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CONTENT/SADRŽAJ

A Message from the Editor-in-Chief

Serbian Journal of Engineering Management is a scientific journal, published by School of Engineering Management and Society of Engineering Management of Serbia. The Journal is cathegorized by the Ministry of education, science and technological development of the Republic of Serbia. From 2020 the Journal is accepted for indexing in EBSCO databases. This international Journal is dedicated to the wide scope of themes in engineering management and industrial engineering and is published semiannualy. The papers are presented in English, Serbian and other former Yugoslavian languages.

Themes included in the journal are: Engineering management, Industrial engineering, Project management, Strategic Management, Logistics, Operations management, Production systems management, Quality control, Quality management, Entrepreneurship, Risk management, Human resources management, Financial management, Information systems, High technologies management, Environmental management, Maintenance management, Creative industries management, Security management, and Marketing.

Editorial board is consisted of distinguished academics from various countries dedicated to establishing the highest academic standards and promoting engineering management principles in Serbia.

Information on the journal in English and Serbian can be found at the journal web page: https://fim.edu.rs/en/serbian-journal-of-engineering-management/.

Prof. Dr. Vladimir Tomašević, FRSA

Reč urednika

Serbian Journal of Engineering Management je naučno-stručni časopis, koji izdaje Fakultet za inženjerski menadžment i Društvo inženjerskog menadžmenta Srbije. Časopis je kategorisan od strane Ministarstva prosvete, nauke i tehnološkog razvoja. Časopis je takođe od 2020. godine prihvaćen za indeksiranje u EBSCO bazama. Ovaj međunarodni časopis je posvećen temama inženjerskog menadžmenta i industrijskog inženjerstva i izlazi dva puta godišnje (u januaru i julu). Zastupljeni jezici su engleski, srpski, kao i jezici država bivše SFRJ.

Teme zastupljene u časopisu su: inženjerski menadžment, industrijsko inženjerstvo, upravljanje projektima, strategijski menadžment, logistika, menadžment operacija, menadžment proizvodnih sistema, kontrola kvaliteta, upravljanje kvalitetom, preduzetništvo, upravljanje rizikom, upravljanje ljudskim resursima, finansijski menadžment, informacioni sistemi, menadžment u visokotehnološkim industrijama, menadžment životne sredine, menadžment održavanja, menadžment kreativnih industrija, bezbednosni menadžment i marketing.

Uredništvo časopisa čine istaknuti naučnici iz različitih zemalja sveta koji su posvećeni postavljanju visokog akademskog standarda i promocije principa inženjerskog menadžmenta u Srbiji.

Informacije o časopisu i poziv za autore, na srpskom i engleskom jeziku, nalaze se na web stranici časopisa: https://fim.edu.rs/istrazivanje-i-saradnja/naucno-strucni-casopis/.

Prof. dr Vladimir Tomašević, FRSA

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Važni faktori pri oživljavanju industrije biodizela u Srbiji - prilika ili zamka?

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Apstrakt: Ukoliko Srbija nastavi sa evrointegracijama, politike Evropske unije vezane za korišćenje biogoriva će morati da se implementiraju. Direktiva 2009/28 / EZ podrazumeva udeo od 10% biogoriva u transportnom gorivu na tržištu, do kraja 2020. godine. Iako je proizvodnja i korišćenje biodizela u skladu sa praksom razvijenih zemalja, u Srbiji se još uvek ne proizvode niti troše značajne količine ovog goriva. Na osnovu sprovedene analize ustanovljeno je da Srbija ima potencijal da proizvede biodizel preradom domaćih sirovina. Logičan korak je dakle, uspostavljanje domaće proizvodnje biodizela. Ovaj rad predstavlja i diskutuje važne faktore za proizvođače biodizela i/ili investitore, u pokušaju da umanji poslovne rizike ili da pruži polaznu tačku u traženju načina da se ovi faktori pretvore u dobitke. Za razvrstavanje tih faktora korišćen je PESTEL okvir, često korišćeni alat pri donošenju strateških odluka.

Ključne reči: industrija biodizela u Srbiji; podsticaji za biodizel, domaće sirovine za biodizel; PESTEL analiza.

Important factors in the revival of the biodiesel industry in Serbia - progress or pitfall?

Abstract: If Serbia is to continue with European integration, European policies related to the use of biofuels will have to be implemented. Directive 2009/28/EC implies 10% of biofuels in transport fuel by the end of 2020. Although the production and use of biodiesel is in line with the practice of developed countries, Serbia does not produce nor use significant quantities of this fuel. Based on the conducted analysis, it was established that Serbia has the potential to produce biodiesel by processing its domestic raw materials. The logical step, then, is to re-establish the domestic biodiesel industry. This paper presents and discuss important factors for biodiesel producers or / and investors, in an attempt to mitigate business risks or to provide a starting point in a search for ways to turn these factors into gains. The PESTLE framework was used for classification of these factors, on account of its common use in making strategic decisions.

Keywords: biodiesel industry in Serbia; biodiesel incentives; domestic biodiesel feedstock; PESTLE analysis.

1. Introduction

The fight against pollution makes diesel vehicles almost certainly futureless in major European cities. Over the next decade, according to Bloomberg (2019), 24 European cities with a total population of 62 million people will ban diesel vehicles, and 13 of those cities will ban all internal combustion cars by 2030. This trend leads to a decreased price of used diesel vehicles on the market. This, on the other hand, enables the citizens of Serbia, a country with a far lower economy than the European average and less strict regulations on pollution, to get used diesel vehicles cheaper. In addition to the fact that diesel has been already the most dominant fuel in transport sector in Serbia, the mentioned trend additionally contributes to the increase in the overall diesel consumption. In 2017, 2,466,000 tons of crude oil were imported in Serbia, while in 2018, this number increased by 7.3%, reaching a value of 2,660,100 t (Statistical Office of the Republic of Serbia, 2019). Although Serbia has the domestic petrol industry,

the amount of extracted and processed crude oil is insufficient in relation to exiting needs, mostly because it is determined by the availability of this natural resource and operational and strategic decisions of the company that have access to it. In order to decrease foreign trade deficit of Serbia, it is necessary to find other ways to reduce imports. Many countries cope with crude oil demand, while simultaneously tackling other important state matters by inducing substitutes for petroleum derived fuels in the form of various biofuels, produced domestically by biomass processing. It results in several benefits. By domestic biofuel production, demand for crude oil is reduced which further reduces foreign trade deficit (Bomb, McCormick, Deurwaarder & Kåberger, 2007). At the same time, local agrarian industry is boosted by increasing employment opportunities. Silalertruksa, Gheewala, Hünecke, & Fritsche (2012) estimated that in Thailand, production of bioethanol could generate 17-20 times more workers than gasoline production. Furthermore, energy products supply is diversified, which contributes to the country's energy security (Uría-Martínez, Leiby & Brown, 2018). Finally, it reduces the overall pollution and is believed to help in coping with the climate emergency (Korać, Mićin, & Čupić, 2019; Fivga, Speranza, Branco, Ouadi & Hornung, 2019).

Since the diesel is predominant transport fuel in Serbia, biodiesel as its substitute is expected to be predominant among biofuels. It is considered to be a non-toxic, biodegradable substitute for petroleum diesel (Fivga *et al.*, 2019). Three basic raw materials used for the production of biodiesel are lipid materials (vegetable oils or animal fats), alcohols and catalysts which accelerate the reaction between lipid materials and alcohol (Stamenkovic, Stamenkovic-Ilic, Stamenkovic, Veljkovic & Skala, 2009; Knothe, Krahl, Gerpen, 2015; Fivga *et al.*, 2019). Since the cultivation of different oilseed crops in the agrarian industry can provide significant yields of lipid raw materials, vegetable oils represent the most common feedstock for biodiesel production. According to statistical data (Statistical Office of the Republic of Serbia, 2019) and most importantly, several comprehensive studies by various authors, it has been shown (See heading 3.4.2.) that Serbia has the potential to domestically produce sufficient amounts of biodiesel feedstock that meet quality criteria (Babić, Đurišić, 2008; Đurišić-Mladenović, Kiss, Škrbić, Tomić, Mićić & Predojević, 2018; 2019a; Latinović, 2019, 2019a).

Numerous European countries have highly developed biodiesel industry, especially Germany and France. The majority of those countries also have a vibrant domestic biodiesel market. Almost or all of their supply is used to meet domestic mandate-driven demand. According to Rouhany and Montgomery (2018), "this dual role, as both producer and consumer, partially explains the limited international trade in biodiesel feedstock". On the other hand, various actions by the Government of Serbia have led to the almost complete shutdown of the domestic biodiesel industry (Tešić, Kiš & Janković, 2010; Latinović, 2019; 2019a) which goes against the policies of the European Union concerning the use of biofuels, specifically Directive 2009/28/EC (Directive 2009/28/EC) that implies 10 % of biofuels in transport fuel by the end of 2020.

As Serbia has the potential to produce biodiesel by processing domestic biodiesel feedstock, the logical step is to re-establish the domestic biodiesel industry. For this to happen, it is necessary to involve potential investors and/or producers. This paper identifies and discusses important factors and potential hindrances in biodiesel industry investment projects in order to minimize business risks and help future investors and/or producers to turn these factors into gains.

2. Methods

This manuscript is based on the identification, analysis and critical review of the main factors that may affect biodiesel production, as well as the risks that potential producers and/or investors in biodiesel investment projects in Serbia may face. On the account of its common use in strategic decisions making, as is the case with the initiation of biodiesel production, PESTLE framework was used for their convenient classification. Another reason for choosing this framework was that the biodiesel production was recognized as a complex system, linked to the sustainability assessment dimension (economic, social, environmental, political and technological) (Bautista, Espinoza, Narvaez, Camargo, Morel, 2019). Furthermore, an overview of the potential of Serbia for the production of domestic lipid biodiesel feedstock was provided (See heading 3.4). This potential was determined on the basis of the current and official data of the Statistical Office of the Republic of Serbia as well as on the comprehensive and thorough study conducted by Đurišić-Mladenović *et al.* (2018).

3. Results and discussion

A critical review of important factors for the development of the domestic biodiesel industry is given through the PESTLE analysis framework. It is a strategic tool that provides a framework for analyzing the external environment of an organization. It identifies six key areas that should be considered when attempting to identify external influences that could cause gains or represent threats (Cadle, Paul & Turner, 2018). These areas that constitute the PESTLE acronym, are: political, economic, socio-cultural, technological, legal and environmental.

3.1. Political factors

In Serbia, Biodiesel became an interesting fuel couple decades ago, specifically during the sanctions against Serbia and Montenegro, although this period was characterized by primitive production with small overall capacities (Babić. Đurišić, 2008). In the year 2008, European Union and the Republic of Serbia signed the Stabilization and Association Agreement. It entered into force September 1th, 2013 (Ministry of foreign affairs of the Republic of Serbia, 2019). This agreement was a confirmation of Serbia's perspective toward membership in European Union, but it was a two-way street. In addition to the assistance of the European Union, Serbia needed to accept certain ethical, economic, environmental, legal and other norms of the European Union before it would become its full member. Among other things, this included certain obligations regarding the increase in the share of renewable energy sources in the total energy balance. Even before signing this agreement, in 2006, Serbia accepted the obligation to submit a plan for the implementation of the Directive 2003/30/EC to the European Commission. This directive implied 5.75% share of biofuels, such as biodiesel and bioethanol, in petroleum fuels, by the end of 2010 (Directive 2003/30/EC). This should have been a step towards a more serious approach to biofuel production at the state level. Investors indeed believed that this was a reliable indicator for biofuel product placement, thus it has led to several significant investments in biodiesel production (Latinović, 2019b). The most significant one was Victoriaoil biodiesel plant in Šid with installed capacity of 100,000 tons of biodiesel per year.

