorithm is PoS, which will in future replace PoW. Most important reason are better security, better scalability and higher energy efficiency.

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Importance of Blockchain technology for supply chain management

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Abstract—Competitiveness of the supply chain requires the digital transformation of various processes at all levels of business. In this context, the risks in the logistics and other activities in the supply chain can be reduced or eliminated by introducing modern solutions Industry 4.0. One of them is blockchain technology, which represents a decentralized database. This technology is widely used in supply chains due to transparency, reliability, and security of information, efficient inventory control, etc. The aim of this paper is related to the understanding of the blockchain concept and its application in supply chains. By using blockchain technology could improve the quality of customer service, which represents a key factor in the competitive supply chain. The paper analyzes blockchain technology from aspects of improving the functioning of the supply chain in the field of reducing costs and increasing the level of customer service.

Keywords—— blockchain, supply chain, digital transformation, customer service

I. INTRODUCTION

A supply chain represents a group of interconnected companies that exchange materials, energy, and information in logistics processes. These processes include all activities from the collection of raw materials to the delivery of finished products to end users [1]. Industry 4.0 is characterized by the development and implementation of new technologies to more efficiently implement processes and activities at all levels of the supply chain. E-business is a term that is increasingly used in modern business, from e-ordering, through e-payment, e-delivery, to e-complaints, and the like. For e-business to be successfully realized, it is necessary to use new technologies. One of them is Blockchain technology, which is increasingly important for supply chain sustainability. Blockchain technology is a decentralized database. It consists of several smaller databases that are digitally interconnected. The implementation of Blockchain technologies in the supply chain aims to provide accurate, timely, and secure information, but also to reduce costs. The application of Blockchain technology can improve the quality of customer service, as a key factor in the functioning of supply chains. Given that this is a new technology, its users have certain difficulties and ambiguities during its implementation [2].

Known world companies such as Google, Amazon, etc. use blockchain technology, which proves that the application of this modern solution can provide significant changes in the traditional supply chain. In e-business, there are numerous challenges related to transparency, availability, security of information. For example, some users do not have information related to the status of the ordered product and/or customer service. Given that in traditional business the process is mainly manually verified, the loss of one part of information can cause significant costs in the supply chain. By applying Blockchain technology, such and similar inconsistency are eliminated. This ensures a secure exchange of information in real-time. The application of this technology affects the improvement of e-business because it increases the accuracy and security in the exchange of information in the supply chain so that information cannot be changed or deleted after it is entered into the database.

Blockchain technology has a wide application in various industrial areas and in customer service, which concludes that it has notable importance for the successful management of supply chains. The aim of this paper is to get acquainted with Blockchain technology and with the functioning of the supply chain when it is applied. Of particular importance is the fact that a peer-to-peer network, which is based on using this technology, allows one to get in direct contact with the service provider. In this way, it is possible to reduce costs, commissions, and prices, which affects the strengthening of the competitive position of the supply chain in the world market.

II. METHODOLOGY

The paper is organized into several chapters. After the introduction, the third chapter explains the concept of Blockchain technology, the way of its functioning, the place and role in the supply chain. The fourth chapter provides an analysis of the functioning of the supply chain without and with blockchain technology. At the same time, the advantages that can be achieved by the implementation of this technology have been identified, as well as certain disadvantages that may occur. The fifth chapter of the paper will discuss the success factors and challenges in the implementation of this technology. In the conclusion,

certain observations in the implementation of blockchain technology in the supply chains will be presented, as well as some of the directions of future research in the analyzed area.

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Loyalty system development based on blockchain technology

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Abstract - The subject of this paper is a development of a loyalty system based on blockchain technology. The theoretical section of this paper will analyze different types of loyalty programs, their advantages and disadvantages as well as the current market situation. The concepts of blockchain technologies and the possibilities of applying blockchain in the implementation of loyalty programs will be explored in detail. Also, the possibilities of blockchain integration, mobile and IoT technologies for the realization of loyalty programs in smart environments will be analyzed. In the practical section of this paper, a system of partner loyalty program as a smart city service will be designed and implemented. The Hyperledger Fabric development environment will be used to implement the blockchain component of the system. The implementation will be carried out in microservice architecture. An Android mobile application will be developed for user interaction with the platform.

Keywords - loyalty systems, blockchain, Hyperledger Fabric, Android Studio, smart city

I. INTRODUCTION

Loyalty systems have been one of the most common and diversified ways of marketing since ancient times. Research predicts that the global loyalty program market will grow from $7.6 billion, in 2020 to $15.5 billion in 2025, with a cumulative annual rate of 15.3% [1]. Many companies in various industries are considering the applicability of blockchain technology which would ensure data protection, simplify supply chain management, lower maintenance fees and increase customer retention [2]. Urbanization combined with constant population growth requires social, economic and environmental sustainability. Internet of things has started a technological revolution that represents the future of communication and the need for innovative technology [3].

This paper discusses the use and develops a partnered loyalty program based on blockchain technology while incorporating the principles of smart cities.

II. LITERATURE REVIEW

A. Loyalty systems

Science defines quality as satisfaction and possibly overcoming customer requirements, while loyalty is defined as the willingness of the customer to return to the company and cooperate with it, which is a consequence of a positive experience and perception of the value that the company offers. Through the years loyalty programs developed into four different types: points, tiered, partnered and premium based, each bringing certain advantages and challenges.

B. Blockchain technology

Blockchain is a chained data structure that combines blocks of data and information in a chronological order and records the blocks in encrypted form as a distributed ledger that cannot be tampered with or forged. Broadly speaking, blockchain technology uses block-type data structures to validate and store data, distributed node consensus algorithms to generate and update the data, and encryption to ensure data transmission and to ensure security [4].

C. Blockchain as a solution to loyalty system problems

Even with the constant improvement of loyalty systems there are still persisting challenges in its implementation and usage. The table below shows those obstacles and how blockchain technology can be used to overcome them.

Table 1: Main problems and blockchain suggested solutions

Problem with loyalty systems	Blockchain solution
High maintenance fees	Although blockchain requires initial investment, smart contracts and transparent transactions reduce the costs of management, intermediaries and human error. Companies that are part of a network of partner loyalty systems share this cost with each other.

Problem with loyalty systems	Blockchain solution
Low flexibility rate, low redemption rate	By using a single electronic wallet, users can use the points of different companies in almost real time, through one platform and one cryptocurrency [5]. By doing so, blockchain centralizes customer loyalty programs, cancels time limits, and increases the flexibility and likelihood of customer returns.
Data security and privacy	One of the main advantages of blockchain technology is data security and validity. Each transaction created in the network has its own date and time, each block is approved by transparent consensus, encrypted and placed in a chain that cannot be changed as needed.
Distrust in a partnered system	Blockchain forms a distributed network of stakeholders who are familiar with the implemented smart contracts under which new blocks are added to the chain. Given that transactions and contracts are transparent, and that consensus needs to be reached, members are confident in the authenticity of gaining and using points.

This paper discusses a solution of forming a partnered loyalty network based on blockchain technology. Such a platform increases flexibility, reduces maintenance costs and ensures privacy and security, regardless of the existing structure of each individual company.

III. METHODOLOGY

A. B Loyal platform

Through market research of loyalty systems and current technologies, the concept of the B Loyal platform was created. B Loyal is based on blockchain technology, serving as a system in which city municipalities, trade SMEs, individual customers and tourists are incorporated.

The platform is an ecosystem of a partnered loyalty program based on a point system. SMEs engaged in sales, regardless of the potential possession of an already built loyalty system, can access the platform and use the infrastructure to evaluate and award points to their customers.

Each customer has the ability to download a mobile application that provides tracking and use of points earned at any point of sale of the network partners. Tourists as a special group of users have the opportunity to collect points solely by visiting local sights, museums and galleries. City municipalities are also part of the ecosystem, regulating the system and allowing users to collect points through socially useful and city significant activities.

Platforms' online presence is introduced through a detailed website and main social media channels, the purpose of which is better market positioning and strengthening brand's visual identity.

B. Potential customers and their benefit

The benefits that target groups acquire over the use of traditional loyalty systems are shown in the table 2.

Table 2. Benefits of the B loyal platform

Parties involved	Benefits
Small and medium sized enterprises	no manufacturing and maintenence fees low marketing costs platform and data security high level of point utilization high flexibility high exposure to new users ease of use
City municipalities	great coverage access to surveys tourism promotion promoting socially useful work promoting humanitarian actions accessibility to all citizens

```
root@c22733ed05c6:/opt/gopath/src/github.com/hyperledger/fabric/peer# peer chaincode invoke -o orderer.bloyal.com:7050 -C bloyal -n bloya
lcc --tls --cafile /opt/gopath/src/github.com/hyperledger/fabric/peer/crypto/ordererOrganizations/bloyal.com/orderers/orderer.bloyal.com/
msp/tlscacerts/tlsca.bloyal.com-cert.pem -c '{"Args":["readPoints","sarap"]}'
2020-07-29 09:28:15.040 UTC [chaincodeCmd] chaincodeInvokeOrQuery -> INFO 001 Chaincode invoke successful. result: status:200 payload:"{\
"docType\":\"points\",\"username\":\"sarap\",\"noofpoints\":3}"
```

Figure 1: Chaincode invocation on network

Customers and tourists	single account for all loyalty systems simple and unified collection of points high flexibility in multiple areas of trade data security and privacy digital wallets greater participation in communal work point gains through tourist activities

C. B Loyal platform architecture

Hyperledger is an open source project that offers the necessary framework, tools and guidelines to build blockchain applications for various industries. Hyperledger Fabric is used to build products, applications and solutions for business use. B Loyal is built in Hyperledger Fabric and consists of organizations with one orderer with the SOLO service system as well as the business logic written in Golang. Docker is brought up to deploy the blockchain network and host containers as it is the tool used for developing, running and shipping applications. This tool provides the ability to package and run the application in an isolated environment.

Hyperledger fabric-sdk is used to ensure a safe interaction with applications outside the blockchain network. B Loyal platform is made possible to communicate with users who created their account on an Android platform through fabric-sdk.

Presented below is a successfully invoked chaincode execution on the running blockchain network.

D. Pedometer implementation

Android Studio is the official integrated development environment for Android applications. A web service is created within the Android application for communicating with the blockchain network. To demonstrate a smart city principle integrated in this platform, a pedometer is implemented through the Android application.

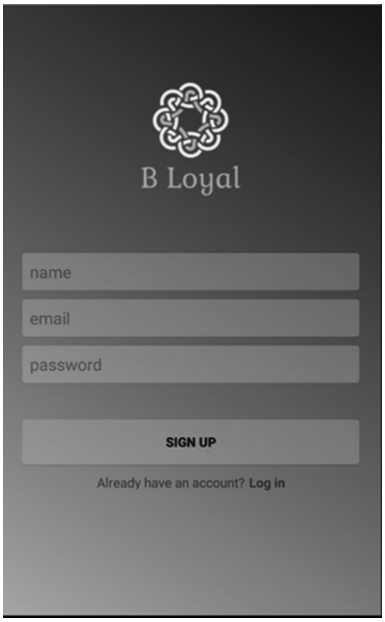

Figure 2: B Loyal applications' sign up activity

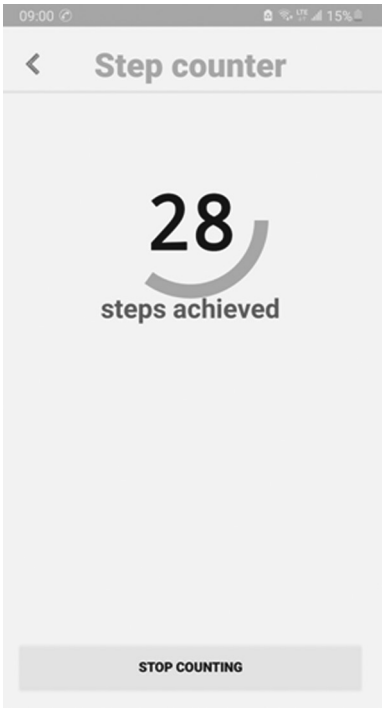

Figure 3: B Loyal applications' pedometer activity

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IOT AND SMART ENVIRONMENTS

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Design and Development of IoT Based Smart Irrigation Sensing, Control and Monitoring System for Agricultural Applications

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With a rising population, there is a need for increased agricultural production. For providing support to farmers towards greater production, the demand for freshwater has been increased in the agricultural area. At present, The total water consumption for agriculture applications is around 83% of available resources in India [1,2] where the water has not been utilized in a planned way. Consider this aspect, there is a requirement of such systems which can provide effective solutions for the utilization of water for the cultivation of land so that the farmers will not be faced any crisis of water towards cultivation. The plant health management systems could be a solution for reducing such problems by taking botanicals parameters from achieving their full genetic potentials in an agricultural area where plant monitoring is one of the most important tasks in any agriculture-based environment [3]. Mostly, farmers have been used manual/traditional method which has the major disadvantages that are very time consuming, labor cost is very high, and a huge amount of wastage of water. Consider this aspect, some semi-automated and automated have been explored by some of the researchers such as drip irrigation, ditch irrigation, sprinkler system [4,5]. During the automated systems, IoT plays an important role in the agriculture industry where IoT is a shared network of objects or things. This can interact with each other provided the Internet connection. By using IoT, smart agriculture helps to reduce wastage which helps in increasing the crop yield. In this work, a system is developed to monitor crop-field using sensors (soil moisture, temperature, humidity, and wireless camera) and automate the irrigation system. The data from sensors are sent to a Web server database using a cloud network system. By using a soil moisture sensor, the levels of soil moisture can be checked. Whenever there is a change in humidity moisture in the soil this sensor senses the change and an interrupt signal is passed to the microcontroller and depending on this the irrigation system works. The automated irrigation system also can be connected using a web/android application so that the user can access the automated irrigation system and monitor and control the developed system remotely on the mobile phone. The smart IoT irrigation system uses perfect real-time data in the field. The main intention of this type of irrigation system is to develop a fault-tolerant, reliable, low latency, and energy-based IoT control system.

This paper contributes to the following points.

(a) Development of an automated irrigation system for efficient water management

(b) Measuring four parameters such as soil moisture, temperature, humidity, and online monitoring system in the mobile phone

(c) Design of analytics using IoT cloud platform

A smart drip irrigation system for plantations is being developed. In this system, the soil moisture sensors (FC-28), four humidity and temperature sensors (DHT22), and one wireless camera with a submersible pump (5V) are connected to the microcontroller. The pump is automatically controlled by the Arduino controller according to the sensor readings. A buzzer is also integrated with the controller to indicate different modes of operation. For a continuous visual feed of surroundings, a wireless camera is also introduced. The sensor readings are sent to a PC over the wired LAN network for data logging and visualization purpose. An Ubidots IoT Cloud platform is used for the cloud network systems which can help in monitoring plant health conditions. When building an IoT-based system, the developed control systems send sensor data to the cloud platform where the data can be stored, and also built charts and graphs by using analytics. An Ubidots IoT cloud platform is used which has the capability of PaaS Platform as a service. These services can be enabled in the developed boards to connect to remote services or other service providers. These platforms can perform heavy work. The sensor data are uploaded to the cloud IoT platform and the short message can be sent by enabling the trigger external action option. These platforms have the capacity to send data through the cloud computation plate form of IoT. Using this platform, the data can be visualized on the mobile phone. A wireless camera along with a monitoring system will also be integrated for visualization purposes. By interfacing wireless cameras, the plant/crop health can be monitored anywhere. By conducting different experiments, it provides a remote monitoring solution to find the plant condition. By using this system, the users like farmers can monitor the plantation condition which improves the yielding of plantation towards enhancing overall production. It is concluded that an IoT-based smart irrigation

system is a promising approach in precision farming and agricultural applications.

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Privacy versus Security – scenarios over Smart Societies

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Abstract—Some of the most important inventions of the last century are the computer, the Internet and, not least, the mobile phone. These have completely changed the world we live in. Understanding their ability to collect data and information about anyone and everyone, they proved to be the perfect tools for mass surveillance. Often the media presents articles written as a result of data leaks within public institutions or private companies, data that has the power to alter the safety of citizens. Today we are witnessing the pursuit of the individual on a much larger scale than Orwell could have imagined. We will first begin by presenting the Edward Snowden case, former CIA employee and government contractor for Booz Allen Hamilton, who publicly disclosed information about mass surveillance, and, based on this and few other similar cases, we want to raise awareness regarding the very unstable equilibrium between security and privacy in the new era of smart states and communities. The article is presented as an essay.

Keywords—information society, privacy, security, smart cities

I. INTRODUCTION & BACKGROUND

In the first half of 2013, Edward Snowden (former CIA employee and government defense contractor for Booz Allen Hamilton) publicly disclosed inside information from the US and UK Intelligence Agencies - information classified as Top Secret [1]. Thus, the world has begun to hear about projects such as PRISM, XKeyscore and the like – examples of programs that American Information Services is running against the world today.

If we look a little back at George Orwell's predictions about surveillance [2], we realize that he was an optimist. Today we are witnessing the pursuit of the individual on a much larger scale than Orwell could have imagined [3].

The following photo (Fig. 1.) is taken on the buildings of the NSA (National Security Agency) Data Centre in the state of Utah, USA, known as the first Intelligence Community Comprehensive National Cyber-Security Initiative Data Centre, and began operations on May 14 2014. This database, as it is described on the official website, is both a super-efficient computing center and a huge data warehouse capable of storing up to a yottabyte - one thousand billions terabytes, being the first data storage in the world that has such a huge available volume.

This is a huge area dedicated to data collection and analysis – according to the official website, only the buildings occupy a floor area of 140,000 m2, of which 9,000 m2 the data centre, and the rest for technical support. For the sake of comparison, the hall has the size of two football fields and is stuffed with hard disk drives (HDD), while the other buildings, which together make up more than ten football fields, are dedicated to technical support. The electricity bill alone goes up to 40 million USD per year.

This means that organizations such as the NSA can collect data about each of us and store them for virtually unlimited periods of time. This is what is called 'Wholesale Surveillance of the Whole World' [4] - an activity that obviously comes with a set of new risks, risks to which we are all exposed

Fig. 1. Utah Data Center [Source: https://nsa.gov1.info/utah-data-center/]

The United States has the legal right to supervise and monitor foreigners whose data and information reach, or transit through, US. Normally, the surveillance of foreigners is not so bad – that is until we realize that everybody, everywhere (including US citizens inside US) is 'a foreigner' in the vision of the American legal system. So, we are really talking about wholesale, permanent surveillance and each and every one of us - ours of all those who use telecommunication systems and the Internet.

However, there are types of surveillance that we agree with: when the police forces try to find a criminal or prevent a terrorist attack; if they have suspects, or clues of any kind, it is justified to listen to their phones and intercept their communication on the Internet. In these situations, there is no doubt about morality. But, projects like PRISM are not developed for that. They are not meant to supervise people for whom there are reasons to act in this manner.

They supervise people who are known to be innocent.

Here are some arguments that support the above ideas:

The first, and probably most important one is that when we begin to argue the injustice of surveillance, there are voices that want to minimize the effects it has by saying that 'I knew, I knew all this' or 'There is nothing new about this'. To prove it, I asked on my Facebook profile, if the world knows that when we search for something through dedicated search engines, that information is probably coming to the US Information Services. Nine minutes later, I received a response from a former student of mine, who told me that this is neither surprising nor new. Moreover, another participant in the discussion, replies soon after that 'It would be a shame to be different'.

But that is not true. People who believe that 'this was known already' are making a terrible mistake because it was not known. Our most terrible thoughts might have been something like this, but we didn't think that it would happen. Nobody knew anything about PRISM or XKeyscore or any other project run and maintained by the American Intelligence Agencies – it is now known. Nobody has believed that American Intelligence Services would go so far as to infiltrate standardized code to sabotage encryption algorithms. That means they took over something that was perfectly secure; an algorithm that was so secure that if someone use it to encrypt a file, no one can decrypt it. Even if they used every computer in the world just to decrypt that file, it would take millions of years. Therefore basically, that file is 100% safe; uncrackable. NSA took something that was so good and deliberately weaken it, thus shaking the safety of every citizen.

The equivalent in the real world would be that the Intelligence Services would have a secret PIN code for each alarm system in everybody's home so that they could get in anywhere, explaining that the perpetrators might have alarms at home. This would make everybody more vulnerable. The existence of such a flaw in an encryption algorithm is at least surprising; it creates confusion in everyone's mind.

But of course, the Information Services are doing their job. These are the tasks that have been assigned to them: to monitor the communications, to monitor the traffic on the Internet, to react to the signals detected along the communication channels. That's what they are trying to do. And since most of the Internet traffic is today encrypted, then they have to find gates – and the most convenient thing is to sabotage encryption algorithms. This is a great example of how intelligence agencies are losing ground in the battle with technology. They lost control and are now struggling to regain possession

II. CONCLUDING REMARKS

Surveillance has the power to change the course of history. Let's take as an example of President Nixon – what he could have done if he had the tools available today [6]. Former president of Brazil, Mrs. Dilma Rousseff, who was the target of the NSA while she was still the president of the her country – her email was intercepted and read by the American Intelligence Services, and she said 'In the absence of the right to privacy, there can be no true freedom of expression and opinion, and therefore no effective democracy. That's about it!! Privacy is one of the pillars on which a democracy is built and supported.

Edward Snowden has been accused of many things. Some have accused him of shaking the software and cloud industries by his actions. But blaming him for these things is like accusing environmentalists of global warming.

The methods that today's governments are using are barbaric, tactless and should not be accepted and promoted. According to the saying: 'Without knowledge action is useless and knowledge without action is futile', just by knowing what is happening, the situation will not change. It will change if everybody will move away from systems developed in the United States. That is not an easy task. No country in the world can develop systems to replace existing ones overnight; however, cooperation can bring beautiful results – an example is the Open Source platforms. These are developed as a result of international collaborations. They are open systems – easy to check, free and well secured. Thus, the existing surveillance systems can be bypassed.

Malcolm Gladwell, a Canadian sociologist, said that it is enough to make a small wave, because then, through collective efforts it could turn into a tsunami [7] that would have the power to replace the current systems. One such example is the e-learning Moodle platform, developed by a group of ten Australians but collaborating with over seventy software development houses around the world. Let's take them as an example and act accordingly.

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Testing the efficiency of Wi-Fi data transmission in ESP-based IoT systems

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Abstract—This paper describes process of designing and testing an Internet of Things (IoT) system for continuous receiving of the input data. The goal is to design a custom IoT system and to test the reliability of the designed system, but also to offer solutions for the improvement. Entire process of designing of both hardware part of the system and the software part of the system is explained and main tool used are described. Main characteristics of the designed systems that are tested are basic RF characteristics but also transmission of data of various waveforms. Implementation and analysis of this type of testing data is important, especially because properties that are tested are part of the majority of modern IoT systems.

Keywords—IoT, Wi-Fi, ESP32, reliability, JavaScript

I. INTRODUCTION

Interest in the development of the IoT systems is continuously growing. Most of the newer devices and systems are already IoT enabled (in terms that they can connect to a remote server or to the cloud and exchange data), while older systems are being empowered with the modules and subsystems that can enable remote data monitoring. In 2011. Cisco IBSG predicted that there will be more than 50 billion devices connected to the Internet by 2020 [1]. Significant improvement in hardware Wi-Fi modules, especially with the emerging of the companies from the East is offering greater possibilities of engaging with these types of modules. Low cost and yet high performance are making them suitable for many applications and for wider research. With the appearance of the ESP8266 module, produced by Espressif in 2014, many possibilities for the application in embedded systems have arisen [2]. Further development of the hardware led to the creation of ESP32 SoC (System On Chip), which is a device that can match performance of the high-speed microcontrollers (MCU), and yet fully utilize integrated Wi-Fi module [3].

With improved availability of these devices, a lot of systems in various industrial areas are designed. This type of systems mostly consists of some modules that collects data from the environment and transmit that data to the remote server or a software platform. In medicine, IoT systems on ESP32 found application in vital health signs monitoring [4]. Kristiani et al. reported a system consisting of multiple heart rate and respiration rate modules. These devices monitor basic vital signs and in case of the irregularities user is informed through Wi-Fi connected application. Rai proposed a smart surveillance system [5]. This system acquires continuous video and transmits it using Wi-Fi capabilities of ESP32. Dhingra presented an air pollution monitoring system [6]. Many gas detecting units are connected to the Arduino board that is controlling ESP8266 devices. User can monitor activity of the gas detecting units over an Android application. Increased interest in this type of systems even led to creation of the software platforms (such as ThingSpeak or RainDrops). These types of platforms offer possibilities to the IoT system designers to pass around software part of the programming and to focus on the hardware connections and devices. In most of these types of applications, aggregated signals are mostly in limited voltage range and in limited frequency range.

Even though that there are reports on the design and operation, reports concerning reliability of this type of systems are lacking [7]. Investigation on the reliability of the software part of the IoT system is given by Meneghello [8]. It states that many low-end IoT commercial products do not yet support security mechanisms. In the matter of reliability of the hardware part and the system in general, Montoya-Munoz reported an approach based on Fog Computing [9]. This approach improves reliability of the data collection process focusing on outlier detection. Assessment of the reliability of the parts of IoT system is yet to be further analyzed.

II. DESIGN AND EXPERIMENT SETUP

The goal of the experiment setup is to design an appropriate environment for the receiving data, transmission

of the data and visualization of data. Experimental setup consists of two parts, hardware part and software part.

A. Hardware part

Two main approaches of using Wi-Fi modules in embedded systems are noted [2,3]. First, that is using a controlling, driving microcontroller that controls MCU with Wi-Fi module and second, where Wi-Fi powered MCU performs as a standalone system. First method is characteristic for older generations of Wi-Fi modules where MCUs consisting Wi-Fi modules are not able to deliver high performance (mostly used for the ESP8266-01 that is controlled by more powerful MCU using UART over AT commands). Second method became more versatile when the development of the chip consisting both Wi-Fi module and many serial interfaces came to be. This allowed users to use less devices for the system design and therefore to reduce energy demand and system cost. However, in the system where MCU with higher performance is needed, first method is the only method that can deliver appropriate results. For this research, only second method is used. Still, other MCU (STM32 chip with DAC (Digital to Analog converter) is used, but not to control standalone Wi-Fi modules but to generate various waveform that are used as a testing signals for the Wi-Fi modules. Wi-Fi MCU accepts these signals and transmits them. Block scheme of the experiment is shown in Fig. 1.

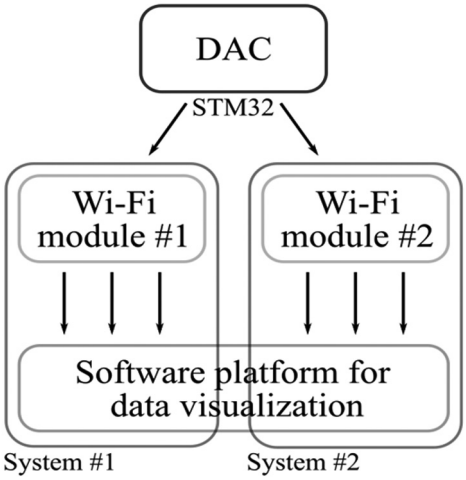

Fig. 1. Block scheme of the experiment environment.