Although such incentives might seem like a “green light” for potential biodiesel producers, they can also represent a trap, if they get omitted at some point. Olteanu (2009) examined trends and historical data on biodiesel industry in Germany and found out that there were numerous biodiesel investment closures and considerable reduction both in the number of producers and production capacities. This was due to volatility of crude oil and feedstock prices, as well as decline in government aids and gradual increase in the excise tax burden on German biofuels. Non-relatedly, but similar event has happened in Serbia, too. Contrary to the expectations, instead of the state incentives and aid, Serbian government has introduced high excise taxes on biofuels along with “Regulation on the quality monitoring of oil” and biofuels and “Regulation on the marking of oil derivatives” in 2015. These steps have led to the almost a complete shutdown of the Serbian biodiesel industry (Tešić, Kiss, Janković, 2010; Latinović, 2019). Victoriaoil stated that in 2007 it produced only 27,000 tons of biodiesel. Luckily, their technology allowed them to conserve the biodiesel plant and switch to the production of edible oil.

In 2013, a legal framework that would force oil companies to blend petroleum products with biofuels with the state control was announced once again, but the adequate decree has not been issued until today. However, in 2015, The Energy Development Strategy of the Republic of Serbia until 2025 was adopted, although it was not legally binding document.

Meanwhile, Directive 2003/30 has been replaced by Directive 2009/28/EC. New directive implies 10 % of biofuels in transport fuel by the end of 2020 (Directive 2009/28/EZ). Regarding the Serbia's path towards European integration, it is expected that mandatory use and production of biofuels will be a current topic in the near future.

3.1.1. The Energy Development Strategy of the Republic of Serbia

On December 4th, 2015, the National Assembly of the Republic of Serbia adopted the Energy Development Strategy of the Republic of Serbia until 2025 with projections until 2030. (The Energy Development Strategy, 2015). The strategy signalizes points listed below as priorities.

- Ensuring energy security, reducing import dependence, securing energy reserves of oil and natural gas and building new electricity capacities.

- The development of the energy market within the EU energy market in which the Republic of Serbia is integrated with the signing of the Treaty establishing the Energy Community, which contributes to the economic development and stability of the country and the construction of modernization of the electricity and gas infrastructure.
- Establishing a sustainable energy sector through the application of energy efficiency measures, the use of renewable energy sources and the application of environmental protection standards and the reduction of adverse impacts on climate.

Mitigation of import dependence on oil and encouragement of renewable energy source usage are key factors regarding the biodiesel industry.

While national biodiesel policy implementation in major producing countries such as USA, Brazil and Germany (Su, Zhang & Su, 2015) seems to address a wide range of interests across several objectives, according to Rouhany and Montgomery (2018), the situation is actually reversed. They stated that: „In reality, the support of specific sectors and interests, such as farm lobbies and energy groups, often determines policy design and implementation ".

It remains to be seen how the Republic of Serbia will behave in this field in the forthcoming period, given the historical data on its unpredictable behavior and will it be able to avoid the traps that intertwine other countries.

3.1.2. Marking of oil derivatives

The Government of Serbia has adopted two regulations concerning the marking of oil derivatives. These are „Regulation on the quality monitoring of oil and biofuels " (2015) and „Regulation on the marking of oil derivatives " (2017). These regulations allow market inspection to control fuel in tanks of business entities vehicles, specifically in trucks, buses and agricultural machines. The goal is stated to be the determination of the origin of transport fuel and provision of quality products to consumers. This is an advanced technique in suppressing the black market, completely in accordance with European practice. However, the legislator did not properly approach to the protection of small agricultural producers who produce biodiesel for their own needs. Large scale producers who place their product on the fuel market would have no concerns regarding these regulations, but for small agricultural producers this represents a significant obstacle. Regulations impose that transport fuel in Serbian market must be marked with the appropriate marker at the appropriate concentration. Blending marked fuel with a self-made biodiesel would lead to diluted markers.

This means that in the case of market inspection, business entities such as small agricultural holdings, caught with "irregular" fuel would be faced to huge penalties, from 50,000 to 2,000,000 RSD. This however, is not in line with the European practice and the adopted strategy of energy development of Serbia. As long as the legislator does not pay attention and adopt regulations that support this kind of production and consumption of biodiesel, a part of agricultural waste biomass and waste frying oil remains unused on the account of inadequate legislation. Such waste represents the most suitable feedstock for biodiesel production from the environmental and economic aspect and it is believed to contribute to rural development even more (Heijman, Szabó & Veldhuizen, 2019; Rodrigues, Da Silva & Silva, 2019; Latinović, 2019a). Using those waste materials as feedstock would help solving the problem of their disposal as waste and reduce the share of the agriculture feedstock usable for food production being used for fuel production. Moreover, precisely in the area of waste recycling, the effect of a larger number of such small producers using biofuels for their own consumption is recognized as a potentially significant factor in sustainable waste management at the state level (Latinović, 2018).

3.1.3. Excise taxes

Biofuels in Serbia are subjected to the excise tax law (The law on excises, 2019). This law also prescribes the amount of the excise tax. At the time this paper was written, the excise tax on biofuels in Serbia amounted RSD 56.04 which was € 0.4571 at the middle exchange rate of the National Bank of Serbia on May 31, 2019. The imposition of taxes was justified by the frequent illegal mixing and participation of biodiesel in petroleum diesel, without the knowledge of customers. Since it was cheaper than petroleum diesel, according to state officials, the state has lost its balance.

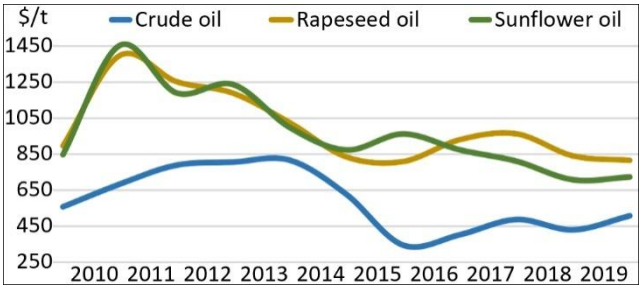
3.2. Economic factors

3.2.1. Biodiesel and petroleum prices volatility

Between 2005 and 2015, global biodiesel production experienced an increase of more than 20% per year. It resulted in a sevenfold expansion in one decade. It all happened at the same time, together with the rise in the price of petrodiesel. However, petroleum price has been in decline since 2014 (Fig. 1) and this is considered to have stimulated petrodiesel use again. The widespread use of biodiesel on voluntary level could be expected only if it were cost-competitive to fossil diesel (See heading 3.3 - "Socio-cultural factors").

Energy content of biodiesel, on the average, is lower by about 12.8% on a mass basis, and about 8.7% on the volume basis (Sinčić, 2014). In other words, for the same volume of fuel injected, engine power with biodiesel should be lower by 8.7%. This means that for the same engine performance level achieved by using one volume unit of diesel fuel, it would require 8.7 % larger volume of biodiesel fuel. Applied to the price of biodiesel, it should be about 9 % lower than the diesel price. Appreciation of this fact while forming the price of biodiesel was brought into question by the high excise tax on biofuels, imposed by the state (See heading 3.1.2.).

Figure 1: Global crude oil, rapeseed oil and sunflower oil prices per ton, from 2009-2019.

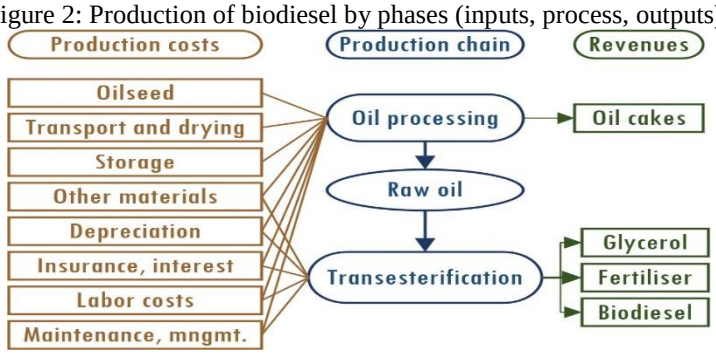


Data source: Index mundi 2019; 2019a; U.S. Energy information administration, 2019.

The sensitivity analysis of a biodiesel investment project, conducted by Kiš and Jovanović (2007) showed that such a project (Fig. 2) is most sensitive to changes in final prices of biodiesel, purchase price of lipid feedstock and petrodiesel prices (Kiš, Jovanović, 2007). Namely, it has been shown that the cost of feedstock makes up as much as 70 – 95 % of the total operating costs of a biodiesel plant (Banković-Ilić, Stamenković & Veljković, 2012). Considering pressure from rising prices of oilseeds and volatile crude oil prices, the government aid is necessary in order to make biodiesel production economically feasible (Naylor and Higgins, 2017). However, the current cost of biodiesel production depending on the current price of feedstock, used technology and operational production settings is not the part of this study.

Despite the downward pressure due to low global petrodiesel prices (Fig. 1) and policy uncertainty in some markets, biofuel production and demand continued to increase in 2016, and biodiesel further retained a dominant position in the transport bio fuel with about 4 % in the total world consumption of transport fuels (Naylor and Higgins 2017). This can be attributed to the compulsory mixing and use of biodiesel that ensures consistency in demand. Furthermore, future trend of international prices of biodiesel is expected to be in the inclination in nominal terms over the next 10 years, driven by the recovery of crude oil markets and prices of biofuel feedstock (Rouhany, Montgomery, 2018).

Figure 2: Production of biodiesel by phases (inputs, process, outputs).



Source: Kiš, Jovanović (2007).

3.2.2. Serbian biodiesel market size

In 2018, 228,900 freight vehicles, 9,980 buses, 8,979 work machines and 1,999,771 passenger cars were registered in Serbia (Statistical Office, 2019c), although the exact number of diesel passenger cars was not available. Still, the final energy consumption of transport diesel fuel in Serbia in 2017 was 1,571,130 t (Statistical Office, 2019b). If Serbia had reached the target of 10 % of biofuels in Petro fuel products, 157,113 tons of biodiesel would have been consumed that year, just in the form of transport fuel.

Although, there is a trend of ejecting diesel engines from urban areas in several European countries, it is not the case in Serbia where, on account of the economic situation, there is a significant demand for used diesel vehicles from European Union. There is no indication that this trend will be declining in the near future and diesel fuel still represents the most used fuel in transport sector.

3.3. Socio-cultural factors

The experience from leading biodiesel producing countries such as Germany and the UK showed that most consumers purchase biodiesel only if it was price competitive with petrodiesel. In Germany, the availability and price of biodiesel has allowed pure biodiesel to find its way to customers and its sales continue to grow. However, in the UK, the experience indicates that only few consumers are willing to purchase B5 at a price premium. The environmental reasons for purchasing biofuels are simply overshadowed by price and availability (Bomb, McCormick, Deurwaarder & Kåberger, 2007). These authors concluded that biodiesel, on account of price sensitivity of the market, would face difficult survival without state aids. „Consumers purchase cheap rather than green "(Bomb *et al.*, 2007).