Two different systems are analyzed. Systems use identical software part of the system, while the hardware part is different in each. Main difference is in using different types of Wi-Fi modules, which lead to some other minor differences in connections. In each system, module is connected to the display that is used to inform user of the ongoing actions. Each part and block in the block scheme will be explained in detail in the full version of the paper.

B. Software part

Main capability of the designed software application is to continuously receive signals and to visualize them. One of the goals was to use same programming language for the hardware and software, explicitly JavaScript. Even though JavaScript is not the most common language for the MCU programming, with the usage of JavaScript interpreter Espruino, almost all of the hardware resources (serial interfaces and peripheral units) can be exploited completely. On the other side, usage of Espruino allows using standard JavaScript commands and functions related to the server communication and data transmission making it ideal for IoT application. Synergy between concepts and commands eliminates robust programming while still allowing full functionalities for both server application and for the ESP32 chip. Each part of the used toolchain for the application design will be explained in detail in the full version of the paper.

III. EXPERIMENTAL RESULTS

It is expected to see whether will all of the testing signals sent from the STM board be reproduced and able to visualize. While fully successful transmission is expected for low frequency received signals, for the high frequency received signal, data sending rate will be limited. These limits can cause that not all of the collected data be transmitted. This type of missing data will be visible in visualization graph. One of the expected results is to see what are the main parameters that are causing these distortions. To see if those distortions are related with testing signal amplitude and specific waveform. Most important practical implications include:

- Describing critical frequencies of the input signal for the reliable transfer of data for used Wi-Fi modules.
- Describing impact of waveform and amplitude on the critical frequencies.
- Impact of other hardware limits influencing reliable work;

All of the mentioned implications can impact IoT system developers for the possible failures on data acquisition. Depending on the systems, these failures can negligible but can also be rather serious.

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The role of a mobile operator in the enablement of responsible consumption in smart residential communities

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Abstract— The fifth generation of mobile networks (5G) gives mobile operators the possibility of enabling the transformation of the different industries and the society at large. To seize such an opportunity, operators need to make different partnerships and take an active part in or even initiate the creation of new ecosystems. This paper portrays the potential role of mobile operators in the new, smart residential communities. It outlines the contribution of the different Internet of Things (IoT) applications, enabled by 5G, in resolving urban challenges. The special focus is put on „smart living" services related to responsible consumption. The paper describes the operator's business model for such a scenario and the necessary technical and organizational prerequisites for it. As the business model and the business ecosystem are tightly interdependent, the paper also addresses the ecosystem creation, main interactions among the key actors, and the value created for each participant and the whole society.

Keywords—5G, mobile operator, Internet of Things, responsible consumption, smart residential community

I. INTRODUCTION

The development of mobile technology has changed to a great extent not only the way we are communicating with each other, but also our shopping, entertainment, working, learning, and many other habits and preferences. The fifth generation of mobile networks (5G), which is currently being introduced worldwide and promising superior performances, is expected to make even more radical changes. Together with the technical capabilities to enable different high-bandwidth, ultra-reliable and latency-sensitive use cases, and to provide connectivity to the plethora of the different smart devices, the 5G gives the chance to mobile operators of going beyond the traditional roles of connectivity provider and the legacy business models [1]–[4]. Smart cities are undoubtedly among the domains that are expected to benefit from the development of mobile technologies. They are also an opportunity for the mobile operator to expand its offering beyond infrastructure and to monetize on new capabilities [5]–[7].

Recent academic and industrial publications that are exploring potential benefits of using 5G in smart environments are mainly focusing on providing conditions for smart production (smart manufacturing) or improving the functioning of various public and communal services (e-health, public safety, smart parking, public lighting, waste management, etc.) [8]–[11]. In contrast, this paper focuses on services intended for individual users and householders. The basic idea is to take advantage of the opportunities offered by the 5G network, but also other solutions that rely on advanced information technologies (e.g. big data, ML, AI, blockchain) and thus improve the offer and overcome the limitations of previous smart home/smart living implementations. The paper aims to answer what are the prerequisites for the enablement of such services from the mobile operator's perspective, how the operator's offering should be positioned in the relevant ecosystem, and how to create a sustainable business model.

A. Theoretical background

The concept of smart city and the relevant sub-topics have been attracting significant attention from both academia and the ICT industry in the last decade. The extensive analysis of the existing literature, made by Winkowska, Szpilko, and Pejic [12] has shown that a majority of academic work was focused on the technological aspect only. Such an approach caused many issues in the implementation of smart cities [12]. The same study and other recent works conclude that technology is necessary, but not a sufficient prerequisite for transforming a city into the smart one. For successful planning and implementation of the smart city, the real needs of the citizens should be the utmost priority, while advanced technology should be a tool for achieving goals [12], [13].

On a broader scale, this is recognized in the concept of a smart, networked society. The strategic program of the Government of Japan, the vision of the future society, Society 5.0, in which advanced technologies are an integral part of both business and social life, defines primarily as human-centric, ie a society in which the needs of the population come first [14]–[17]. To meet these needs of citizens and create new value for society, it is necessary to unite different entities that share the same vision and goals, and who are willing to cooperate, and that through this cooperation, each based on their comparative advantages, to achieve benefits for all participants. What is important in this type of partnership is the need for joint leadership and incentives that for each of the participants should be aligned with a common goal. This type of association is called the human-centric ecosystem [18].

B. The needs of urban residents

In addition to well-known urban challenges, the COVID-19 pandemic has been redefining the way of working and living in urban communities and has increased the reliance on technology, innovations, and e-commerce [19]. The main needs of urban residents seen from the perspective of an individual inhabitant or household can be grouped in the following categories [19], [20]:

- Digital infrastructure for remote work and education
- Infotainment – access to information and entertainment
- Social contacts
- Health and wellbeing
- Mobility and transportation
- Homelife – including home security, home tasks, and consumption

II. BUSINESS ECOSYSTEM AND BUSINESS MODEL DESIGN

This paper addresses the citizens' need for a convenient purchasing of food and other commodities, and the goal of society for responsible consumption (United Nation Sustainable Development Goal 12)[18]. Despite the numerous options for online purchasing, existing alternatives are still fully dependent on human requests, thus delivery timing and the purchased amount might not be the optimal ones. Furthermore, existing purchasing patterns often lead to stockpiling and then to the waste of food, either in the households or in the stores, due to the expired validity.

The idea is to trigger a purchase automatically when the quantity of groceries (e.g. eggs, milk, flour) is below a predefined threshold.

A. Ecosystem design

Modeling of the business ecosystem, including key partners identification and designing of relationships and main interactions among them, is performed through several iterations. Following the best practices, this process requires constant verification if the ecosystem supports the creation and exchange of sustainable value for all participants [21], [22].

Sustainable value proposition design [23] is used as a guideline for mapping and understanding the ecosystem's stakeholders.

B. Business model design

An innovative approach in the implementation of different aspects of the smart city requires innovation in the corresponding business models [24]. This paper leverages the study from 2019 which proposes an enriched version of the well-known Business Model Canvas (BMC). This new framework is called Smart City Business Model Canvas (SC-BMC) [25]. Whereas the original and well-known Business Model Canvas (BMC) is intended to support an individual organization to develop its business model, this new framework considers the holistic business model for a network of actors in smart environments (e.g. Actor 1: city, Actor 2: end-user, Actor 3: core partner, Actor 4: supporting partner). This network of actors is supposed to create, deliver, and capture value in a collaborative effort, and SC-BMC is intended to support all the participants in this ecosystem taking into consideration their relationships and interactions[25]. The SC-BMC integrates the concepts of co-creation and network-centric value creation, which simultaneously address the social and environmental dimensions of the solutions deployed. The building blocks in the new framework are the following: Network Beneficiaries, Value Proposition, Data, Deployment Channels, Actor Relationships, Revenue Streams, Key Resources and Infrastructure, Key Activities, Key Actors, Key Actors Offerings, Key Actors, Co-Creation Operations, Budget Cost, Environmental Impacts: Costs and Benefits, and Social Impacts: Values and Costs [25].

III. DISCUSSION AND IMPLICATIONS

A. Implementation Considerations

- Feasibility, advantages, and limitations of the proposed model
- Factors that will be impacting residents' acceptance
- Implications on operator's organization and business processes

B. Operator as the successful player in a 5G ecosystem

- The key value and differentiators that mobile operator can bring to the ecosystem
- Technology, platform, and business enablers needed for successful engagement with the partners

C. Operator's participation in broader ecosystems

- Using autonomous vehicles in the delivery
- Partnership with public cloud providers
- Participation in the data marketplace
- Linking with Smart agriculture ecosystem

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Development of a crowdsensing IoT system for tracking air quality

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Abstract—The main aim of this paper is the development of a crowdsensing Internet of things (IoT) system for tracking air quality. The introductory part of the paper will describe the concepts of the Internet of things, m-health, smart healthcare and crowdsensing. The possibilities of applying crowdsensing methods for collecting data from the environment with the help of intelligent and mobile devices will be analyzed. A developed crowdsensing IoT system for tracking air quality will be presented. The developed system will use intelligent devices such as microcomputers, various IoT sensors and sensors embedded in mobile devices for monitoring the air quality parameters in the environment. This crowdsensing IoT system will enable citizens to receive information on the air quality in specific locations and via a developed healthcare mobile application.

Keywords— Internet of Things, smart healthcare, crowdsensing, m-health, air quality

I. INTRODUCTION

Air pollution represents a global challenge, most prevalent in developing countries. The growing number of cars in the traffics, improper waste disposal, the opening of more factories in which mass production is carried out are just some of the sources of air pollution. Since developing countries are not able to invest in environmental protection due to a lack of resources, no action is taken to the prevention of the emission of harmful substances into the atmosphere, which consequently leads to endangering public health.

Stationary and mobile sources release various chemical pollutants, including suspended particulate matter (SPM), carbon monoxide (CO), oxides of nitrogen (NOx), oxides of sulfur (SOx), volatile organic compounds (VOC), and other toxics which may increase the occurrence of diseases such as lung cancer, pneumonia, asthma, chronic bronchitis, coronary artery disease, and chronic pulmonary diseases [1][2]. The problem of testing air quality and getting real-time information is present at the global level. Insight into the presence of harmful substances in the air in real-time would enable citizens to take appropriate actions and reduce their exposure, which would have a positive impact on both the public and their health. The global problem of testing air quality and getting real-time information could be solved by combining mobile healthcare and Internet of Things (hereinafter: IoT) concepts.

M-health represents a term used in the field of medicine and public health, which refers to the use of personal mobile devices to improve the provision of healthcare [3]. Mobile applications specializing in health typically include the use of mobile devices to collect clinical data, provide health information about patients to physicians and specialists, monitor patients' conditions in real-time, and directly provide health services through mobile devices [4]. In this way, doctors, patients and other stakeholders in the health ecosystem have improved communication, real-time monitoring and delivery of useful information, online consultations and other services using mobile health applications.

Mobile applications specializing in health usually enable the improvement of healthcare provision, engaging patients through participation in disease management and active involvement in their therapy [5]. These applications facilitate remote monitoring of patients' health, faster response to their needs, securely transfer confidential medical information between different healthcare institutions and increase the efficiency and effectiveness of medical business processes to improve the general health of patients [6].

Mobile health applications can be applied in the crowdsensing field [7]. Conceptually, mobile crowdsensing is a term for the wide collection and sharing of data in different domains via mobile devices, smartphones and tablets, using different sensors. These sensors can collect a huge amount of data. Also, not only smartphones can be used for crowdsensing, but also many other devices, such as IoT

devices or consumer-oriented devices capable, which also can gather useful information [8]. By mentioned approach, the users share useful healthcare information that implies an increase in e-participation.

Smart healthcare is an increasingly popular concept that relies on the synergy of different engineering concepts and intelligent technical innovations applicable to healthcare [9]. Today, a significant number of applications belong to the category of smart healthcare applications. Some applications are used in clinical practice to eliminate paperwork. Some applications aim to empower patients, clarify symptoms, improve self-monitoring, etc. Applications are also often used to speed up the process of drug registration and reimbursement, as well as for research or studies conducted by epidemiologists.

The IoT represents part of many smart healthcare systems. In his paper [10], Fioccola describes the IoT as a paradigm that has recently become very popular in the context of modern wireless telecommunications. This paradigm represents "a globally distributed network of interconnected objects that are uniquely addressed and based on standard communication protocols" [11]. The basic idea of the Internet of things is the distribution of ubiquitous "objects" or "things" that are used for collecting and exchanging data.

This paper aims to provide a detailed description of the development of the crowdsensing IoT system for tracking air quality. The proposed system will provide users with real-time information about the locations where unfavorable parameters of air quality are located, their intensity and the prevention measures that users should take. Users via the developed smart healthcare application will be able to view the mentioned information via personal mobile devices.

II. METHODOLOGY

Developed crowdsensing IoT system consists of Raspberry Pi microcomputer, Arduino microcontroller and appropriate sensors for tracking air quality parameters.

According to Painter [12], air pollution means "the presence of one or more pollutants in the Earth's atmosphere, in sufficient quantity to cause short-term or long-term adverse effects on human, animal or plant life, or the environment."

Air pollutants can be classified into two groups [10]:

- Primary pollutants - compounds of carbon, nitrogen, sulfur and halogen elements. They are released directly into the atmosphere from their sources and have a very strong impact on health.
- Secondary pollutants - nitrogen dioxide, hydrogen peroxide, ozone, sulfates and nitrates. They aren't emitted directly but are created by chemical processes in the atmosphere, acting on primary pollutants.