In this respect, media coverage as a key factor in forming customer behavior (Jagodič & Vukasović, 2019) would also need to influence biofuel market in order to make customers participate voluntarily. In 2014, a comprehensive overview on media coverage of environmental issues in Serbia was conducted by Jovanović and Aćimović. They stated that independence of media on environmental issues is necessary if the level of information, development of value systems and relations to the environment is to be raised. For the Republic of Serbia this fact is of particular importance given the process of European integration. They concluded that there was an increasing range of thematic coverage on environmental issues. However, it should be noted that the manuscript reviewed the coverage of all environmental issues, not just biofuels (Jovanović, Aćimović 2014). Still, the economic situation in Serbia does not play in favor of the voluntary purchase of biodiesel. It is highly likely that from the aspect of the social status of the average Serbian citizen, production and the compulsory use of biodiesel would be an additional economic burden, rather than a benefit (Latinović, 2019a). The aptitude of Serbian society is still at a level where significant purchases of biodiesel can be expected on voluntary basis only if it was price competitive with petrodiesel.

3.4. Technological factors

3.4.1. Technological innovations in the field of lipid feedstock for biodiesel production

The quality of biodiesel is determined by the quality of lipid feedstock, the processing technology used, and the process parameters (Knothe *et al.*, 2015; Rathore *et al.* 2016). When it comes to biofuels and

feedstock generally, the four-generation division is often mentioned. The first generation of biofuels most commonly refers to biofuels produced from cultivated crops such as corn, sunflower, rapeseed, soybean, palm, etc., otherwise intended for human food (Bezergianni & Dimitriadis, 2013). Second generation biofuels are made by processing non-edible biomass with few remaining limitations related to the cost-effectiveness involved in scaling the production to a commercial level. Third generation biofuels are made of feedstock produced by microorganisms, while fourth generation biofuels are made by genetically modified microorganisms to enhance production while simultaneously removing carbon from the atmosphere (Abdullah *et al.*, 2019; Alalwan, Alminshid & Aljaafari, 2019).

Biodiesel lipid feedstock can be divided into following groups: plant oils (edible), plant oils (non-edible), used or waste edible oils, microalgae oils and animal fats (Vignesh & Barik, 2019). Beside common oilseed plants used for the production of biodiesel such as rapeseed, soybean, palm, sunflower, etc., several others were tested. Efe, Ceviz & Temur (2018) conducted a comparative study on characteristics of biodiesels obtained from common oilseed plants – soybean and sunflower, but also from canola, hazelnut and corn. The study showed that it was possible to obtain biodiesel by processing these plants and that B20 hazelnut biodiesel showed the most superior performance among all other biodiesel samples. Bolonio, García-Martínez, Ortega, Lapuerta, Rodríguez-Fernández & Canoira (2019) tested grape seed oil, potential waste in Spain and other wine producing countries, and found that it represented a promising feedstock for biodiesel production. Also, several non-edible oils such as pyrolysis oil, Calophyllum Inophyllum Linn oil, Jatropha Curcas, Madhuca Indica and Pongamia Pinnata oil were successfully tested as a biodiesel feedstock (Suresh, Jawahar, Richard 2018).

In addition to lipid feedstock obtained from agriculture, waste edible oils (WEO) can also be used for biodiesel production (Maneerung, Kawi, Dai & Wang, 2016, Tran, Kaiprommarat, Kongparakul, Reubroycharoen, Guan, Nguyen & Samart, 2016; Vignesh & Barik, 2019). It is oil generated as a waste in food production, also referred to as "waste frying oil" (WFO) or "waste cooking oil" (WCO), or as a by-product of industrial production of edible oils. The use of this type of oil has double advantage – on the one side, it represents perspective and cheap raw material for industrial biodiesel production and on the other side, in this way the problem of appearance of oil as a waste and its disposal is solved (Đurišić-Mladenović, Predojević, Škrbić, 2015). However, high free fatty acids (FFA) in waste oils represent a serious disadvantage in the process of transesterification (Sahar, Sadaf, Iqbal *et al.*, 2018). Such oils require more complex and resource demanding preparation prior to biodiesel production. Since waste oils are scattered, generated in small quantities at a stochastic pace by a large number of generators, this capillary distribution represents another logistical problem to be solved (Latinović, Jovanović, 2019).

Another type of waste suitable for biodiesel production was found to be spent coffee grounds (SCG). Atabani, Shobana, Mohammed *et al.* (2019) presented the possibility of using extracted oil from SCG for biodiesel synthesis. The produced biodiesel was then blended with Euro diesel, butanol, pentanol and hexanol to improve its density, kinematic viscosity and cold flow properties in order to satisfy specifications - required by defined standards (See heading 3.5.1.). In a similar study conducted by Kamil, Ramadan, Awad, Ibrahim, Inayat & Ma (2019), beside technological feasibility of such a feedstock, profitability of a SCG biodiesel plant was estimated at over 10,000 t/y. What also gained attention in recent years was waste tallow biodiesel. It was tested in different blends with WCO biodiesel, and was observed that it had the proper characteristics, but it was concluded that further research was needed to ensure that its use for these purposes was economically justified (Hazrat, Rasul, Khan, Ashwath & Rufford, 2019).

In recent years, great efforts have been made in attempts to use algae for the production of lipid biodiesel raw materials. In the media and literature, micro-algal biodiesel production was considered to be a promising biodiesel production method for future applications with several benefits: renewability, sustainability, clean-burning, safety and cost-effectiveness issues. However, microalgae are grown in aquatic conditions. This implies that appropriate natural conditions for their cultivation, such as natural or artificial lakes and ponds, are required. Although they can be built on land that is not otherwise intended for agriculture, it would be necessary to provide enormous amounts of water, starch, sun and carbon dioxide to make algae give a more significant yield. The lipid yield of microalgae in relation to plants currently used to obtain biodiesel was indeed, up to 100 times higher (Ljupković, 2014; Danilović *et al.*, 2014), but recent research showed that their cultivation for the purpose of biodiesel production was still neither sustainable nor economically justified (Kenny, Flynn, 2017). Researchers

are still in the search for a higher productivity production method with higher stability to be used in industrial processes (Deniz, Aslanbay, Imamoglu, 2019).

Finally, all of these alternative raw materials come with new hurdles that need to be overcome. They are either in the testing phase, scattered in small quantities or derived from plants non-native to Serbian soil. Such feedstock should be seen only as a possible supplement, where significant amounts of domestic lipid feedstock should be expected only from domestic agriculture.

3.4.2. Domestic biodiesel feedstock potential of Serbia

The republic of Serbia covers the area of 88,499 km². Around 70% of its total area is used for agricultural purposes (Pocuca, Draskovic, 2015). Table 1 shows the actual yields and coverage area of the most important oil seed plants in Serbia in 2018, which are sunflower, rapeseed and soybean. Babić and Đurišić in 2008 roughly estimated arable land considered available for the production of oilseeds in Serbia on around 600,000 hectares (Babić, Đurišić, 2008). In year 2018., these plants reached covering area of around 481,248 hectares and they gave total yield of 1,514,735 tons of grains (Statistical Office of the Republic of Serbia, 2019a). With an average yield of 3 tons per hectare (Table 1) and with 36% of oil per ton of rapeseed grain (Enguidanos *et al.*, 2002) one hectare of rapeseed in Serbia would provide enough grain for production of 1.080 kg of biodiesel. Sunflower gives yield of 40 – 42% of oil per seed and with the yield of 3.1 tons per hectare, one hectare of sunflower would ideally be sufficient for up to 1,302 kg of biodiesel. Soybean on the other hand, has the lowest oil yield from those three plants with the average oil content of 15 - 25% of oil in the seed (Sharma, Kaur, Goyal & Gill, 2011).

Table 1: Rapeseed, Sunflower and Soybean area of coverage and yield in 2018.

	Area (ha)	Yield	
		Total (t)	t/ha
Rapeseed	45,628	135,422	3.0
Sunflower	239,148	733,706	3.1
Soybean	196,472	645,607	3.3

Source: Statistical Office of the Republic of Serbia. (2019a)

If the total yield from these three oilseeds in 2018 went for the production of biodiesel, it would have resulted with over 471,000 t of produced biodiesel. However, if this was the case, no livestock feed nor food products would have been made of these plants. Using edible vegetable oils as feedstock for biodiesel production is not regarded as long-term sustainable choice. This is the central issue of the "Food *vs.* Fuel" debate. It is an actual global debate on sustainability of biofuels given the food availability and price (Latinović, 2019; 2019a) but it is out of the scope of this paper.

Finally, in 2018, Đurišić-Mladenović, Kiss, Škrbić *et al.* (2018) thoroughly summarized the biodiesel production capacities and the indigenous oil-based feedstock potential. For the first time, it was done so comprehensive and fundamentally. They paid particular attention to the principal oilseed crops as biodiesel feedstock in Serbia. Also, the total 1st generation biodiesel production potential was discussed by balancing between available areas for cultivation of oilseed crops, and domestic edible oil and fodder requirements.

According to Đurišić-Mladenović *et al.* (2018), the annual theoretical biodiesel production in Serbia is estimated at 128,000 – 266,000 tons depending on the type of oilseed crop used as the feedstock. This number is in addition to the quantities of oilseed crops required by the domestic food and fodder industries. However, the real potential might be lower on account of several factors. The Autonomous Province of Vojvodina is the largest agriculture base in Serbia and it is almost completely plain. Such landscape along with moderate continental climate makes favorable climate conditions for development of agriculture. However, oil crops occupy around 19% of Vojvodina's arable which is believed to be near of its biological maximum (Đurišić-Mladenović *et al.*, 2018). On the other hand, Central Serbia have trivial share of around 2% of oil crops of its total arable land area, which means that a substantial increase in areas under oil crops cannot be expected in Vojvodina, but Central Serbia. Still, there are many obstacles for substantial production of biodiesel feedstock in this region.

Agricultural holding in Central Serbia have relatively small average size of arable land, (around 2 ha) and they are scattered (Statistical office of the Republic of Serbia, 2018). This represents a significant logistical problem, which would likely cause increased transportation costs on account of organizing

production and collecting oilseeds and capital investments in new collection centers would likely be needed. In addition, this region has no tradition in the production of oil crops, which means that there is a lack of "know-how" and specialized machines for oil crop production (Đurišić-Mladenović *et al.*, 2018). These authors also noticed that rapeseed oil has more favorable properties than sunflower oil in respect to the compliance with the SRPS EN 14214 standard. They stated that the prevalence of polyunsaturated acids like in the case of several soybean and sunflower sorts (e.g. Zlata and Somborac, respectively) might make them unsuitable for the production of biodiesel in accordance to the same standard. This is due to high iodine number. Mixing with other vegetable oils of lower iodine number would be necessary if biodiesel is to meet requirements imposed by SRPS EN 14214:2019. As an alternative, they proposed increasing the production of high-oleic sunflower types (oleic acid > 70%) whose iodine number is less than 120 I_2 $(100g)^{-1}$. There are several domestically developed high-oleic types of sunflower (e.g. Oliva) but there are no data on areas under these crops, their potential yields and economic feasibility (Đurišić-Mladenović *et al.*, 2018).

3.4.3. Glycerol as the main by-product in biodiesel production

The main by-product in the production of biodiesel is glycerol, making about 10% of the weight of generated biodiesel (Quispe, Coronado, & Carvalho Jr., 2013). It is a virtually nontoxic organic compound with the molecular formula $C_3H_5(OH)_3$, with wide range of applications, especially in pharmaceuticals, personal care, foods and cosmetics (Tan, Abdul Aziz & Aroua, 2013).

At the very beginning of the development of the biodiesel industry, due to its widespread use, this by-product was a significant additional revenue for producers. Nevertheless, the availability of glycerol has increased multiple times due to remarkable growth of the biodiesel production worldwide. More than a decade ago, it became apparent that the existing glycerol demand market could not accommodate the excess amounts of glycerol generated from biodiesel production, which has become its bottleneck. Johnson and Taconi (2007) stated: "The flood of glycerol has created a glut in the glycerol market". Before year 2003, the cost of crude glycerol was in the range of € 250 – 300 per ton, falling to even 0 € about a decade ago (Mizuno, 2009). In 2016 more than 30.8 million m^3 (Mm^3) was generated, which is 7.5% more than in 2015, while future growth was estimated by around 4.5% annually, reaching 41 Mm^3 in 2022 (Monteiro, Kugelmeier, Pinheiro, Batalha & da Silva César, 2018). In 2011, it was estimated that 2 million tons (or just 40%) of a total of 5.1 million tons of glycerol was used, while the remaining 3 million tons were excess. Predictions on the global production of glycerol are to reach 7.66 million tons in 2020 (Anuar & Abdullah, 2016) making an even bigger gap between its supply and the demand.

However, there are various efforts and recent studies aimed at finding a novel use for glycerol, such as production of lactic acid by Enterococcus faecalis on waste glycerol from biodiesel production (Ciric *et al.,* 2020). Another one was thermochemical conversion of glycerol to medium methane content biological synthetic natural gas (bio-SNG). Researchers estimated that the bio-SNG made of glycerol containing only 80 wt% of free glycerol, could substitute up to 24% of the natural gas used at a pilot soybean biodiesel plant. They conducted a discounted cash flow analysis showing that it was possible to generate positive net present value and achieve internal rates of return within the hurdle rate (12%) for biomass gasification technologies (White *et al.*, 2019).

Perhaps the most promising one was the substitution of metalworking fluids (MWF) based on mineral oils and biocide additives by sustainable biodegradable glycerol-based MWFs (Winter *et. al*, 2012; Umamaheswara *et. al,* 2020). Around 2011, consumption of MWF in Germany alone was approximately 740 kt *per annum*, comprising about 70 kt of mineral oil components (Wichmann *et al.*, 2013). Moreover, glycerol-based MWF with 40% glycerol showed both good biostatic and technical properties, while at the same time being regarded as a sustainable and less hazardous substitute (Winter *et al.*, 2012; Wichmann *et al.*, 2013).

Finally, there were a few recent technological steps towards a glycerol-free production process. It is a relatively new alcohol-based reaction, although discovered decades ago. It is an interesterification reaction involving methyl acetate, but more research and development is required in order to make biodiesel production sustainable and economically feasible (Tan & Ang, 2019).

Nevertheless, it is still not realistic to expect that this will significantly affect the demand for glycerol in the near future, but efforts in these directions should be taken into consideration, especially in relation to mineral oil MWF substitution by glycerol-based MWF.

3.5. Legal factors

3.5.1. Biodiesel as a subject of standardization

Standards are, in their essence, documents that are accepted on a voluntary basis. However, governments are often referring to them in different technical regulations, which are legally binding documents, so it is essential to keep in mind that biodiesel as a final product have to meet different standards in order to find its place in the market. Since the technology of compression-ignition (diesel) engine is well established and widespread, biodiesel and its blends with petrodiesel have to adapt to it through a comprehensive standardization aimed at providing the appropriate characteristics of such products on the market (Latinović, 2019a).

Serbian standard that prescribes biodiesel characteristics is SRPS EN 14214:2019 and it fully corresponds to the European Standard EN 14214:2019 (ISS, 2019). As Sinčić (2014) stated, some of these characteristics partially coincide with characteristics of petrodiesel fuel. However, some characteristics are non-existing on account of their substantially different chemical composition. Due to the high total diesel fuel consumption levels, well established and relatively secure crude oil and diesel supply channels and its importance for the overall economic activity, biodiesel cannot completely replace diesel fuel. Therefore, it is most commonly used as a component for fuel blend with petrodiesel, in various proportions. In this case, its characteristics are specified by the standard SRPS B.H2.133:2015, which is identical to the standard ASTM D6751-15a (ISS, 2015). Blends are designated as "B" followed by a number that indicates the percentage of biodiesel. For example, the designation B100 represents pure biodiesel while B20 refers to the blend consists of 20 % of biodiesel and 80% of petrodiesel.

Following the adoption of the Directive 2009/28/EC, B10 is becoming more and more common in the European Union (Latinović, 2019a), which eurointegrations expect to be realized in Serbia as well. In step with the gradual increase in biodiesel share in petroleum products, new standards have been adopted. Blends containing up to 10% (v/v) of FAME are covered by EN 16734:2019, or in Serbia, its equivalent SRPS EN 16734:2019. It specifies requirements and test methods for marketed and delivered automotive B10 diesel fuel, containing up to 10.0% (V/V) FAME (ISS, 2019a).

Furthermore, Serbian standard SRPS EN 16709:2019, identical to EN 16709:2015+A1:2018 CEN/TC 19 specifies requirements and test methods for marketed and delivered high FAME (B20 and B30) diesel fuel for use in diesel engine vehicles designed or subsequently adapted to run on high FAME (B20 and B30) fuel (ISS, 2019b). Such blends are intended to be used on the voluntarily basis, and is expected to be mostly by agricultural sector and for working machines. Its price is the primary factor for choosing such a fuel type. In addition, further biodiesel share increase in the fuel blend, demands additional changes in petroleum diesel standards so that the quality of final blend can pass the environmental and technological requirements (Hart Energy, 2014).

However, the EU itself has had contradictions in attitudes towards biofuels in the transport sector. Official European strategy is to promote an increase in the share of biofuels in transport fuel, and it is being covered by appropriate policies, directives, standards, etc. At the same time, the European Union is beginning to question the sustainability of biodiesel and its impact on reducing GHG emissions in general. Questioning of the viability of using biodiesel as well as its impact on the environment is not without reason. There are many well documented adverse effects that follow biodiesel industry (Latinović, 2019; 2019a). Some of them are: increased NO_x emissions (Chauhan & Shukla, 2011; Nestorović, Jovanović, Manić & Stojiljković, 2012; Jovanović, Joldžić, Jovanović, 2015), jeopardized food and water procurement referred to as „food or fuel“ and „drink or drive“ issues (Taheripour, Hertel & Tyner, 2010; Koizumi, 2015; Tomei & Helliwell, 2016) and various issues with engine operation, performance and durability, most specifically crankcase oil dilution and fuel system clogging (Fraer, Dinh, Proc *et al.*, 2005; Yüksek, Kaleli, Özener & Özoğuz, 2009; Thornton, Alleman, Luecke *et al.* 2009; Gili, Igartua, Luther & Woydt, 2011; Kurre, Garg & Pandey, 2016). However,

these fluctuations in EU courses concerning biofuels make the future of the entire biodiesel industry uncertain and this should be taken into consideration while making projections on return of investment period of a biodiesel investment project.

3.5.2. Political situation in the country concerning the rule of law

Eurointegrations of the Republic of Serbia also imply entering the reform process according to the model offered by this regional integration (Jovanović, 2012). The process itself involves the introduction of EU standards into national legislation, which further requires an enhanced form of enforcement control, but also of all other standards as well as the creation of new special institutions that will oversee the correct implementation of the newly adopted rules. It is being overseen both at the national level, at the local level and at the level of the organizations themselves (Jovanović, Stokić, Matavulj & Igić, 2012). In the end, all this implies the acceptance of a value system that applies in the EU countries. Since the Republic of Serbia is a candidate country, that is, in the process of negotiations with the EU, it should be underlined that by the date of accession, it is obliged to adopt EU legislation in various fields, including in the field of environment and energy. In this way, a completely new business environment is created. All this may be considered as a positive signal for potential investors in biodiesel industry.

Though, at the same time with European integration, Serbia is going through a difficult political period of various fluctuations and contradictions. Although political and legal factors are often intertwined, the political situation in the country has found its place in this section because it does not talk about government policies, but rather speaks of investor protection and security in conducting business within the envisaged legal frameworks and Serbian business environment. This is a particularly important topic for potential investors because the biodiesel industry is closely related to government policies, standardization and various legal regulations.

However, it is very ungrateful to talk about the political situation, especially in the native land of the authors. Therefore, in order to avoid any coloring of the text by the bias of the authors, Freedom House was chosen as a partially independent entity that has some credibility regarding to the subject. Their annual 2019 report on the Freedom and state of Democracy in the World stated that Serbia's status of Free country has declined to Partly Free country (Freedom House, 2019). According to the same report, Serbia was the fourth country with the largest decline in political rights and civil liberties in the World. It ranked just below Venezuela, Tanzania and Nicaragua. As democratic standards in Serbia continued to fall, while Russian and Chinese influence started to raise, Freedom House's latest "Nations in Transit report" classified its regime as "Hybrid". This means that Serbia has lost its status as a democratic country (Freedom House, 2020).

Concerning the rule of law this report stated: "The independence of the judiciary is compromised by political influence over judicial appointments, and many judges have reported facing external pressure regarding their rulings. Politicians regularly comment on judicial matters, including by discussing ongoing cases or investigations with the media, etc. Due process guarantees are upheld in some cases, but corruption, lack of capacity, and political influence often undermine these protections. Among other problems, rules on the random assignment of cases to judges and prosecutors are not consistently observed, and mechanisms for obtaining restitution in civil matters are ineffective. High-profile, politically sensitive cases are especially vulnerable to interference "(Freedom House, 2020). However, concerning rights to own property and establish private business without undue interference from state or nonstate actors, the same report stated: "In general, property rights are respected, but adjudication of disputes is slow, and problems such as illegal construction and fraud persist. An estimated two million buildings in Serbia are not registered… " (Freedom house, 2020).

Although it is not certain that these factors will have negative consequences on biodiesel industry investment projects in Serbia, it should be taken into consideration in order to prevent the possibility that the future success of the investment depends on one's goodwill.

3.6. Environmental factors

3.6.1. Disappearance of agricultural land

Annually between 6,000 and 30,000 hectares of agricultural land get obliterated and become unsuitable for agriculture. This reduction of agricultural land is due to urbanization, Greenfield investments, infrastructure construction and various excavation sites (Pocuca, Draskovic, 2015). Agricultural land in Serbia has experienced an alarming disappearance. For less than one human lifetime, the size of arable land in Serbia has reduced from 3.6 million ha in 1960 (Ševarlić, 2012) to around 2.5 million ha in 2018 (Statistical office of the Republic of Serbia, 2018). This means that Serbia has left without virtually one third of the cultivable land in only 60 years. Regarding the Serbia's potential for biodiesel feedstock production, this represents a significant risk. Given that the earnings and prices of agricultural products cannot compete with prices and earnings from other industrial branches, agricultural production is the weakest link in that chain. By its vulnerability, biodiesel industry is jeopardized as well.