To measure the level of air pollution, the following parameters are mainly monitored: carbon monoxide (CO), carbon dioxide (CO2), nitrogen dioxide (NO2), methane (CH4), hydrogen sulfide (H2S), ozone (O3), ammonia (NH3), benzene (C6H6), ethanol (C2H6O), toluene (C7H8), propane (C3H8), temperature, humidity, amount of rain, light intensity, presence of flame or rain, tin oxide (SnO2), liquefied petroleum gas [10]. Additional parameters that can be monitored are sulfur dioxide (SO2), nitric oxide (NO2), as well as PM2.5 and PM10 particles [13]. The following sensors can be used for tracking mentioned air quality parameters [14]:

- The DHT11 is a digital temperature and humidity sensor.
- The MQ-7 sensor module is important for detecting the concentration of carbon monoxide (CO) in the air.
- The MQ-135 sensor module uses tin dioxide (SnO2) and it can be used to test for various harmful gases.
- The MQ-6 sensor module is mainly used to detect LPG-like gas, i.e. liquefied petroleum gas which is colloquially referred to as gas.
- The MQ-9 sensor module also uses tin dioxide (SnO2) for detection, which is characterized by low conductivity in clean air. This sensor can detect a wide range of concentrations of carbon monoxide and flammable gases.

Some of the mentioned sensors will be used for the development of the crowdsensing IoT system for tracking air quality since they can measure parameters that are important for monitoring air pollutants. Sensors are planned to be placed at different locations, where they will monitor the intensity of previously mentioned air pollutants. Sensors will be connected to the Arduino microcontroller. Since the mentioned sensor works with analog inputs, the values they read are in the range from 0 to 1024. Measured values will be forwarded to the Raspberry Pi microcomputer. On Raspberry Pi measured values will be processed using appropriate scripts. Appropriate mathematic formulas will be applied to values from some sensors.

Processed values will be forwarded to the mobile healthcare application via service. Therefore, the proposed system will be connected to the crowdsensing mobile application for the detection of allergens. The developed mobile healthcare application contains an interactive map, where the intensity of the parameters measured by the IoT system will be displayed to the end-user. Locations, where the system is set, will be pinned on the map as markers. By clicking on the marker, a text box that contains the names of the parameters and measured values will be shown to the user. Furthermore, the application will display an explanation of the measured value, therefore will understand if the air quality parameters are inconvenient.

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A system for evaluation of human driving based on IoT and computer vision

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Abstract—Object of research in this document is human driving. The primary goal of this research is to simplify and improve driver education for newcomers. This is achieved through combination of technologies and libraries in Python. OpenCV is used for computer vision, which predicts and observes traffic participants with Kalman filter via Raspberry Pi microcomputer and its camera. Artificial intelligence is used for classifying images of traffic signs via Tensorflow for evaluating human compliance with traffic rules.

Keywords—human driving, computer vision, artificial intelligence

I. INTRODUCTION

Safety of human driving, especially along side traffic participants in a busy traffic, depends on a large number of variables. Naturally, there will be some errors that can result in a tragic accident. Unfortunatly, each year 1.35 million people are killed on roadways around the world, and crash injuries are among leading causes of death globally [1]. That's the main reason why companies like Tesla and comma.ai are working on automating vehicles, each on their own way.

Tesla is a leading company in this field, and they're making branded cars. Some of those cars have full autonomous option, which is known as autopilot. Their advanced sensor coverage with 12 ultrasonic sensors, 8 surround cameras and 360 degrees of visibility makes the car one of the safest choices regarding self-driving today [2]. In comparison, in Q1 2021, there was one accident for every ~ 6.74 million kilometers for drivers that had autopilot enabled, but NHTSA's data shows that only in US there is a vehicle crash every ~ 779.000 kilometers [2]. On the other side, there's also comma.ai, that tries to make everyday cars fully autonomous with their product, known as comma two. They are known for open source policy, so everyone can contribute to the openpilot software, and be a part of the community. This product can be really helpful during long trips, or simply as a way to rest the driver for some period, without worrying for his safety. Need for driving, while driver is exhausted, is another way to get into an accident. These are only some of the efforts to reduce traffic accidents, and fatal outcomes. However, not much is being done in educating newcomers, as it is as traditional learning experience, as it was in the last century.

This paper dives into the complexity of driving and human compliance with traffic rules. Main goal is to give drivers opportunity to visually see the results of their driving, which can be really helpful, especially for beginners. It evaluates compliance with traffic signs, road lines, and overall safe driving around other traffic participants, pedestrians, etc. After the driving session, drivers can evaluate their results, and on that basis to iteratively improve their driving.

II. METHODOLOGY

Using cameras and sensors with Raspberry Pi microcomputer [3] is a great way to improve the human experience and safety of an environment. Adding the logic to the software that uses the parameters from sensors and cameras, and ability to exchange data with other devices, makes the device in use a smart device. User is interacting with the device via user interface (UI), which is connected with the server side of the software that "communicates" with the data. On the other end, smart device with camera and sensors, communicates directly with the server side, so that parameters can be evaluated by the software and then be stored into the database.

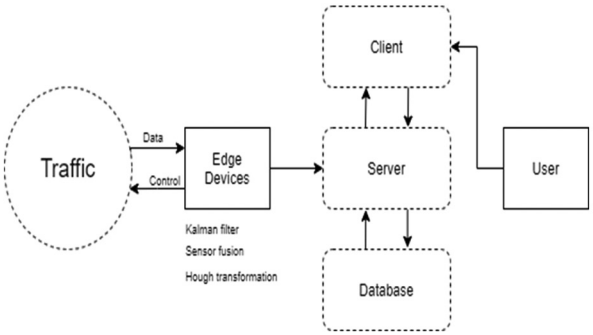

Figure 1 - System architecture

In this paper, three main components are identified as major points of interest:

- Management of distance from traffic participants
- Staying in lane
- Detecting traffic signs

A. Management of distance from traffic participants

One of the ways, how human driving can lead to an accident, is poor management of distance from other cars or ignoring pedestrians close to the pedestrian crossing. A way to fix that is detecting and tracking the cars and pedestrians while driving, which is possible with OpenCV library in Python, and using sensors for evaluating the distance and speed, which are the most important parameters for keeping the driver safe [4]. Common rule for safe distance is a "3-second rule", where driver can calculate the distance from another car using a fixed object that is passed by the car in front, and if he passes that object in less than 3 seconds, he is too close. That rule can be converted into distance from another car, but it varies based on the driving speed. If driver is driving at about 80 km/h, the safe distance would be at about 67 meters, and if the driving speed is at 50 km/h, then the safe distance is reduced to about 42 meters, etc.

Pedestrians are harder to detect and predict their behavior. Even in everyday human driving, it is sometimes hard to see some pedestrians in busy city traffic, and that can lead to serious and fatal outcomes. However, software can be trained to see things that human would normally miss. Goal is to detect and predict pedestrian behavior with techniques like Kalman filtering, and based on that alert the driver if he's too close while not slowing down.

B. Staying in lane

This tends to be difficult for newcomers to driving, but it can have some serious consequences. Sometimes, driver can easily wander off, and without knowing start to change lanes, which can be dangerous if there're already other cars. To mitigate that behavior, camera is tracking lines throughout the whole driving session, and if the driver treads the line, it will alert him with the built-in sensor, and it will be shown in the results afterwards. The lines are tracked via Hough transformation, which is a famous technique for extracting lines from a video.

C. Detecting traffic signs

Another important aspect of human driving and overall safety for all traffic participants, is human compliance with traffic rules that can change based on the location, weather conditions, and other factors. Using Tensorflow and implementing artificial intelligence, software can learn to detect traffic signs, and then evaluate if driver follows the rules via logic implemented in Python programming language [5]. For example, if there's a stop sign, sensors should give the information to the software if driver stopped on the sign, as it's expected. After the driving session, the results are shown to the driver for his further evaluation.

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KNOWLEDGE MANAGEMENT, RESEARCH AND SCIENTIFIC ISSUES

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Open Science and Preserving the Digital Cultural Heritage

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Abstract—Cultural heritage is increasingly important in the modern world, not only as an important part of both collective and individual identity, but also as a significant economic resource in the tourism industry. Enabling efficient and simple access to digital representations of relevant artefacts is among the most valuable missions of a modern museum or institution of culture. In this paper we present the system that enables the users to generate highly detailed digital reconstructions of real-world objects from a series of photographs through the use of Structure from Motion approach. The system is containerized and suitable for both standalone and hosted use. In order to increase the long term value of the system we use open science principles and open-source software.

Keywords—open science, digital cultural heritage

I. INTRODUCTION

We live in turbulent times. While the advances in areas of information and communication technologies are rapid and transformative, there is an ever-present danger of alienation and isolation facing each individual. Loss of identity and lack of historical connections serving as a real-world anchors have only been exacerbated by the difficulties caused by the current pandemic, but both predate it, and will outlive it. Preservation of cultural heritage is of paramount importance in the modern fast-evolving digital world and digitizing it provides more efficient access and preservation means to us. One of the dangers connected to the process of digitization is the prospect of the digital Dark Age due to outdated hardware, software or file formats [1].

One of the means of solving this issue is to use open and well documented formats, readable and writable by freely available and usable software – open-source software, while employing geographically distributed and redundant storage and compute resources through the use of modern cloud-based systems. This approach is based on the notion of FAIR data which if findable, accessible, interoperable and reusable.

Another issue is related to relatively complex software used to produce, manage and access the cultural heritage data. This issue arises from several factors, from the use of legacy software that evolved for a long time and accumulated a significant amount of very specific functionality that only needlessly complicates the use in a modern environment, through the need to create workflows consisting of several independent software packages with questionable compatibility, to the use of file formats that are of limited use in the modern environment.

In this paper, we present the system developed as a part of the project of digitization of cultural heritage collection of the Museum of Republic of Srpska as a part of VI SEEM and NI4OS Europe Horizon 2020 projects [2][3]. The wider system enables both the museum staff as well as the general public to easily access the relevant data, while the narrower system described in this paper enables the reconstruction and post processing of three dimensional representations of a real-world object from a series of photographs through the use of structure from motion approach.

II. DESIGN OF THE SYSTEM

Using photographs and similar visual aids to document physical artifacts collected by museum has a long history and it enables not only a simple way to reference the object, but also a relatively crude way to conduct some of the measurements without access to the object itself.

As photographs are two dimensional representations of real-world objects, it is understandable that loss of information is inevitable and measurements that can be executed are limited in nature and prone to errors due to perspective distortion, different planes of reference and measurement, etc. As the technology progressed, the use of dedicated 3D scanners became more widespread. First, the scanners were based on manual scanning of individual points, then they evolved to employ line lasers and cameras to scan a line at a time, and finally to structured light

scanners. These scanners project a pattern onto the object while recording the deformed pattern with a camera module offset to the projector [4]. Based on the deformations, the scanner software can calculate the shape of the object. An example of such a scanner is given in Fig. 1.

The issue with structured light scanners lies in the fact that they need a fairly well controlled lighting environment and, as such, are mostly suitable for indoor use. They are also aimed at being used for objects of modest dimensions, from several centimeters to few meters, and are rarely used for outdoor scanning of large structures. As such structures are very common in cultural heritage (monuments, sacral objects, archeological excavations, etc.) there is a clear need to provide a suitable solution for this problem.

Fig. 1.Zeiss COMET L3D 5M structured light scanner system

Due to rapid advancements in digital photography, modern cameras are practical, affordable and high-quality imaging devices usable in a wide variety of conditions and lighting environments. By obtaining a sufficient number of photographs of the object from different viewpoints it is possible to first calculate the relative positions of camera and then to reconstruct the shape of the surface of the object. As the photographs contain texture data as well, the produced model can be further enhanced by incorporating this data. This approach of digital reconstruction of a real-world object is called structure from motion (SfM) [5] [6].

III. RESULTS

There are several commercial desktop software packages and cloud services that can produce satisfactory reconstructions, but, keeping in mind the benefits of using open science and open software, we have developed a containerized solution that is usable in both standalone manner (running on a user computer) and as a web based hosted solution requiring no additional software or high performance hardware from the user as the system uses the resources of ETFBL CC01 compute cluster for allowed users. The system utilizes several open-source projects such as VisualSFM [7], PVMS/CVMS [8], Poisson [9], etc. The workflow is very efficient and simple as it consists of creating a project, uploading the photographs and starting the reconstruction process. After the process finishes, the user is presented with the full output of the SfM pipeline as seen in Fig. 2. The user is then free to further process the generated object through the web based version of Meshlab software by choosing the "Edit" option, providing users with the most important and most frequently used tools in an easy to use package. When the user is satisfied, it is possible to measure various elements of the reconstructed object directly in a web environment that is based on 3D HOP viewer and enables users to rotate, move and scale the objects, to alter the lighting in order to better observe features, to create cross sections, etc. This component is presented in Fig. 3.

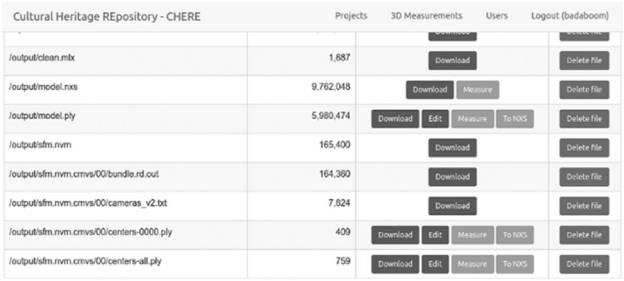

Fig. 2. Output of SfM pipeline with reconstructed objects

Fig. 3. Web based measurement system for 3D objects

The core of the system was adapted and used for measurements of dental plaster study models and compared with manual and photogrammetric measurements with all three methods producing measurements in agreement.