3.6.2. Water consumption and waste water treatment

Feedstock cultivation, usually row-crop agriculture, is the most water-intensive of biofuel production stages. More intensive agriculture would require more irrigation, which would create pressure on water resources in many areas (Diamantopoulos, 2015). This issue often referred to as "Drink or drive issue". In addition, the largest biodiesel production facilities in Serbia, such as Victoriaoil plant in Šid, use Lurgi technology, where the process itself requires large quantities of water. The primary uses of water for biodiesel refining are to wash plants and seeds for processing and for removing catalyst that lags in the ester fraction from which it is eliminated by multiple rinsing with hot water (Stamenkovic *et al.*, 2009; Sincic, 2014; Efe, Ceviz & Temur, 2018). This water becomes wastewater, containing residues from the production process such as: oil, soap, methanol, glycerol etc. (Daud *et al.*, 2015). It is required to be processed, bringing new technological challenges and additionally increasing the production cost. Wastewater treatment processes vary from simple reservoirs, relying solely on sedimentation, to refined processing processes with advanced biological processing as we know it today. Processing aims to reduce the pollution contained in wastewater such as bacteria and viruses, components that consume oxygen, nutrients, pharmaceuticals, chemicals and heavy metals from wastewater before they are discharged into the receiving water. Rattanapan *et al.* (2011) found that efficiency of dissolved air flotation for biodiesel wastewater treatment can be enhanced by acidification and coagulation processes. Furthermore, Nikhom *et al.* (2019) demonstrated that oil recovered from biodiesel wastewater can be used as an alternative feedstock for biodiesel production. They recovered 33 g of oil from wastewater generated during the production of one liter of biodiesel.

Wastewater treatment in Serbia falls under the Regulation on limit values for emission of pollutants into water (2016). This Regulation establishes the emission limit values for certain groups or categories of pollutants for: technological wastewater before their discharge into the public sewage system; technological and other waste water directly discharged into the recipient; the waters that are discharged from the public sewage system to the recipient and the wastewater discharged from the septic and collecting pit into the recipient after the treatment, as well as the deadlines for their reach.

3.7. PESTLE analysis summary

Although all factors have been previously discussed individually in the respective headings, Table 2 and Table 3 present an abbreviated systematic overview of respectively, positive and negative key findings of the PESTLE analysis, for ease of review.

Table 2. Positive key findings of the PESTLE analysis.

Political	**Economic**	**Social**
- The Energy Development Strategy of the Republic of Serbia is basically in favor of biofuel producers.	- Diesel fuel is the most dominant transport fuel in Serbia. - If Directive 2009/28/EC is implemented, Serbia will have a notable domestic biodiesel demand.	- There is some media coverage on the topic.
Technological	**Legal**	**Environmental**
- Serbia has the potential to produce sufficient amounts of domestic biodiesel feedstock; - Domestic oilseeds are adequate as biodiesel feedstock	- Biodiesel on the market must be in accordance with the SRPS EN 14214:2019 standard; - In general, property rights are respected Adjudication of disputes is slow.	- The disappearance of agricultural land should not significantly affect the potential for biodiesel feedstock production.

Overall, based on the positive findings, it can be concluded that all the basic technological preconditions for the production of biodiesel in significant quantities for the Serbian market have been met. Serbia has the potential to produce sufficient amount of domestic biodiesel along with the feedstock for its production. The production technology has been well developed, tested in practice and it has already been confirmed that it meets the criteria imposed by regulations and standards.

Table 3. Negative key findings of the PESTLE analysis

Political	**Economic**	**Social**
- Unstable political situation in the country; - Lack of democracy; - Uncertainty in government incentives and aid; - Uncertainty in EU attitudes toward biofuels in the future.	- Volatile crude oil prices with a tendency to fall; - Rising prices of biodiesel feedstock; - Government aid is still necessary; - High excise taxes on biofuels.	- Voluntary purchase of biodiesel can be expected only if its price is competitive to the price of Petro-diesel.
Technological	**Legal**	
- No major breakthroughs in production technology have been reached; - Momentous revenue from glycerol by-product should not be expected.	- Possibility of interference in the work of courts; - Adjudication of disputes is slow; - Directive 2009/28/EC is still not implemented.	

However, there are several factors that represent significant biodiesel industry investment project risks. Political situation is unstable with not entirely clear progress on the path towards the European integration as well as the full implementation of European Union directives concerning the mandatory use of biofuels. The latter is essential perquisite for the stability of biodiesel demand. Also, the state of the art of the biodiesel production technology is such that state aid is still necessary in order to make profits, and the recent history of measures of the Government of Serbia has shown that reliance on the state support can be a double-edged sword.

5. Conclusion

This paper presented and discussed several factors that authors assessed as important for the establishment of the biodiesel industry in Serbia. Given the importance of the topic for both economy and European integration of the Republic of Serbia, the factors were classified based on the PESTLE analysis framework in order to make the manuscript findings more receptive to strategic decision makers. Although, some factors may belong to multiple areas of PESTLE framework, or may have some overlap, their classification was not as important as their identification and understanding.

Most importantly, Serbia was found to have the potential to produce sufficient quantities of the domestic biodiesel feedstock as well as to have notable biodiesel demand. That is, if the Directive 2009/28/EC is finally implemented. If that is the case, and if the biodiesel production in Serbia is established, such a model of production for the local consumption will not be unique to Serbia alone. The majority of countries that produce biodiesel also have a vibrant domestic biodiesel market.

However, a final assessment of whether or not to invest in biodiesel production is not be made in this manuscript. Considering pressure from rising prices of oilseeds and volatile crude oil prices, as well as the traditional biodiesel production technologies, the government aid is still necessary in order to make biodiesel production economically justified. Numerous factors concerning not only the external environment but also the internal environment of potential investors and / or produces, impose on each individual investor or / and producer to create their own economic study and assessment. It is necessary to choose between several options and choose the one which would be the most desirable for the company according to its own capabilities and capacities to cope with such uncertain business environment. Furthermore, the conduction of an unbiased objective economic study is questionable given the unstable political situation, history of unpredicted and contradictory moves of the Government of the Republic of Serbia as well as uncertainty in attitudes of European Union on biofuels in general.

Nevertheless, if all these factors were adequately anticipated in the planning phase, hopefully, potential investors and / or producers could take steps to prevent or mitigate negative outcomes.

6. Conflict of interest

We declare that we have no financial and personal relationships with other organizations or persons that can inappropriately influence our work. There is no professional or other personal interest of any nature in any product, service or company that could be interpreted as influencing this manuscript entitled.

7. Literature

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Podobnost polimerne ambalaže za reciklažu

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Apstrakt: U odnosu na ambalažu se postavlja niz zahteva, od funkcionalnih, estetskih, ekonomskih, ergonomskih, a u današnje vreme sve se više pažnje poklanja ekološkim zahtevima. Od ukupne proizvodnje plastičnih materijala, najveći udeo ima industrija ambalaže. Pored toga, polimerna ambalaža, zauzima i najveći procenat od ukupne proizvodnje ambalaže. Razlog njene primene leži u nizu dobrih osobina kao što je npr. niska cena, raznovrsnost, mehaničke i barijerne osobine, itd. Međutim, sa ekološkog aspekta, ona predstavlja poseban problem zbog kratkotrajne upotrebe i nagomilavanja nerazgradljivog otpada. Zato ambalaža u današnje vreme treba odgovarati i sve većim zahtevima ekonomične i ekološki podobne prerade nakon njenog korišćenja. Iz navedenih razloga se u ovom radu daju osnovne smernice za izradu i izbor ambalažnih materijala u cilju poboljšanja podobnosti za reciklažu, uzimajući u obzir i kriterijume oznake materijala i konstrukcijske izvedbe.

Keywords: polimerna ambalaža, reciklaža, podobnost

The suitability of polymer packaging for recycling

Abstract: Packaging must fulfill functional, aesthetic, economic, and ergonomic requirements, and nowadays more and more attention is paid to environmental requirements. Of the total production of plastic materials, the largest share is refers to the packaging industry. In addition, polymer packaging occupies the largest percentage of total packaging production. The reason for its application is due to a number of good properties such as low price, variety, mechanical and barrier properties, etc. However, from the ecological aspect, it represents a special problem due to short-term use and accumulation of non-degradable waste. That is why packaging nowadays should meet the growing demands of economical and environmentally friendly processing after its use. For these reasons, the paper provides basic guidelines for the manufacture and selection of packaging materials in order to improve recyclability, taking into account the criteria of material labeling and construction performance.

Keywords: polymer packaging, recyclability, suitability

1. Introduction

Global production of plastic materials in 2018 was about 360 million tons. Total European plastics converters demand was about 51.2 million tons. The biggest end-use markets for plastics are packaging (39.9%), and building & construction industry (19.8%) (Plastic Europe, 2019). The most commonly used polymer types for packaging are given in Table 1.

Table 1: The most commonly used polymer packaging materials

Type of polymer[1]	Usage examples
LDPE	Foils, bags, sacks, hollow plastic containers
HDPE	Foils, bottles, containers, tapes
PP	Foils, cups, closures, strips, food containers
PS	Cups, closures, foils
PET	Bottles, bags, heat-resistant foils, food packaging containers

[1] Abbreviations used: LDPE (low-density polyethene), PP (polypropene), HDPE (high-density polyethene), PET (polyethylene terephthalate), PS (polystyrene).

The reason for using plastic for packaging manufacturing is the transparency of materials, various barrier properties, and good mechanical and thermal properties. The largest group of packaging is food packaging, and among, the most important group is flexible packaging (monofilms or multilayer compositions combined with paper and aluminum films) (Izdebska, 2016).

The share of plastic packaging materials in the total amount of packaging is significant and amounts to 43.8% on the market. The share of paper, cardboard and corrugated cardboard is 32.7%, metal 16.5% and glass 7.1% (Neue Verpackung, 2015).

The basic function of packaging is to hold and protect the content beginning from the packaging process, to the distribution and to the end consumer. Besides the economic production and optimal performance of the function in the phase of use, the packaging should meet the growing demands of economically and environmentally friendly processing after its use, among other things, its suitability for recycling.

The main problem with plastics in general is the increased generation of non-degradable and the ever growing amount of waste. According to Horodytska (p. 415), "the EU through the Waste Framework Directive (2008/98/EC) has established the following waste management hirarchy: prevention, preparing for reuse, recycling, recovery and disposal". According to Foltynowicz (p. 65), ''The European Commission (EC) set a target of 2030 to increase recycling of plastic packaging stating that the only long term solution is to reduce plastic waste by recycling and reusing more".

Improving product recyclability leads to easier recycling. Suitability for recycling is primarily determined at the design stage. In that way, the designer can notice the shortcomings at an early stage, which would eventually contribute to the modification of the design, and thus to energy savings, reduction of emissions, etc. (Zhi Li et al, 2017).

The following part of the paper analyzes the above problems and briefly states the basic guidelines for material selection and production of primary polymer packaging, in order to improve recyclability, based on the most important criteria:

- Choice of materials,
- Material markings, and
- Construction designs.

2. Choice of the materials

The required technical-technological knowledge of a number of different polymer materials used for the production of packaging is the basis for their selection with regard to recyclability. According to their thermal properties, they are divided into thermoplastics, elastomers and duroplasts.

Thermoplastics are most often used for the production of packaging. They can be melted when heated and hardened when cooled, and therefore be recycled and reused several times. Duroplasts and elastomers do not have this property and are used only as auxiliary materials.

To improve the suitability of packaging material for recycling and use, when choosing a material, the designer should pay particular attention to:

• Possibilities of reducing the types of materials,
• Tolerability of individual materials,
• Possibilities to increase strength, and
• Homogeneous packaging material.

When choosing the material, the necessary auxiliary parts of the packaging, such as adhesive tapes, closures and labels, must also be taken into account.

Separation of certain types of packaging material and their reduction has a positive effect on the sorting process and the suitability of materials for recycling.

If the packaging composed of different materials cannot be separated, it is necessary to pay special

attention to the compatibility of polymeric materials - Table 2.

For the assessment of the compatibility of different materials, there is literature as well as available data from the manufacturer (Pahl, G.; Beitz, W., 1996, Scalice Kovacs et al., 2009).

Table 2: Compatibility od polymer materials

	PE	PP	PS	PVC	PET	PC	PA
PE	1	3-4	4	4	4	4	2-4
PP	2-4	1	4	4	4	4	2-4
PS	4	4	1	4	3	2-4	3-4
PVC	4	4	2-4	1	4	3-4	4
PET	4	4	4	4	1	1	3-4
PC	4	4	2-4	4	1	1	3-4
PA	4	4	3-4	4	3	4	1
PBT	4	4	2-4	4	3-4	1	3-4

1-compatible; 2-can be mixed up to 20%; 3-can be mixed up to 5%; 4-not compatible

As a rule, different polymeric materials cannot be mixed on a molecularly homogeneous basis, because the recycled material would have poor properties (Nickel, 1997). If the desired purity of the material type is not achieved, macromolecular auxiliaries can be used.

By increasing the strength of the material by uniformly orienting the molecules (eg monoaxial OPP and biaxial BOPP), better recyclability is achieved because the use of combined materials and additives is reduced (Nickel, 1997).

The best suitability for recycling is achieved by a homogeneous structure of packaging - from one material. However, the avoidance of combined and alloyed materials needed to achieve better required properties of packaging material (e.g. permeability, toughness, transparency, slipperiness), as well as due to the requirements of the packaging content itself (especially for food and pharmaceutical packaging), can hardly be avoided. Replacement of multilayer packaging is possible only if the protection of the product is provided to the same extent (Kaiser et al, 2017.)

Research of the recycling of multilayer films goes in the direction of adding compatibilizers (Horodytska et al., 2018). When choosing different types of materials to be joined by gluing, welding or shape, the difference in their densities should be greater than $0.1 g/cm^3$, in order to allow separation (Nickel, 1997). However, even in this case, the separation is problematic because with the usually combined packaging, the individual layers differ greatly in density.

3. Markings (signs) on the packaging material

In addition to consumer and marketing information, labels also serve as a criterion for sorting packaging. Appropriate material labeling should facilitate the sorting of polymer packaging by type and contribute to an economically and environmentally sound packaging cycle. The type of labeling should be closely related to the available collection, sorting, and processing procedures. Image, image-text tags, and markers are most commonly used.

Image and image-text labels also have an informative character. They indicate to the consumer that recycling was taken into account when designing the packaging. The recognizability of the signs is important. In addition to the well known signs, signs for biodegradable materials for compostable packaging have recently become significant.

For polymeric materials where it is not easy to detect the composition or properties by which they differ from other materials, it is possible to use markers. They are important in the recycling process in order to facilitate automatic sorting by type of material and achieve the purity of individual types of material.
The procedure with markers enables even marking of different types of the same type of polymeric materials. If a direct print on the packaging is not used, labels (made of paper or polymer foils) are used, which are glued to the packaging. If water-soluble adhesives are used, then labels from other materials can be accepted. If adhesive residues cannot be removed from the surface of plastic

packaging, small particles in the form of powder, fibers, etc. cause impurities in the recycled material. In addition, adhesive residues can disintegrate in the further melting process, leading to discoloration of the material as well as undesirable changes in mechanical properties.

For suitable recycling, polymer labels should be made of the same material as the packaging. If paper labels are used, it is necessary to stick with water-soluble glue. In addition to the insufficient content of information, in the case of pictorial and additional markings, the practical application is questionable, and their direct connection with the available waste collection systems is also problematic.

Further labeling in order to differentiate individual materials would be possible by standardizing colors for certain types of polymeric materials. For the same purpose, it is also possible to use a variety of surface structures on the packaging, with each structure determining the type of material. Care should be taken not to use imitations of other types of materials (e.g. paper).

4. Construction of the packaging

Due to the importance of suitability for sorting recyclable materials, it is necessary to avoid auxiliary parts for opening /closing packaging with appropriate construction or to be made of the same material as the packaging, and to enable good separation of different materials.

In order to reduce the impurity of the packaging used, such a design of the packaging is required to be suitable for emptying the rest of the packaged product. First of all, the contact surfaces of the product and packaging should be smooth and without the so-called *dead zones*.

Design suitability for recyclability of packaging is characterized by two basic criteria:

- Material joining technique, and
- Separation of different materials.

The technique of joining different parts of the packaging is based on known joining principles. For the evaluation of compounds with respect to the goal of this paper, the criteria were selected and their suitability was evaluated-Table 3.

In the case of joining different materials, the friction and shape joints of the opening/closing elements are more suitable than the joints by gluing and welding. However, welded joints should only be used for the same polymeric materials. Bonding joints are only conditionally separable (Nickel, 1997).

Table 3: Assesment of the joining (Müller, 2000)

Types of joints / Eligibility criteria	Gluing	Welding	With friction	Whit shape
Separation without permanent deformation	3	3	1	1
Separation with permanent deformation	3	2	1	2
Joint load	2	1	2	1
Suitability for recycling	3	1	2	2

Assesment of the type of joining: 1-most suitable, 2-suitable, 3-less suitable

Separation of different polymeric materials is expedient if the separation in the recycling process is done by crushing. However, e.g. in the sorting process, the auxiliary elements are not removed, and in principle this cannot be expected from the consumer either.

Trying to open/close the polymer material packaging as easily as possible often leads to an increase in the number of additional parts, which should be kept to a minimum due to their recyclability. If they are made of metal or differ from the packaging material, they should be constructed so that they can be easily separated due to their size and strength.

5. Conclusion

These requirements and guidelines for improving the suitability of polymer packaging for recycling, processed through three main influencing criteria, could be summarized according to their importance in the following order:

- Choice of thermoplastics instead of duroplasts and elastomers;
- Production of packaging from one type of polymeric material;
- Use of labels made of polymeric material instead of paper;
- Application of water-soluble labels;
- Direct printing instead of labels;
- Use of printing inks and additives as little as possible;
- Structural coloring of the material.

Regarding the construction of polymer packaging, there are significant requirements:

- The best possible separation of different materials;
- Avoiding auxiliary parts of the packaging, and
- The best possible discharge from the rest of the product content.

The stated requirements and guidelines for packaging recyclability in this paper can be considered only within other requirements related to the function of packaging (content protection, rationalization, marketing, etc.). Since the technical possibilities of packaging recycling in our country are limited, it is necessary to design the most recyclable packaging, raise the environmental awareness of the population and improve the system of staff education

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Koncept računarstva u oblaku u obrazovnim sistemima

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Apstrakt: Klaud tehnologija predstavlja sistem koji omogućava efikasnije, jednostavnije i jevtinije korišćenje IT resursa. Ekonomičnost primene ove tehnologije ogleda se u optimizaciji operativnih troškova, optimizaciji kapitalnih investicija, kao i smanjenju troškova. Elektronsko obrazovanje kao sistem počinje da ”živi” krajem 20. veka u obliku IT aplikacija. Danas se ove aplikacije nalaze u novom okruženju – računarstvu u oblaku.

Količina podataka koju treba obraditi raste i ima tendenciju ubrzanja. Neophodno ju je memorisati, transferisati i procesuirati u jedinici vremena, što iziskuje razvoj određenih sistema. Dati sistemi koji omogućavaju menadžment resursima su big data sistemi, internet stvari, klaud platforme, virtualizacija, veštačka inteligencija, 5g, itd. Platformska struktura koja nosi navedene sisteme jeste računarstvo u oblaku.

Primenom računarstva u oblaku kao nove tehnologije za realizaciju elektronskog obrazovanja unapređuju se obrazovni i naučno-istraživački sistemi, u pogledu skladišnih i protočnih kapaciteta, brzine obrade podataka i dostupnosti informacija sa ciljem kvalitetnijeg obrazovnog okruženja koje poseduje veću mogućnost kontrole, ekonomičnije je, efikasnije i bezbednije u odnosu na tradicionalan koncept. U radu je predstavljen prikaz uticaja IKT odnosno računarstva u oblaku na obrazovne sisteme koji bi trebalo da budu deo novih kretanja iz razloga prednosti koje ova tehnologija nosi sa sobom.

Ključne reči: računarstvo u oblaku, obrazovni sistem, informaciono komunikacione tehnologije, elektronsko obrazovanje

Cloud computing concept in education systems

Abstract: Cloud technology is a system that enables the use of IT resources more efficiently, simply and cheaply. The cost-effectiveness of applying this technology is reflected in the optimization of operating costs, the optimization of capital investments, as well as the reduction of costs. Electronic education as a system began to "live" in the late 20th century in the form of IT applications. Nowadays, these applications are in a new environment - Cloud Computing.

The amount of data that needs to be processed grows and has a tendency to accelerate. This huge amount of data is necessary to store, transfer and process in a unit of time this requires the development of certain systems. The given systems that enable the management of the given resources are big data systems, internet of things, cloud platforms, virtualization, artificial intelligence, 5g, etc. The platform structure that carries these systems is cloud computing.

The use of cloud computing as a new technology for the realization of e-learning enhances educational and research systems, in terms of storage and flow capacity, data processing speed and availability of information with the aim of a better educational environment with greater controllability, is more economical, efficient and safer in relation to the traditional concept. The paper presents the impact of ICT and cloud computing on educational systems, which should be part of new trends due to the advantages that given technology brings.

Key words: Cloud Computing, education system, ICT, e-education

1. Introduction

Cloud computing is an infrastructure that enables the use of computing resources, namely servers, databases, data warehouses, network subsystems, software applications and special artificial intelligence (AI) systems. The resources provided are available online. Cloud computing makes it faster to access and pay for only the resources which are used. In this paper there is an attempt to represent influence of given concepts on educational systems in order to comprehensively improve governance processes on a long-term basis. Economics affects all aspects of the education system, ie. there is a need to reduce operating costs. It is only logical that the funds are less in the budget, and therefore the IT sector, which is required to do more with less money.

There are 2.5 quintillion bytes of data created every day at a certain speed, but speed is increasing with the advent and development of the Internet of Things (IoT), which has been recognized as an opportunity to change how educational institutions operates and enhance student learning experience, as well as experiences for teachers and other stakeholders (Srivastava, et al. 2020). We now do more than half of web searches from a mobile phone. More than 3.7 billion people use the Internet (up 7.5 percent from 2018). Google processes more than 40,000 searches every second (3.5 billion searches a day) on average (Forbes, 2019)

These changes affect the education system as well as the wider socio-economic system. Due to the improvement of conventional business processes, certain development methods are used as an important part of the development process, as well as new ICT technologies, which enable business automation. The modern ICT technologies on the market are big data systems; iot, virtualization, 5g, cloud systems, artificial intelligence, robotization. The given technologies are part of the business solution, and converge into a well-organized information system that optimizes information management and business system.