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Algorithm of Co-Authors Selection for Preparing Scientific Works based on Gaussian Models and Data from the E-library Web Resource

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Abstract—The article deals with the urgent task of selecting co-authors of scientific works using cluster analysis methods. In particular, on the basis of the resources of the scientific electronic library in Russia, E-library, test data on scientists were selected. These data were used to unite scientists into clusters according to interests and topics of their publication. To solve this problem, a clustering method based on Gaussian mixture models (GMM) was used. The result of the research groups selection showed that the algorithm is able to qualitatively select scientists with common interests. To assess the effectiveness of the algorithm, the clustering results were checked, where the groups of scientists who already had common publications were chosen as the base. The obtained clustering accuracy was 100\% according expert assessment and exceeded the indicators obtained using the K-means algorithm.

Keywords— Cluster Analysis, Web Engineering, Gaussian Model of Mixtures, K-means, Research Teams, E-library, Education.

I. INTRODUCTION

Today, for effective work in higher educational institutions, teachers need to conduct active publishing activities [1]. In the context of the rapid development of information technology, teachers of disciplines in the field of computer science are also forced to actively work on improving the courses they teach. On the other hand, in the humanities, the workload of teachers is also increasing. This, in turn, leads to a deterioration in publication activity. In addition, scientific foundations often hold competitions, for the submission of applications for which a large number of competencies are required, which are not always available within one university department. The most important condition for maintaining publication activity with high-quality material that allows the publication of high-level scientific works is the breakdown of the work on the article between co-authors. The selection of co-authors today often takes place within one structural unit, sometimes with the involvement of graduate students and students. However, analysis shows that the most successful articles are prepared by distributed teams [2]. However, finding coauthors “from outside” is time consuming. Therefore, it is desirable to reduce the initial reduction in the circle of potential scientific partners using data mining algorithms.

Moreover, today there are many international competitions for scientific projects [3]. Usually well-coordinated teams from different countries, between which there is already a connection, take part in such competitions. These connections most often arise in the framework of international conferences. However, during the period of restrictions introduced due to the spread of coronavirus infection, the likelihood of such contact is significantly reduced. Thus, an urgent task is to develop an algorithm that will analyze the publication activity of authors and, on the basis of such analysis, propose research teams.

This article discusses an algorithm for clustering multivariate data based on Gaussian mixture models (GMM), which will be described in detail in the next section. As data for the analysis, characteristics from the Russian scientific electronic library E-library \cite{4} were selected. E-library allows authorized users to view information about authors, articles and citations.

II. GAUSSIAN MIXTURE MODELS

One of the popular clustering algorithms is the GMM [5-7]. The popularity of this model is due to the use of a normal distribution, with which most of the real data can be described. Another advantage of the model is its applicability to multidimensional data. The GMM, like the K-means algorithm, requires a preliminary determination of the number of clusters, as well as several more parameters. On the other hand, there are information criteria, on the basis of which the optimal GMM can be chosen for the given parameter options. These criteria include the Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC) [8]. The selected parameters of the model include the following:

1) Number of clusters K.

2) Characteristics of the covariance matrix.

A covariance matrix is classified by the relationship

between parameters within one class into a matrix with full and diagonal structure. According to the relationship between different clusters, covariance matrices are divided into shared and unshared. This classification takes into account the orientation and size of the clusters. With the standard approach to the clustering problem, ellipsoids describing clusters can be oriented in multidimensional space at any angle, which is provided by the full structure of the covariance matrix. For a diagonal structure, the orientation must be strictly perpendicular and parallel to the axes of the main parameters. Since the data can be heterogeneous, and the clusters contain a completely different number of objects, they use covariance matrices with a unshared structure. The shared structure implies that all ellipsoids will have the same dimensions along each axis and the same orientation in space.

3) Regularization parameter R .

This parameter usually takes values of tenths, hundredths or thousandths. Regularization allows the Gaussian model not to fall apart when obtaining an unsuccessful covariance matrix, since this parameter provides a positive value for the determinant of the covariance matrix.

Thus, if the distribution of parameters describing the object is approximated by a Gaussian distribution, the probability of high accuracy of clustering will be quite large.

In the general case, the system can have K clusters, to which, based on the analysis of N parameters, M objects should be assigned. The simplest case describes the situation when there are two classes into which objects with only one property X should be distributed. Thus, the solution to the clustering problem is represented in the form of a classical Bayesian detector.

There is a distribution of the parameter X under two hypotheses: H_1 is about belonging to class №1, H_2 is about belonging to class №2.

Based on the current value X_i , describing the property X for the i-th object, it is required to determine the closest distribution. It is clear that this can be done by estimating the probabilities that X_i is an object of classes No. 1 and No. 2. For this, it is possible to construct the probability distribution density function (PDF) of the parameter X for both classes. The Gaussian distribution is described using mean and variance. The one-dimensional normal PDF is known to have the form (1).

$$f(x)=\frac{1}{\sqrt{2\pi}\sigma_x}\exp\left(-(x-m_x)^2\Big/2\sigma_x^2\right) \qquad (1)$$

where m_x is average value of the parameter X, σ_x^2 is variance of the parameter X .

The difference between distributions (1) for hypotheses H_1 and H_2 consists in different values of the distribution parameters.

However, if the total distribution is constructed based on distributions of the form (1) for the global case of the presence of K clusters and, accordingly, hypotheses, then it is possible to write an expression of the form (2), which describes the model of Gaussian mixtures.

$$f_{GMM}(x)=\frac{1}{K}\sum_{i=1}^{K}f_i(x) \qquad (2)$$

where K is the total number of clusters in the task.

For example, let's plot such a mixture for two clusters. In this case, the first cluster is described by a normal distribution with parameters $m_{x1}=0$, $\sigma_{x1}^2=1$ and the second cluster has $m_{x1}=7$, $\sigma_{x1}^2=2$.

Fig. 1 shows a plot of the PDF of the mixture.

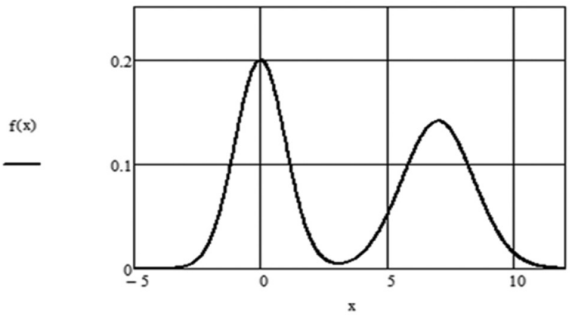

Fig. 1. Mixture of two Gaussian distributions

Analysis of expression (2) shows that the area under each figure will be equal to 0.5. On the other hand, the variance for the second distribution is greater; therefore, intuitively, the probability of an object falling into the second cluster should also be greater. However, for Fig. 1, the probabilities of belonging to each cluster coincide. To simulate a situation in which the areas under the curve formed by the PDF will be different, it is necessary to produce a weighted mixture of distributions. In this case, the weights can be the probabilities of belonging to each cluster $p_1,p_2,\ldots p_k$. It should be remembered that the sum of these probabilities should be equal to 1.

Let's rewrite the mixture model in the form (3).

$$f_{GMM}(x)=\sum_{i=1}^{N}p_i f_i(x) \qquad (3)$$

To illustrate, let us mix two distributions in such a way that the probability of hitting the first cluster is 75%, and the probability of hitting the second cluster is 25%. The distribution parameters correspond to the distribution parameters from Fig. 1. So Fig. 2 shows a mixture of normal distributions with different proportions.

Analysis of Fig. 2 shows that the general distribution of the variable X is such that the PDF of the mixture has 2 maxima. Depending on the distance to the nearest maximum, the classification of any object described by the parameter X can be easily performed. And the average values for the distributions of the parameter X in clusters 1 and

2 will be the centers of the clusters. And since variances determine the spread of values, they allow us to choose the correct cluster sizes.

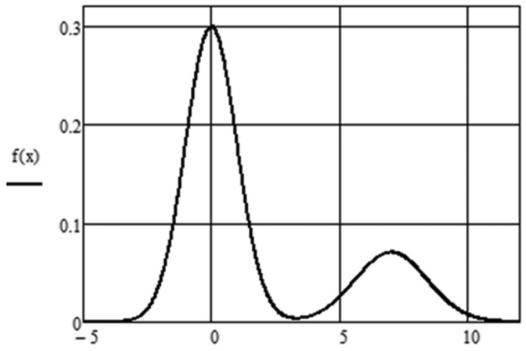

Fig. 2. Proportional mixture of Gaussian models

Obviously, the further in space the maxima themselves diverge, the easier and more accurate the clustering will be. In addition to the X parameter, a whole vector of parameters $X=(X_1\ X_2\ \dots\ X_N)$ can be used to describe each object. Then it is necessary to make a transition to a multidimensional GMM. The convenience of such a model lies in the fact that it is quite simple to generalize to the multidimensional case. If for the considered example, clusters are considered in the form of segments on the axis of the parameter X, then in the two-dimensional case the sections of Gaussian distributions are ellipses. Such ellipses are used to describe clusters. In the three-dimensional case, GMM provides ellipsoids, etc. It is also important that the model, for which the specified type of covariance matrix, regularization and the number of clusters are specified, is able to independently select normal distributions and build data clusters from the available data. Thus, when applying the Gaussian model, neither data markup nor training is required.

It should be noted that an increase in the number of parameters does not always lead to an increase in the efficiency of clustering. Sometimes some properties can introduce additional complications, so the choice of the main characteristic properties of objects is important. Despite this, the model based on Gaussian mixtures was chosen to develop the algorithm for clustering scientists. The choice of algorithm is easy to understand since the choice of the scientists parameters was made in manual mode, and they were chosen in such a way that the multidimensionality should not cause a decrease in the efficiency of the algorithm.

III. SOURCE DATA SAMPLING AND CLUSTERING RESULTS

For the research 10 scientists were selected using the E-library system. This choice was made based on four articles with 4, 3, 2 and 1 authors. The first 2 keywords were selected from each article. Further, for each of the selected scientists, the share of the use of each keyword in his works was calculated. It is important to understand, since several keywords can be used in one work, the restrictions on the total value of the share will not be one, but the number of keywords being checked.

Table 1 shows the results of the preparation of the test sample. In order to protect information, the personal data of scientists were anonymized, and the keywords were indicated as they really are. It should be noted that, according to the expert opinion, only the group of coauthors from the third article (2 coauthors) has a low probability of overlapping the area of interest with other coauthors.

After data collection a covariance matrix was calculated to analyze the relationship between topics for the selected scientist. Table 2 shows the results obtained from covariance matrix. However the covariance was normalized so Table 2 provides correlation coefficients between topics.

The following abbreviations are used in Tables 1 and 2: CV - Computer Vision; ML - Machine Learning; IP - Image Processing; AR - Autoregression; LC - Laser Coagulation; RP, Retinopathy; CNN - Convolutional Neural Network; AUG - Augmenation.

Analysis of the results obtained shows that Table 1 contains 10 objects described using 8 parameters. Accordingly, these objects can be clustered using GMM. Table 2 shows which topics are most related to each other.

However, this analysis is recommended not for a small sample of 10 scientists, but for the entire system. Moreover, Table 2 shows that scientists working with laser coag-

Table I. Distribution Of Topics By Scientists

Topic/Scientist	CV	ML	IP	AR	LC	RP	CNN	AUG
Scientist1 (Paper1)	0.226	0.34	0.787	0.52	0	0	0.333	0.189
Scientist2 (Paper1)	0.189	0.2	0.654	0.16	0.05	0.05	0.255	0
Scientist3 (Paper1)	0.614	0.135	0.59	0.12	0	0	0.614	0.018
Scientist4 (Paper1)	0.578	0.642	0.435	0.372	0.037	0.037	0.656	0.382
Scientist5 (Paper2)	0.218	0	0.805	0.92	0.12	0.12	0.182	0.012
Scientist6 (Paper2)	0.189	0.236	0.732	0.514	0.08	0	0.165	0.12
Scientist7 (Paper2)	0.756	0.522	0.792	0.2	0	0	0.718	0.365
Scientist8 (Paper3)	0.108	0.151	0.332	0	0.5	0.3	0.102	0.067
Scientist9 (Paper3)	0	0	0.5	0	0.75	0.75	0	0
Scientist10 (Paper4)	0.614	0.756	0.614	0.21	0	0	0.614	0.432

Table II. Correlation Matrix Of Research Topics

Topic/Scientist	CV	ML	IP	AR	LC	RP	CNN	AUG
CV	1	0.720	0.159	-0.058	-0.672	-0.619	0.981	0.720
ML	0.720	1	-0.009	-0.076	-0.541	-0.525	0.767	0.966
IP	0.159	-0.009	1	0.643	-0.567	-0.471	0.136	0.041
AR	-0.058	-0.076	0.643	1	-0.437	-0.403	-0.061	0.002
LC	-0.672	-0.541	-0.567	-0.437	1	0.968	-0.713	-0.459
RP	-0.619	-0.525	-0.471	-0.403	0.968	1	-0.651	-0.440
CNN	0.981	0.767	0.136	-0.061	-0.713	-0.651	1	0.742
AUG	0.720	0.966	0.041	0.002	-0.459	-0.440	0.742	1

ulation can only cooperate with scientists studying retinopathy. Indeed, retinopathy is a disease that can be treated using laser coagulation.

In general, depending on the level of correlation between topics, it is possible to search for co-authors by specifying the topic and choosing other topics with a level above a certain threshold, for example, with a correlation greater than 0.5. Then, going to Table 1, it is possible to select a scientist whose share of work in the field of related topics also exceeds a certain threshold, for example, with a share of keywords greater than 0.5. The higher the selected thresholds, the narrower the circle of specialists will be selected by such a filter.