2. Information technologies and cloud computing

Due to better understanding the IT environment, and, if one looks at IT from the inception of computers to the present day, it may be possible to divide the interval into intervals in which IT possessed certain characteristics on the basis of which the relevant trends were defined. The 1950s were characterized by large mainframe computers, followed by mini computers in the 1960s, with the 1980s being characterized by personal computers and client server architecture. The end of the 20th century saw the emergence of the Internet, and the beginning of the 21st century was characterized by virtualization of server platforms, which formed the basis for the development of cloud services (cloud computing).

Technologically speaking, cloud computing can be defined as a service that offers unlimited amounts of disk space, processing power, working memory, bandwidth, etc. in the moment as needed and as needed in a way that independently controls the allocation of given resources, either through its own application/ specific portal.

Economically speaking, it is a service where the company is no longer the owner of the infrastructure or is in charge of its maintenance (administration), but pays the time rent of the amount of resources that it needs at a given moment. This means that the company no longer needs capital investments related to the IT sector. Given includes the procurement of a large amount of IT equipment that needs to be maintained without the need for it. The company also has no need to rush to acquire new hardware when current needs go beyond the capabilities of a given infrastructure.

Cloud computing can be divided into certain categories with sufficient accuracy depending on the economic and technological aspects. According to first category, from economic aspect, it can be separated into public, private and hybrid (public-private). The public cloud is owned by the provider - the service provider (Amazon, Google, Microsoft, etc) and the user pays for the service (service). There are many examples: Amazon EC2, Google Apps Engine, Windows Azure, etc. The private cloud is owned by the company and some departments, teams, etc. use the services when they need and how much they need. One of the given definitions of cloud computing is not satisfied, and it is an economic definition that is not fully satisfied, because a given resource for a company is a capital cost or an investment. In other words, all resources belong to a given company.

However, since this technology reduces costs, and the depletion of resources itself is large as a result of the application of new technologies (deployment of virtualization processes, the top components that make up infrastructure, etc), the private cloud is a cloud. A hybrid model where part of the services is in the cloud (resources are outside the company, ie with the provider of the service provided) and part is with the owner/ user. Based on the second category, where the technological aspect dominates, the following division is distinguished: IaaS (Infrastructure as a Service) - infrastructure as a service, PaaS (Platform as a Services) - platform as a service and SaaS (Software as a Services) - software as a service.

The following development trends are currently available: Green Cloud Computing, Edge Computing, Cloud Criptographs, Load Balancing, Cloud Analytics, Mobile Cloud Computing Big Data, Cloud Deployment Model. For example, Green Cloud Computing saves energy, while in Edge Computing, data is processed at the edge of the network instead of in the data warehouse. Edge Computing is a new field that also optimizes resource utilization and improves system security. Cryptography can convey content with sufficient security. Cloud analytics is a combination of data analytics and cloud computing technologies. Cloud analytics is useful for both small and large organizations. Analysis has a broad scope, because there are many areas that require research. Cloud analytics consists of business intelligence tools, analytics management, and risk management.

Many organizations define the combination of public and private cloud as the best business solution. In a survey of nearly 800 companies in 2019, 94% used some form of cloud. Many businesses are still in the early stages of implementing cloud, deploying around 20% of their applications on a given platform. Gartner predicts that more than half of cloud-based companies today will move all their resources to the cloud by 2021. The worldwide public cloud service market will reach 228 billion in 2019, growing 15.8% over 2018 in US dollars. Software as a service will remain the largest segment, reaching over 170 billion dollars in 2023. Further, due to revenue, IBM and Oracle are corporations that have a significant role in the cloud computing world, compare to, for example, Google and Alibaba (Pažun, 2018). Comparing to 2017 when the estimated revenue of the world's largest cloud-based companies, according to Gartner, Microsoft Commercial cloud (Azure, Office365, Microsoft365), when was 21,2, in 2019 was 44.5 (in billions of dollars), as well as Google Cloud Platform, G Suite from 4,0 in 2017 has increased in 2019 with 8.9. Estimated revenue of Amazon AWS has been increased as well, from 20.4 in 2017, to 35 billion of dollars in 2019. (Gartner, 2019)

3. Cloud computing role in education system development

Nowadays, the importance of cloud is obvious. Some advantage is related to educational sustainability because given concept provides the required infrastructure, software, and storage, as well as cost reduction and improvement of education quality (Vaquero, 2011). Universities use cloud technology in higher education in many shapes. Virtual classroom is a concept which is used due to reducing the need for expensive textbooks by providing e-books and video materials to students online. Applications and storage systems are in the cloud, or students can use services such as Google Drive and Dropbox to store files, and the need to invest in storage devices is minimized. Also, software purchases are reduced when they are able to process text and spreadsheets online through Google Docs.

Virtual Labs, other form in which students can perform hands-on instructor-led exercises in online labs that are safe, convenient, and accessible anytime, anywhere, and on any device. These solutions reduce the cost of both students and educated institutions. For example, the Google Company, as the most valuable brand, has announced its cloud platform (GCP) as a project with free accessibility. Users can download 15 Google cloud services, including 30 GB of compute engine/ month, five GB of storage cloud storage/ month, Pub/ Sub with a capacity 10 GB/ month, and cloud function with a capacity of two million callings/ month, and meet their needs through these services by GCP. (Asadi, et al. 2019)

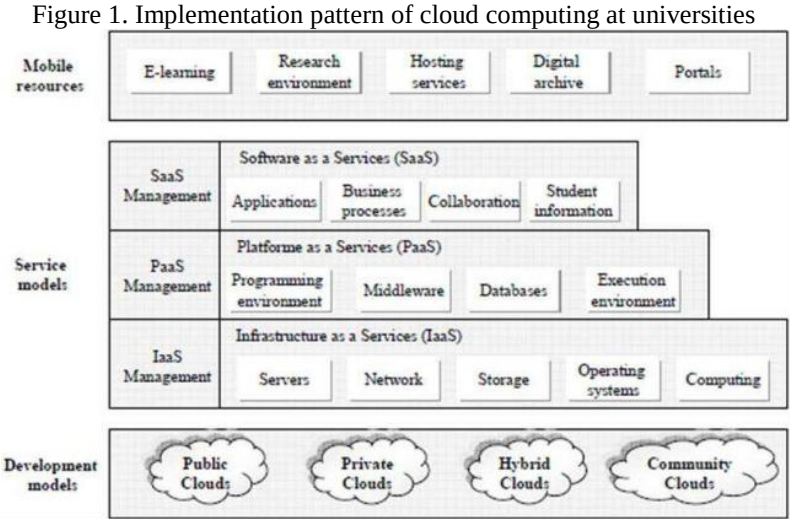
One of the studies conducted in the mid-2000s regarding the use of cloud computing in higher education showed that universities could still find themselves in the "early adoption" phase alongside other sectors, such as commercial and government. The factors that influenced the decision to use cloud computing in higher education were different from other sectors. In other words, according to company COMING - Computer Engineering, 70% of IT leaders in the field of higher education (out of 302 respondents) considered that improving IT services was the most important factor, while only 38% gave the primacy of cost reductions. Comparison of the given data with the most recent ones, however, results in increased investment in the IT sector.

Research shows that IT investments are very important in the field of higher education. In 2012, a survey by the Gartner Group found that 49% of educational institutions were already involved in some form of cloud computing. More recent research shows that schools and universities will increase their investment in cloud applications and infrastructure by 22.3% by 2023, due to the latest five-year forecast (Marr, 2018). According to Metaari (formerly Ambient Insight), an ethics-based quantitative market research firm that identifies revenue opportunities for advanced learning technology suppliers in 126 countries, funding for higher education technology companies increased to 740.58 million US dollars in 2019, twice as much as funding in 2018. What was surprising, according to research conducted by Metaari, is reduced funding for companies that support learning in lower education (bellow 12 years old pupils, aka PreK-12). Funding for academic education represented 8.6% of global investment in 2019, a decline of 11.2% in 2018 and significantly less than 21.4% in 2017. And as well, it should be mentioned that USA has returned to the first place as the leading learning technology investment hub, where it alternates with China (Adkins, 2020).

On the other hand, some disandvantages of cloud usage should be mentioned. Data security is a statistically significant challenge when it comes to cloud systems implementation in higher education (Juma, Tjahyanto, 2019). Cloud security providers have developed systems security protocols; however, the question is whether the systems in question are secure enough. A possible solution for providing the security of sensitive data in the cloud comes in the form of a combination of firewall and data encryption process (Mircea, Andreescu, 2010). Lack of control is an important issue, because if an organization places all its resources on the public cloud, allowing decentralization of information management to a certain limit, the question of control or dependence of the service provider arises. The organization integrates into an intricate network of services, which can be interrupted or whose costs could dramatically increase.

The pattern of cloud computing implementation, from development to the deployment of its resources in universities, is given in the following figure:

Figure 1. Implementation pattern of cloud computing at universities



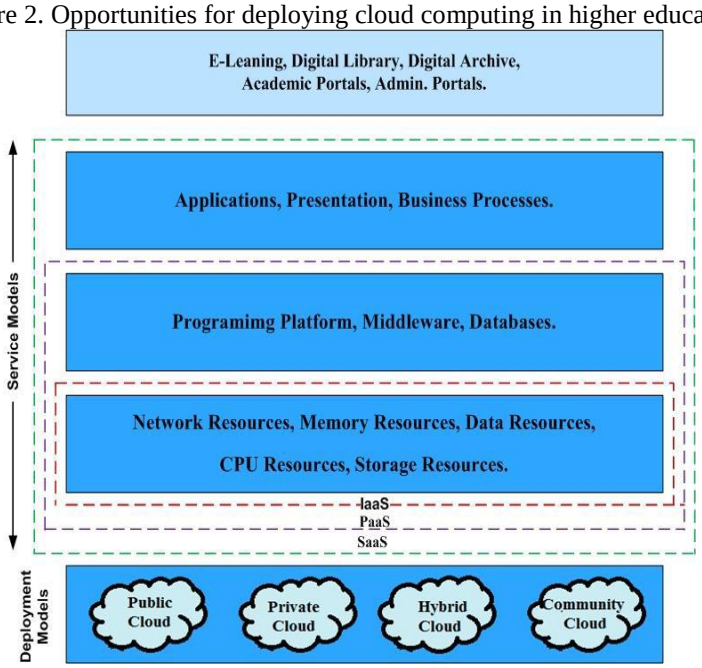
Source: Mircea, Andreescu, 2010

Presented technology enables the creation of reports and analyzes that should lead to rational curriculum decisions by study levels based on identified needs.

The phases of the strategies and/ or development of the transition to the cloud computing, according to the experience of the universities are (Rainer, Turban, 2009; Mircea, Andreescu, 2010): development of knowledge database on Cloud Computing; defining the university's needs for IT resources, solution testing, choice of solution, management of a given solution.