Finally, let's consider the clustering of scientists into 2 classes using a GMM, K-means clustering and implying reference assignment of authors №8 and №9 to a separate cluster.

Table 3 shows the clustering results.

Table III. Clustering of Scientists

Topic/Scientist	GMM	K-means	Expert
Scientist1 (Paper1)	Cluster1	Cluster1	Cluster1
Scientist2 (Paper1)	Cluster1	Cluster1	Cluster1
Scientist3 (Paper1)	Cluster1	Cluster1	Cluster1
Scientist4 (Paper1)	Cluster1	Cluster1	Cluster1
Scientist5 (Paper2)	Cluster1	Cluster2	Cluster1
Scientist6 (Paper2)	Cluster1	Cluster1	Cluster1
Scientist7 (Paper2)	Cluster1	Cluster1	Cluster1
Scientist8 (Paper3)	Cluster2	Cluster2	Cluster2
Scientist9 (Paper3)	Cluster2	Cluster2	Cluster2
Scientist10 (Paper4)	Cluster1	Cluster1	Cluster1

Thus, the analysis shows that scientists №8 and №9 can be combined into one scientific group. In addition, there is the potential for a joint paper to be written for the remaining scientists. This is confirmed by expert analysis. However, the K-Means algorithm also assigned scientist № 5 to the second cluster. This is probably due to the third level of his share of publications in the field of RP and LC.

IV. CONCLUSIONS

The article presents an approach to the preparation of a database and its processing in order to identify potential colleagues in scientific work using open web resources. An algorithm based on Gaussian mixture models was used to unite scientists into groups. This approach made it possible on a test sample of 10 scientists to obtain a classification that fully corresponds to the classification proposed by the expert. At the same time, the K-means algorithm resulted in a discrepancy with expert assessment for the same data. In the future, it is planned to use correlations of research topics to improve the quality of the algorithm.

ACKNOWLEDGMENT

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A New Approach to Scientific-Research Paper Evaluation

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Abstract — Unreviewed sources such as https://arxiv.org [1] have an advantage over reviewed ones, which reflects in the immediate availability of the former to the reader, whereas in the case of the latter, reviewed sources, it takes six months on average from the submission of a paper to the journal to its publication (in case the paper has been accepted). Reviewed papers, however, have obvious advantages that reviewing brings with itself. In the paper, a solution which should unite into one the good characteristics of both approaches is offered.

Keywords — review, scientific paper, citation, autocitation, evaluation

I. INTRODUCTION

When speaking about the publication of scientific papers, the situation is as follows:

- A paper can be published immediately and the same may instantaneously be available to the interested readers who can use it for their further research work. In that manner, the advancement of science is not slowed down. The disadvantage of this manner lies in the fact that there is no review process (such as https://arxiv.org) and it does not enable the grading and scoring of those papers, so there is no guarantee of quality for the reason of that fact.
- In reviewed journals, the papers that are ultimately published are usually published six months upon their submission, during which time period the paper is not available to the reader. Once the paper has become available to the reader and after the reader has carried out research studies in which the same would be cited and after they have written a paper, about six additional months should pass for that new paper to be published and for the initial one to be cited. [3] It means that there is a delay of about one year on average, which slows down the development of science. That is a disadvantage of this manner. On the other hand, the advantage reflects in that researchers want the reviewed papers that have been somehow checked. Reviewing also enables the scoring and grading of those papers.

Both approaches have both advantages and disadvantages. The goal is to make a proposal for and create a new, third approach, which would unite into one the good characteristics of both mentioned approaches. The proposal is an electronic source on which it is possible to upload a paper which has not been reviewed yet at the moment of its publication, but which is available to the reader. In that manner, the development of science would not be slowed down. Readers would be enabled to review the paper under their own name if they want to do that. Both the reviewers and the authors would be graded so as to know which reviews one may believe. The proposal for said solution has in some aspects similarities with the mentioned website https://arxiv.org, [1] but it differs from that website in some important elements, which will be mentioned herein. The author can upload his/her paper as soon as he/she has written and checked it, so that the paper may become immediately available to the reader. At that moment, however, the paper is still unreviewed.

A paper might receive an arbitrary number of reviews. Reviews in the form of comments and numerical grades might be written by all those researchers who want to do that, but they would be doing that signing such reviews with their digital certificates. Of course, the issue of reviewer grading and the grading of reviews themselves is immediately raised.

A typical form of abuse reflects in mutual support in the form of mutually giving good grades. Of course, mutual grading does not automatically imply an abuse, so that it cannot be the ground for making complaints, but the phenomenon of circular reviewing (of an arbitrary length) must somehow be taken into consideration in the calculation.

II. APPLICATION BASIC FUNCTIONALITIES OVERVIEW

The application whose use would enable the uploading and reviewing of a paper, as well as the ranking of reviewers in the described manner, was created.

The application homepage is shown in Figure 1, whereas an Entity-Relationship model (ER model), with the marked primary keys (PKs) and foreign keys (FKs) [2] is shown in Figure 2.

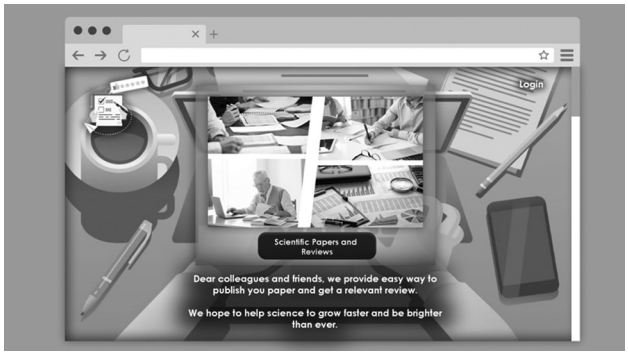

Fig 1. The application homepage

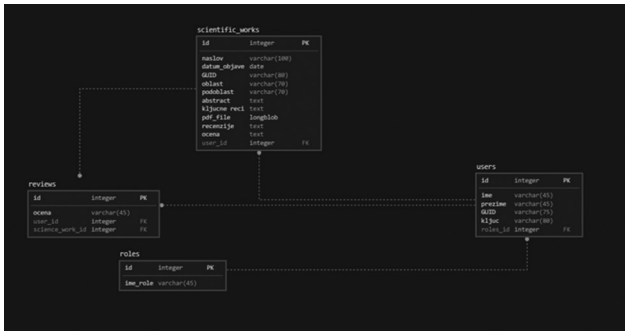

Fig 2. An Entity-Relationship model (ER model)

In the scientific paper database, each scientific paper has the following items defined:

- the name and GUID,
- the author/authors (GUID),
- the scientific area and the subareas,
- the abstract,
- the key words,
- the document in the pdf format,
- the list of the reference reviews, and
- the derived grade based on the reviews.

Each user is enabled to go through the list of the scientific papers classified into areas, select a paper, read it online or download it in the pdf format, all this without logging in.

The user may register as the "Author" or the "Reviewer".

The following items are defined for the "Author"-type user:

- the name and surname, and GUID,
- the list of the scientific papers, and
- the grade derived from the paper reviews that is recalculated with each next review.

The following items are defined for the "Reviewer"-type user:

- the name and surname, and GUID,
- the list of the reviews, and
- the grade.

There is also a possibility of browsing the scientific paper base by:

- the author,
- the scientific area (optional),
- the paper title, and
- the keywords,

with the option of sorting according to the review rating.

There is also a possibility of uploading a review for the scientific paper for which the following items are defined:

- the title of the scientific paper and GUID,
- the author's name (GUID),
- the reviewer's name (GUID),
- the review in the following form: the written form, the grade, I recommend it YES/NO.

There is a possibility of grading the reviewer based on the existing reviews. The reviewer grade is the weight factor of his/her review.

There is a possibility of excluding certain reviews should the Fraud Model be recognizable (e.g. the reviewing cycles).

There is a possibility of showing the list of the authors as per the rank together with the mentioned area in which the paper is published and showing the list of the reviewers as per the rank.

Registered users shall be entitled to the following:

- there is the "Author" role, which has the right to upload a scientific paper and assign it to an appropriate category;
- there is the "Reviewer" role, which has the right to perform the reviewing of scientific papers (anyone may review papers openly);
- there is the "Administrator" role – the Administrator has a possibility to manipulate users and eliminate problems on the application, and
- there is the "Content Administrator" role, which has the right to manage, add and delete the areas and the subareas.

III. CONCLUSION

The following problems are present in the extant scientific-research paper grading system:

- to publish a paper from its submission to a journal if accepted takes a lot of time,
- the scientific-research paper grading objective methods provide very imprecise results due to divers kinds of fraud in the form of adapting to the grading system (mutual citations and so on),
- the work done by reviewers is not valued and the reviewers are not ranked, so there is no sufficient motivation for reviewing,
- there are a large number of mistakes in published papers in spite of the fact that the same have been reviewed, and
- there is a possibility of power and influence abuse.

Overcoming these problems would enable a completely new scientific-research paper evaluation system.

Information technologies enable decentralization, data changing prevention, digital signing, a public and independent check, and transparency/privacy control, by which different kinds of abuse are prevented, and the quick availability of content, cooperation and measuring the influence are enabled. [5]

The application of the blockchain technology to data decentralization and unchangeability, the application of cryptographic solutions aimed at defining and limiting data access control, i.e. data transparency and privacy, digital signing and digital certificates aiming to exclusively create accounts under the real identity and undeniability with the purpose of gaining an insight into the reputation of a participant in this system are possible. [4]

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A model for agile management of virtual teams for developing smart environments

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Abstract—The paper aims to consider the development of virtual team management models in the development of smart environments. The central issue under consideration is the examination of the possibilities for developing a model for efficient management of virtual teams in the development of smart environments using the DevOps approach in the SAFe (Scaled Agile Framework). The focus of the paper will be on designing and implementing the development of a virtual team management model that is specifically tailored to smart environment development projects. The model should make optimal use of the elements of the agile methodology framework and positively influence the process of understanding, adapting, and applying the DevOps approach in project team management.

Keywords— smart environment, virtual teams, agile, SAFe, DevOps, organizational management.

I. INTRODUCTION

In the age of industrial digitalization, companies are increasingly investing in tools and solutions that enable processes, machines, employees, products and services to be integrated into a single network for data collection and analysis, i.e. in smart environments [1]. Smart environments are at the heart of Industry 4. The main purpose of Industry 4.0 is to achieve improvements in terms of automation, operational efficiency, and effectiveness of e-business [2]. Industry 4.0 as a new paradigm [3] is based on new network technologies and requires new procedures (e.g. data analysis software), which require specific capabilities of the company (e.g. continuous innovation, lifelong learning, trust, data sharing), and these conditions development of specific business models as well as new models of organizational management.

A smart environment is complex, and as such seeks an adequate systemic organization that would enable its functioning. Virtual teams have emerged as a convenient structure in such an environment. They are characterized by the use of IT, changes in organizational design, and the dispersion of a multicultural workforce [4]. On the other hand, the development of smart environments and the management of such systems after they are in operation cannot be separated, so the DevOps approach is suitable for the development of smart environments. DevOps enables communication, integration, automation, and close collaboration of all people needed to plan, develop, test, implement, publish, and maintain solutions [5].

Previous research in this area has shown that there are several problems and that the basis for solving this complex organizational environment lies in creating an integrated model. There is a need to explore new approaches and models for organizing virtual teams in new business conditions, starting from current models and practices related to agile software development (Scrum, SAFe, etc.). In agile development, designers, testers, developers, and integrators merge into inter-functional teams responsible for continuous software delivery [6].

The trend of introducing virtual teams in the organization of work has not bypassed academic institutions either. In academia, several applications are used to form a virtual learning environment [7], e.g. Moodle open-source platform [8][9], interactive course materials, labs, and quizzes [10], as well as tutorials and simulations [11]. At the same time, such projects enrich students with real-world experience in intercultural communication, time zones, time management, and virtual socializing [12], assuming they are carefully designed and team members have appropriate instruction. . They provide an invaluable experience that later students as future employers can effectively use [13].

This paper will explore opportunities to develop a virtual team management model in smart environment development based on the comprehensive SAFe 5.0 scaling framework, as well as the DevOps part of the Agile Product Delivery competency in SAFe [14]. The model will rely on the principles and core competencies underlying the SAFe framework. It is assumed that DevOps, as part of the Agile Product Delivery competence in SAFe, meets the needs of a smart environment and is adequate for managing virtual teams. The model should explore potential strategies regarding the formation and use of virtual teams, propose and discuss the development of a virtual team management model in the development of smart environments that encompasses the main directions of the current research literature.

The primary goal of the research is to analyze the possibilities of applying the DevOps approach in the agile framework of SAFe for organizing the work of virtual teams in a smart environment, as well as defining a strategy for developing and adapting an appropriate model of managing virtual teams in a smart environment.

II. METHODOLOGY

A. Modeling of virtual team management system in the development of smart environments

Creating and maintaining a virtual team is not easy. Virtual teams are formed concerning the existing organizational structure, they are multidisciplinary, and to be successful, they are composed of professionals with complementary competencies that are considered suitable and imply opportunities for the development of smart environments.

Research to date has noted four implications that affect the aforementioned execution of collaborative tasks in virtual teams:

- Assistance in creating a common idea and standards in work,
- Facilitating communication,
- Ensuring a mechanism for transparency of work and
- Designing technology that is easy to use.

Understanding all of the above is crucial for analyzing, developing, and using all the resources necessary to support virtual teams, and finding an adequate solution to build and implement virtual team management models [15].

B. Modeling Architectures

The idea is to develop the infrastructure of a virtual team management model in the development of smart environments. The proposed model includes the following components (Figure 1):

1) Virtual team collaboration system: Database, User data management, Data exchange services, Security and data protection.

2) Smart environment development systems: Cloud database, IoT device platform (hardware and software components), Technologies for the development of IoT devices.

3) Management systems: SAFe for managing the development of smart environments, DevOps, Models for monitoring and evaluating the work of virtual teams.

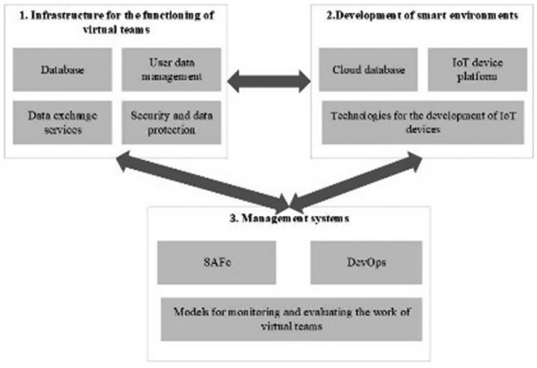

Fig. 1. Infrastructure structure of virtual team management models in the development of smart environments

C. Organization modeling for the implementation of the SAFe framework and the implementation of the DevOps approach

The organization of the management model of virtual teams in the development environment is designed to use the principles and values of the SAFe agile framework and the process of creating IoT as an example of the development environment is based on the DevOps approach,

The scheme of the proposed organization is shown in Figure 2:

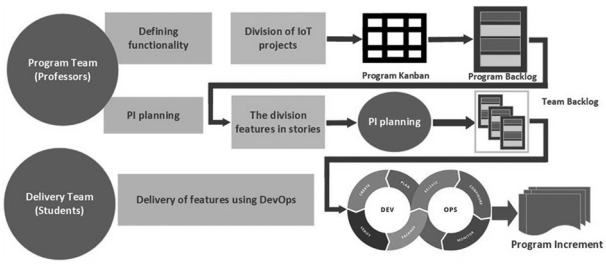

Fig. 2. Application of SAFe framework and implementation of DevOps approach [16]

D. Modeling of software architecture for evaluation and monitoring of the work of virtual teams

For the proposed model the idea is to compile the infrastructure of the system for monitoring and evaluation of projects with the help of tools based on open-source software, ie. open-source tools. Every tool within the system has a role to play. The following will be used to set up such infrastructure:

- Moodle
- Mattermost
- BigBlueButton
- OpenProject
- GitHub

Such a set model creates a comprehensive database that is suitable for the analysis of the work of virtual teams. It is planned that the evaluation will be performed using the analysis of social networks, SNA.

E. Implementation and theoretical implications

The research was conducted at the Department of E-business of the Faculty of Organizational Sciences.

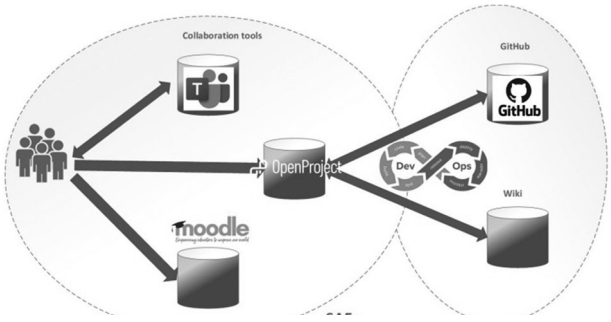

Fig. 3. Model of organizing and controlling a large number of IoT projects based on working in virtual teams

The study was designed so that the use of the e-learning model based on work in virtual teams, organizes and controls a large number of IoT projects (Figure 3).

The SAFe framework and the DevOps approach were used, and it was first adapted to the needs of the educational environment. The biggest challenge was organizing the work of students in virtual teams. The research was conducted with undergraduate students in two subjects: Internet of Intelligent Devices and Risk Management in e-business. Within both courses, students had lectures and exercises on agile methodologies: SAFe and Scrum, as well as on the OpenProject project monitoring tool. Students who attended Risk Management in e-business were given the task of managing IoT projects and had the role of SAFe Scrum master. IoT teams were composed of students who shared the roles of programmer, designer, and tester. Each team had 3 to 5 members. The professors monitored and controlled the entire work of the students [17].

Product Owners (professors) created a list of IoT projects and a list of clearly defined functions that each virtual team had to implement (Product Backlog). Teams were formed, and each was assigned a project. Students organized themselves under agile principles. The task of the SAFe Scrum Master was to provide the development team with all support and assistance to ensure that the team works by the requirements of the assigned project [18]. Team members used the DevOps approach in the development of the IoT project. Code versions are stored on GitHub and documentation on the Wiki. All team members, SAFe Scrum master, as well as Product Owners, used these tools through the OpenProject platform.

The results of the analysis of the implementation of the virtual team management model in the development of smart environments, which contains the above components, should provide answers to the following questions:

- Is it possible to develop and implement a model for the development and evaluation of infrastructure for communication and collaboration of virtual teams using tools based on open-source software?
- Is it possible to improve the performance of virtual teams?
- Is it possible to measure the performance indicators of virtual teams?

The basic idea of the planned experiment is to define a set of continuously measurable characteristics in which each factor will be varied systematically. The aim is to understand the interrelationship of the above variable predictions and outcomes and their impact on teamwork to devise a comprehensive virtual team management model in the development of smart environments that will contribute to the quality of the final solution and project effectiveness.

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The Knowledge Evaluation System in Function of Achieving Competences

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Abstract — In the paper, a proposal for a model for career monitoring through schooling and employment is presented. The system is presented and the application that enables the monitoring and development of human competences is developed.

Keywords — knowledge, evaluation, competences, blockchain technology, monitoring

I. INTRODUCTION

All the listed information about the acquired education, skills and the improvement of competences that different people enter for one person should be available later so that other users could access them. Employers would benefit from being able to have credible information about potential candidates' competences, given the fact that the application of blockchain technology enables the indisputability of the existing data.

Some of the existing systems, such as LinkedIn [1], offer similar possibilities. This paper also contributes in that a blockchain-technology-based system is developed in order to ensure entered information credibility.

This knowledge evaluation system is in function of achieving competences.

The developed application will also be used as an evaluation means. The application will implement and prove the idea and show the efficiency of the proposed system. Blockchain technology application is essentially intended to provide us with undeniable data entered into a database.

In addition to the undeniability of information, it is also very important to consider the already existing educational system that on its part is already facing a problem of assessing students and teachers, because the same assessment made in different educational institutions does not represent the same quality of knowledge.

II. APPLICATION BASIC FUNCTIONALITIES OVERVIEW

The application whose use would enable monitoring and development of human competences, was created.

The application homepage is shown in Figure 1.

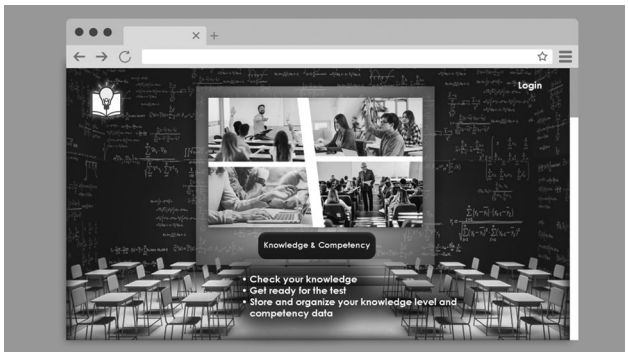

Fig 1. The application homepage

By registering him-/herself, the user obtains a unique GUID (Globally Unique Identifier).

The registered user has the opportunity to record his/her education, the success made on tests, the information about his/her employment through the application. The registered user's card contains the user's name and surname and GUID as the mandatory fields.

There is also information about:

- the schools he/she attended and the success achieved;
- the tests done in accredited institutions, the field in which they were done, and the success achieved on them;

- the courses he/she attended;
- his/her employment, stating the date of the engagement and a possible comment made by the employer.

The registered user has the opportunity to do a test in an accredited institution and to have the achieved test results automatically entered into his/her card.

In case the same test is repeated several times, all the results and number of such exams, the test date and the success achieved on it are stored in the card.

There is a list of courses, including the name of the lecturer and the educational institution. Lecturers and educational institutions have their own GUID.

For each lecturer, the following information should be defined:

- his/her name and surname and GUID;
- the institutions where he/she works or which he/she represents.

For each educational institution, the following information should be defined:

- the institution's name and GUID;
- the country (the country's name and GUID);
- the city (the city's name and GUID).

III. CONCLUSION

The Blockchain has been widely adopted in many fields, e.g., finance, energy, and medical treatment, thanks to its excellence in decentralization, openness, autonomy, tamper-proofing, and anonymity [3].

Sometimes, the e-files of a student are missing or not backed up, and the file data are not shared timely between schools or between his/her school and employer. [2]

The proposed solution and the implemented application enable an authoritative evaluation of candidates, lecturers and educational institutions, which increases the accuracy of data about the acquired knowledge, the quality of lecturers, and the quality of educational institutions at the same time. The data obtained based on the proposed solution and by applying blockchain technology are a credible and undeniable source of competences and offer great benefits to employers.

Information technologies enable decentralization, data changing prevention, digital signing, a public and independent check, and transparency/privacy control, by which different kinds of abuse are prevented, and the quick availability of content, cooperation and measuring the influence are enabled. [4]

The application of the blockchain technology to data decentralization and unchangeability, the application of cryptographic solutions aimed at defining and limiting data access control, i.e. data transparency and privacy, digital signing and digital certificates aiming to exclusively create accounts under the real identity and undeniability with the purpose of gaining an insight into the reputation of a participant in this system are possible. [5]

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Improving engineering research quality in Liby- an higher education institutions and their role in closing the digital divide

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Abstract— This report attempts to uncover the elements that enable Alfateh University to bridge the digital gap and improve the quality of engineering research through successful ICT deployment. The authors investigate the worldwide digital divide, focusing on the inequalities in information technology between developed and developing nations (including Libya), as well as overall rates of social and technical growth. Also, look at the connection between the digital gap and HE instruction, as well as the present state of the digital gap in Libya. It is self-evident that a successful ICT adoption should begin with a thorough grasp of particular faculty demands. The relevance of implementing electronic education at Libyan institutions, as well as the difficulties and solutions to ICT adoption, is then thoroughly investigated. Faculty members should be included at every phase of the design and implementation of cutting-edge technology, according to stakeholders.

This article examines the elements that influence staff members from Alfateh University's Engineering Faculty's use of the Internet. The following research issues are addressed via a questionnaire:

a. What are the internet usage tendencies among faculty members?

a. What are the major reasons for utilizing the internet?

b. What impact does the internet have on research and education?

Keywords— Electronic education; internet; user acceptability; technology transfer; ICT gap; digital divide Keywords: electronic education; internet; user acceptability; technology transfer; ICT gap; digital divide

I. INTRODUCTION

According to the findings of Internet usage data for Africa given by Miniwatts Marketing Group (2011), 5.7 percent of users in Africa and 5.4 percent of users in Libya were subscribers.

In Libya, Internet subscriptions are frequently utilized by many members of a household, cybercafé customers, and library visitors.

Relative poverty, poor quality Internet services owing to infrastructure limitations, insufficient Internet bandwidth, inconsistent energy, and antiquated end-users are the primary barriers to Internet adoption.

These issues impose significant constraints and difficulties on African users, as well as Libyans. Libyans gained access to the internet for the first time towards the end of last year. It was first released in 1998, but it wasn't generally available until early 2000. Internet penetration remains modest, at roughly 3.8 percent, with a 5.4 percent increase in 2011 (see Table 1).

Internet cafés are the most common way for users to connect. Libya's telecommunications infrastructure is regulated and operated by the state-owned General Post and Telecommunications Company (GPTC), which also owns and runs the country's principal Internet service provider. Libya Telecom and Technology (LTT) provides dial-up, DSL, broadband, and satellite Internet services. LTT has a monopoly on the country's international Internet gateway, therefore at least seven other firms have licenses but are functionally subservient to LTT. In October 2006, the Libyan government secured a deal with One Laptop per Child, a non-profit organization based in the United States, to build a low-cost educational laptop computer with the objective of providing one to every Libyan schoolchild by June 2008. This expected to be a huge increase to the availability of information communications technology (ICT) in the country, which had just 130,000 computers in 2002.

This was expected to have a significant impact on the availability of information communications technology (ICT) and the Internet. Libya has one of the greatest budgetary surpluses and one of the lowest government debt levels in the world, thanks to the current oil boom. Libya has begun an economic reform process, and the list of issues to be addressed is vast, notably the country's low GDP.

use of cutting-edge technology to raise the overall level and quality of education

Table 1 depicts the rise of Internet usage in Libya and neighboring countries.

It is impossible to discuss the Internet in Libya and neighboring countries without taking into account the condition of its applications, such as the number of Internet service providers (ISPs) and the cost of Internet access.

TABLE (1): THE GROWTH OF INTERNET USAGE IN LIBYA AND THE ADJACENT COUNTRIES 2011.(www.cia.gov.)

Countries	Population (2009)	Internet users Dec/2000	Internet Users, Latest Data (2009)	Population penetration	User Growth (2000-2011)
Libya	6,324,357	50,000	353,900	5.4 %	3,44%
Tunisia	10,629,18	100,00	3,600,000	33.9 %	3,50 %
Algeria	34,994,93	50,000	4,700,000	13.4 %	9,30 %
Egypt	82,079,6	450,00	20,136,00	24.5 %	4,37%

In Libya, the LTT monopoly boosts the cost of an Internet connection and, to some extent, exacerbates service degradation. For political reasons, several Arab countries create monopolies in the ISP sector by blocking new enterprises from entering the market through measures such as license control. Another reason for the high cost of Internet access and slow connection speeds in Arab nations is that Internet service providers are not permitted to operate their own international gateways.

Table 2 shows the number of internet providers in each country.

TABLE (2): INTERNET SERVICE PROVIDERS IN COUNTRIES NEAR LIBYA (Elzawi, 2008).

Country	Number of ISPs	Example of ISP
Libya	1	Libya Net (www.libyanet.net)
Tunisia	5	Global Net (www.gnet.tn)
Algeria	11	Cerist (www.cerist.dz)
Egypt	38	Link Egypt (www.link.com.eg)

A. Literature review:

According to Hamdy (2007), numerous metrics may be used to estimate the digital gap across nations on a worldwide basis. According to Hamad (2006), most research initiatives at Libyan institutions are designed to meet academic criteria (student certifications, career promotions, and so on), rather than societal demands.

The findings of the Libyan business executive survey/ global competitiveness report (LBES/GCR) are presented by Porter and Yergin (2006).

In terms of university-industry research partnership, Libya is ranked 97th out of 111 nations. Innovative approaches for the development and use of material, as well as the development of knowledge-based products, might improve the use of research operations (such as software). Increased Internet use will aid in the development of transdisciplinary researchers and entrepreneurs, as well as the rise of alternate approaches to digital copyright. Porter and Yergin (2006) propose a number of research issues to address in the coming five years:

- What new academic and scientific journal publication formats, as well as alternative IP licensing systems (such as creative commons), are best fit for African development and Libyan development?
- What effect will new Digital Rights Management technologies have on digital material access in Libyan universities?

Digital Divide of ICT in Libyan Education:

Libyan national ICT policy for education aims to provide access to ICT tools and build a

Infrastructure that is strong. It also promotes research and development to ensure the supply of appropriate learning. Human resource development is one of the primary objectives of the national ICT policy for education, and investing in human resources is a significant aspect in achieving the national ICT strategy's aims and objectives. UNDP and UNESCO collaborate with Libyan government entities to ensure that the ICT policy is implemented properly and on sch This assistance also welcomes the international community and encourages investment in Libya. Libya has had to deal with a lot of obstacles and hurdles. As a result, the implementation of the ICT policy, as well as access to ICT tools and the implementation of the national ICT strategy and development initiatives in several fields, is still in its early stages. The causes of the digital gap amongst researchers in member academic universities include (Table 3), the number of researchers (per million) from 1990 to 2005, and the UNDP's Human Development Report 2007/2008. UNDP. Furthermore, there is a critical lack of ICT-qualified and trained instructors, who are required to integrate technology into classrooms and educate a new generation of technically proficient pupils (Hamdy, 2007).

TABLE (3): NUMBER OF RESEARCHERS (PER MILLION PEOPLE) 1990-2005. (source: human development report 2007/2008 (undp).

No	Country	Researchers
1	Libya	361
2	Tunisia	1013
3	Algeria	-
4	Egypt	493

The Digital Divide has long been associated with a lack of physical access to critical information technologies such as computers and the Internet (Gorski, 2003). The Libyan digital gap exists, and it has a detrimental impact on the group's capacity to utilise information technology. Geographic, infrastructure, and education constraints, as well

as a history of restrictively traditional cultural beliefs, hinder ICT availability in Libya. This procedure has an impact on Libyan member universities' experience and progress, which in turn has an impact on students. This general issue manifests itself in two ways: inadequate research on Engineering Faculty members and an understanding of these universities' viewpoints in the context of the digital divide.

Support, on the other hand, research into new models for content generation and consumption, as well as the creation of knowledge-based goods like software. It will also aid the advancement of researchers in this transdisciplinary field, particularly academics' interests, as well as entrepreneurs' efforts to promote the emergence of alternate methods to digital copyright.

1. What innovative formats for publishing academic and scientific publications, as well as alternative IP licensing schemes (such as creative commons), are most fit for African Libya, as well?

2. What effect will new Digital Rights Management technologies have on digital content access? And where does Libya stand in terms of development and implementation? development and Libyan development in the next five years?

B. Research methodology:

Surveys are often part of a positivist approach to research, according to Yin (2003).

There are flaws in surveys (such as low response rate, possible ambiguities in the questions).

Because of the benefits described by Remenyi et al. (1998) and Saunders et al. (2003), the use of a questionnaire is thought to be acceptable in this case:

- Low-cost research tool - vast amounts of data may be acquired quickly and easily from a big number of people;
- Easy comparisons and statistical analysis are possible with survey data generated using standardized questionnaires.

The replies are analyzed quantitatively and qualitatively, with questions of reliability, validity, bias, and triangulation taken into account.

C. Findings:

- The findings show that there is a digital divide, but they also show that digital content has aided in bridging the significant academic information gap. The purpose of the survey was to get feedback on the final results (Elzawi, 2008). The pilot study provided excellent experience in doing academic research on the internet, contacting and connecting with respondents, and explaining the survey's aim. The following are the key outcomes of this research:
- Making any changes or modifications that are considered necessary.
- Excluding non-academic engineering faculty members from the final poll, focusing on faculty members. The postal survey approach was chosen to meet the study's objectives as well as the necessity for a high sample size for data processing.
- The underlying conclusion was that the respondents' usage of the Internet was influenced by three key factors: employment needs, self-perception, and technological availability.
- However, there were complexities within these three pretty evident features that provided food for contemplation.

The analysis is provided here in a building block style to highlight the progression of the findings, beginning with each of the primary questions covered in the research.

D. Usage of IT Strategy:

To discover whether the Faculties should have an IT strategy independent of University IT strategy. Table 4 shows that 31.25 % of respondents agreed with separate IT strategies while the majority were in favour of having similar IT strategies at Faculty and University levels.

TABLE (4): THE FACULTY IT STRATEGY SHOULD BE INDEPENDENT FROM UNIVERSITY IT STRATEGY.

CASE	Frequency	Percent
Yes	10	31.25%
No	22	69.75%

E. Type of the network:

Table 5 shows the responses to the questions on the type of computer network in faculty.

TABLE (5): TYPES OF THE NETWORKS.

SASE	Frequency	Percent
Only one computer/PC	2	6.25%
Currently in process of networking	4	12.50%
No need for networking	0	0.00
Networking is too expensive	12	37.50%
Networking is unreliable	6	18.75%
Need to improve understanding	8	25.00%
Other	0	0.00

These comments imply that the competent authorities need to provide management assistance, a new strategy, and financial assistance. Networking is just as important as computers and PCs.

F. Usage of Internet:

The replies to the question on how often people use the internet and its apps are shown in Table 6. Apparently, one-quarter of the crew has never used the internet, while slightly over a third utilizes it often.

The distinction here is referring to differences in functionary office viewpoints for the (intranet and internet) to the degree that search serving is required. In Libya, the number of internet users per 100 population in 2010 was 14, compared to 10.80 in 2009 (Source: ITUestimate).

TABLE (6): USAGE OF THE INTERNET. (SOURCE. ITUESTIMATE)

Case (hours used/week)	Frequency	Percent
0—2	6	18.75 %
2—5	17	53.125%
6 –10	7	21.875%
>10	2	6.25%

The distinction here is referring to differences in functionary office viewpoints for the (intranet and internet) to the degree that search serving is required. In Libya, the number of internet users per 100 population in 2010 was 14, compared to 10.80 in 2009 (Source: ITUestimate).

G. Weekly use of Internet.

Table 7 displays the respondents' weekly internet usage in hours. Nearly a quarter of the respondents spend fewer than two hours each week on the internet for academic purposes. Only a quarter of people spend more than an hour a day on the internet. Only two respondents (6.25 percent) said they spend at least 10 hours a week on the Internet. In the study, there was no discernible gender difference in the amount of time spent on the Internet. The belief that people with science credentials spend more time on the Internet is based on common sense, yet the research contradicts this.

Table 7 illustrates that reduced income does not prevent members from surfing the Internet; they spend more than 10 hours a week online. Displays the amount of time spent on the Internet by subject field.

TABLE (7): RESPONDENTS WEEKLY USE OF THE INTERNET

Case	Frequency	Percent
Not used and no plans to use	0	0.00
Not used but plan within next 6 months	8	25.00%
Not used but considering it for the long term	0	0.00
Rarely	4	12.50%
Occasionally	2	6.25%
Quite often	6	18.75%
Frequently	12	37.50%

H. Barriers those are most likely to keep staff from using the Internet.

To avoid future issues with using the internet for research, it is vital to identify any potential barriers and take steps to eliminate them. The responders to this question identified fifteen issues that may prevent them from accessing the internet for academic research:

1- Lack of Internet access. The lack of Internet connectivity at their institutions was cited by twenty (62.5%) participants as the reason for academics not using it.

2- Lack of access of specialized online databases. Seventeen people (53.13 percent) said that they can't use the Internet for research since they don't have access to specialist online databases. In addition, members of Libyan universities are being used for study with the website's researcher.

(For example, science direct/Emerald's/Cambridge Journals online) for every subscription before to 1998.

3- Low speed of connection. Twenty-six percent (62.5%) of respondents said that slow internet connectivity was preventing them from utilizing the internet.

4- Quality of the information source. (Information strategy, diversity and availability of information, information convenience, information quality, unfiltered information, speed of obtaining information, newness of information, and capacity to update).

5- System availability. The lack of computer access in their institution was noted by eighteen (56.25 percent) as a hindrance to their usage of the Internet.

6- Lack of educational institutions' encouragement and incentives. Fourteen (43.75%) members say that their institution's lack of encouragement or incentives is preventing them from using the internet.

7- Lack of skill in the English language. One of the biggest reasons for not accessing the internet, according to twelve (37.5 percent) members, is a lack of English proficiency.

8- Field of study. Thirteen members (40.63 percent) said they could access knowledge sources in their field of study without using the internet.

9- Unfiltered information. Eight (25%) participants said that unfiltered government information occasionally prohibited them from utilizing the internet.

10- Clarity and ease of use. Thirteen members (40.63 percent) said the internet was a confusing and ambiguous source of information.

11- Technical difficulties. Thirteen members (40.63 percent) stated that technical issues are preventing them from using the internet.

12- Lack of interest. Twelve (37.5%) respondents stated that they are unable to use the internet because they lack adequate interest in learning about it.

13- Social factors. Eleven (34.48%) of the participants stated that social constraints restrict them from utilizing the internet. (Because the internet is viewed by a big percentage of the society as a source of illegal material, sev-

eral schools and institutions impose internet usage limits.)

14- High cost of Internet connections. One-seventh of respondents (21.88 percent) said that the cost of an internet connection was one of the factors preventing them from accessing the internet.

15- Lack of training, support computer and Internet skills. Sixteen (50%) members stated that they are unable to use the internet due to a lack of computer and internet skills and training.

I. Results and future recommendations of the study:

There are considerable discrepancies in Libyan academics' assessments on the possible use of the Internet for study and the expected advantages of having access to the Internet. The report offers various suggestions for overcoming some academic staff members' aversion to adopting ICT tools broadly and executing the national ICT strategy.

The study's main finding is that there are considerable disparities in Libyan academics' beliefs about the possible use of the Internet for research and the expected advantages of Internet access. Staff who are focused on new information, such as engineering faculty members, are less likely to regard the Internet as a threat and more likely to regard it as a great instrument for work development. What was surprising was that none of the respondents highlighted the Internet as a tool to get over their culture's limits.

While some of the surveys acknowledged using the Internet to collaborate with coworkers, none expressly noted being able to work extra hours. Because the majority of the materials on the Internet are in English, it is obvious that skill in the English language is required for efficient Internet use. While most respondents recognize the need to enhance their computer literacy and Internet capabilities, many respondents also stated that they required additional Arabic websites as they realized they needed to develop their proficiency in the English language. This abstraction points to a promising area for further investigation. The abstraction should, of course, be checked for validity. Furthermore, the interactions between the nodes and their levels or values may be investigated in order to build a comprehensive body of information on Internet access.

II. CONCLUSION

Faculty use the Internet for instructional reasons rather than communication and research, according to our results. When compared to teaching or research, previous studies assessing faculty Internet usage in the local setting have consistently cited email and communication as the primary motivations for their online activity. When Internet technologies are integrated into the instructional process, students are more likely to use them. This might be a sign that previous research has shown that Internet adoption is still in its early stages. As materials become more available to professors at higher education institutions, the Internet is being used to a greater level. The study found no link between accessible university resources and Internet use throughout our analysis of the hypotheses. This result is consistent with previous research, which found that organizational characteristics had no impact on faculty Internet usage.

The use of research in higher education in Libya, undertaken across the world, explains low adoption rates by blaming teachers; either they are trapped in old teaching techniques and labeled as resistors, or they have unfavorable views toward technology and are labeled as resistors. These unfair explanations are based on a misunderstanding of the various faculties' demands. Understanding individual faculty demands should be the emphasis of the problem of expanding the advantages derived through Internet technology. Faculty members should be included at every phase of the design and implementation of cutting-edge technology, according to stakeholders. If they are involved from the beginning, their demands will be satisfied, allowing for increasing levels of efficient integration of Internet technologies that fit their specific requirements.

This research provides an in-depth overview of Internet usage issues as well as engineering faculty attitudes about the Internet. Technology-based solutions are unlikely to be the panacea for all educational challenges. It is widely acknowledged that technological solutions do not enhance teaching techniques sufficiently. As a result, the emphasis should be on selecting the appropriate technological solution for the educational setting and the faculty members involved. The being element should always be addressed as a starting point when deciding how technology, notably the Internet, might be used to enhance education and research endeavors. Faculty members should be given the opportunity to participate in decision-making on the proper use of technology in their respective academic areas.

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