Solutions to the application of cloud computing in higher education are given in Figure 2:

Figure 2. Opportunities for deploying cloud computing in higher education

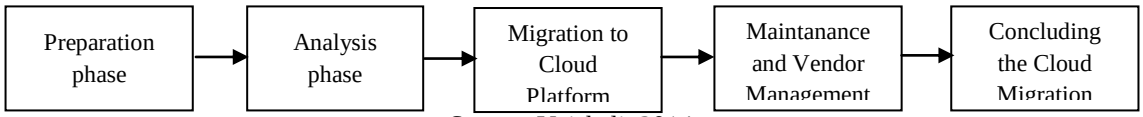


Source: Asniar; Budiawan, 2016

Figure 2 shows that SaaS (Software as a Service) and IaaS (Infrastructure as a Service) services may be suggested for students, lecturers/ researchers and administrative staff. Meanwhile, PaaS (Platform as a Service) and IaaS (Infrastructure as a Service) are services that can be offered to IT staff.

A relatively large number of different methods exist for software architecture development (Pazun, Langovic, 2019). Following figure shows that cloud computing development process can be organized in several stages.

Figure 3. Cloud computing development process



Source: Vaishali, 2014

The preparation phase includes understanding the technology of the cloud and user requirements, then it comes to understanding the feasibility of the project, and in order to get a more realistic picture, swot analysis is used. The analysis phase includes the analysis of user requirements. Phase 3 is reflected in the process of moving to the selected cloud platform. This is followed by the integration of new systems with the existing/ legacy system. Phase 4 represents the final transition to the cloud, ie the migration of data and applications to the cloud, ie the observed platform. It is necessary to provide adequate training for all users for successful migration. In final phase, the information system is active/ operative, as well as the process of evaluation is ongoing.

Considering on-going so-called industry's fourth revolution driven by the use of artificial intelligence and changing the work area from task-centered to human-based, future predictions for the technology include the connections to higher education as a dialectical, intricate, and intriguing opportunity, due to change society for the better. (Qasem, et al. 2019)

4. Edtech implementation due to Covid 19 reality

The explosion of the use of online tools to support learning during the pandemic, and in which we still find ourselves, was the only possible variant of continuing or maintaining some continuity in the teaching process. Precisely the situation emphasizes how necessary it is for the complete educational system (the process of lifelong learning, improvement, etc, as well) to have the possibility of blended learning, that is, how much is important the cloud computing platform existence, that given process

potentiates. Number examples can be captured along countries and their struggle with current situation. Some schools have organized a virtual teachers' room and virtual classrooms on various platforms (Loomen, Microsoft Teams, Yammer) where teachers have communicated daily with their students, given them instructions, checked their activity and completion of tasks, somewhere with central support, including a learning management platform/ system. Programs such as Office 365, Skype, Blackboard are used. Access and cloud services are being created. In Serbia, like in many countries, the most popular edtech tools during COVID-19 pandemy for audio-video classes have been Zoom and Microsoft Teams (WorldBank, 2020). Following table emphasizes two the most used edtech meeting tools during spring 2020.

Table 1. Online meetings Teams vs. Zoom comparison

Features	Microsoft Teams	Zoom
Compatibility		
Desktop App	Windows, Mac	Windows, Mac, Linux
Mobile App	iOS, Android	iOS, Android
Capacity		
Maximum Meeting Attendees	250	300 (optional upgrade up to 1000)
Audio and Video		
HD Video Capable	Yes	Yes
Join Meeting with Audio Only	Yes	Yes
Streaming Quality		Better overall
Chat		
Chat Within and Outside Meetings	Yes	Yes
Content Sharing		
Screen Sharing	Yes	Yes
Application Sharing	Yes	Yes
Annotate Shared Content	No	Yes
Work collectively on a document	No	Yes (share documents via LU Box, Office 365 or Google Drive and share screen)
Whiteboard	Yes	Yes
Remote control of screen	No	Yes
Meeting Capabilities		
Break-out rooms[2] for discussions and subdivision	No	Yes
See whether participants in the room are focusing or not[3]	No	Yes
Polling (voting)	Yes, via 3rd party plugins	Yes
Moderated Q&A	No	Yes (via vebinar function)
Cloud Recording	Yes	Yes
Local Recording	No	Yes
Join Before Host	Yes	Yes
Security		
Approved for Confidential Data	Yes	Yes
Approved for Restricted Use Data	Yes	Yes
Encrypted Meetings	Yes	Yes

Source: Authors, according to official app sites

[2] This is a way of subdividing the group with each group having the possibility of participating in discussions and presentations

[3] In Zoom, monitoring if the participants are focusing on the meeting or if they are working on something else on their computers

5. Conclusion

When it comes to education systems, perhaps the best solution is a hybrid form of cloud that allows part of the resources to remain within the system and the part to be moved to the public cloud of the service provider. Nowadays, it would be useful for resources to develop or grow into a single data center of local character with a shared cloud "around" a given data center, which would be shared by educational institutions. Everything is strategically viewed optimizing the business through reducing business costs and increasing productivity and efficiency.

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Društvena odgovornost u primeni integrisanog marketing komuniciranja

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Apstrakt: Savremeni poslovni subjekti koji posluju samostalno ili su integrisani u okviru modernih tržišno orijentisanih sistema u interakciji su sa okruženjem u kojem posluju. Promovisanjem društvenih vrednosti i normi preduzeća ostvaruju značajnu konkurentsku prednost u odnosu na preduzeća iz svoje delatnosti, povećavajući svoje učešće na tržištu što ima za posledicu porast ukupnog ostvarenog profita konkretne kompanije. Poslovni subjekti imaju veliku ulogu u razvoju i negovanju aktivnosti koja se tiču društvene odgovornosti naročito u oblasti očuvanja životne sredine i pružanja zadovoljavajućeg kvaliteta proizvoda i usluga. Cilj ovog rada je ukazivanje i predstavljanje promena u društveno odgovornom ponašanju u odnosu na trendove u marketinškom okruženju.

Ključne reči: društvena odgovornost, integrisano marketing komuniciranje, potrošači

Social responsibility in the application of integrated marketing communication

Abstract: Modern business entities that operate independently or are integrated within modern market-oriented systems interact with the environment in which they operate. By promoting social values and norms, companies achieve a significant competitive advantage over companies in their field, increasing their market share, which results in an increase in the total profit of a particular company. Business entities have a major role in developing and nurturing activities related to social responsibility, especially in the field of environmental protection and the provision of satisfactory quality products and services. The aim of this paper is to point out and present changes in socially responsible behavior in relation to trends in the marketing environment.

Key words: social responsibility, integrated marketing communication, consumers

1. Introduction

Modern business entities are daily involved in all opportunities and relationships concerning the community and through various activities of their employees show increasing interest in the area that regulates their social responsibility. Social responsibility implies the obligation of the management of the business entity (company management) to perform certain tasks, taking into account broader social goals, which will contribute to increasing the welfare of the entire community and the business system itself (Živković, 2011, 124). Conducting an adequate business policy requires the management of the business entity (manager) to conduct ethical and responsible behavior with the aim of improving existing patterns of behavior concerning traditions, customs, beliefs and norms aimed at preserving traditional values.

In recent years, there has been a growing interest and need of both trading companies and financial institutions to create closer ties with regular customers and potential consumers. The reason for developing long-term good business relationships with customers is to reduce the rate of abandonment of specific companies by customers, increase the rate of their loyalty, reduce the cost of hiring to acquire new ones and increase the profit rate of the company itself. Most of the companies themselves want to build good relationships with their clients, but most also feel a commitment to their potential and regular customers. In most cases, trading companies in practice feel that they have built relationships with their customers and every day they try to strengthen them even more and position them on a long-term level. Creating a long-term level of projected profit is the basic goal of every company, and in order to achieve forecasts, one of the crucial targeted goals is the existence of a base

of loyal consumers. Therefore, the company must first research and examine consumer attitudes about the quality of its own products, services, prices, types of promotion and distribution system.

After the conducted research, it is necessary to create marketing strategies through which consumer satisfaction will be ensured, ie long-term consumer loyalty will be ensured. Consumer behavior under the influence of marketing-oriented companies indicates the need to conduct consumer research if a particular company wants to withstand the pressure of competition in the current turbulent environment. An approach based on building long-term relationships with marketing-oriented companies enables the company to achieve a good image and market position for a longer period of time, a better image of the company in the eyes of the public and gain a recognizable and sustainable competitive advantage. Caring for consumers and solving their consumer problems and fulfilling wishes has over time become one of the main points of business and further survival of a particular company. One of the main features is that the actors understand the necessity of recognizing the values of loyal consumers.

Under the influence of the trends of the modern business environment, there has been a change in the behavior of consumers, which is reflected in the growing number of their demands, desires and expressions of demands for new needs in terms of satisfying their growing and very transparent desires. With the advent of the Internet and the expansion of the digital revolution, consumer behavior towards marketing-oriented companies has gained a new dimension that has imposed a new task on companies in terms of retaining existing ones, attracting new customers and increasing their satisfaction. The Internet has contributed to the creation of online commerce, online portals and websites, and has provided the ability to follow the then traditional media such as television, radio, newspapers and magazines and digitally, which has resulted in questioning the very survival of these media.

2. Literature review in the field of social responsibility in the application of integrated marketing communication

2.1. Corporate social responsibility

Corporate social responsibility is defined as a concept that requires businesses to take care of all stakeholders who have an impact on the business activities of the company. The concept of corporate responsibility towards society includes the responsibility of managers who, when implementing their strategies, tactics and operational tasks, must take into account all elements of the social environment in which a particular company operates (Marić, 2012, 9). It is also of great importance to enable the actions of the economic entity to act in accordance with and in interaction with the factors and elements that act from the internal and / or external environment.

Many companies consider it very important to participate as an active factor in the environment in which they operate. From the very beginning of business, every business entity is obliged to take care of its social responsibility and take care of positive values, ensuring a secure future for new generations. Within the concept of social responsibility, among the numerous activities, which are supported by economic entities, include cultural and sports events that are successfully realized with the support of companies. This type of corporate social responsibility is usually of a humanitarian nature and is implemented under the auspices or sponsorship of a specific company.

Most companies have focused their business on improving and free education for both employees and users of their services in the field of improving health and habits related to nutrition and physical activity. All companies are required to adhere to HACCP standards in their business, which refers to the production and distribution of food to service users. Employees in the facilities must respect the most important aspects of this standard, such as the quality and food safety of users of these types of services. HACCP is an integrated food safety control system at all stages of its production and distribution.

2.2. Dimensions and aspects of corporate social responsibility

Companies are constantly committed to achieving positive business results in a socially responsible way with constant care for the local community, and to the satisfaction of customers and employees with minimal negative impact on the environment.

By integrating social responsibility through their core business to enable sustainable business growth and increase their market share reflected in the number of satisfied customers, companies pay special attention to the population that falls into special categories such as children, youth, people with disabilities, etc. Most are focused on the development of products and services that contribute to the fight against harmful effects on health (tobacco, alcohol, physical inactivity) and improve the quality of life. At the end of the 20th century, great attention began to be paid to business systems that perform their activities in accordance with all the rules concerning a successful business entity. Many business facilities have become aware that only in the process of continuous business improvement and respect for business ethics have they been enabled to grow and develop successfully while increasing the efficiency and productivity of business facilities. The rules of business ethics include business that will increase welfare from the point of view of social equality and individual development for a particular company, as well as its stakeholders, customers (service users), suppliers, employees, shareholders, the environment.

One of the most important dimensions of business is their socially responsible business, which represents the company's commitment and effort to contribute to increasing the quality of life of employees and their families, as well as the economic development of the local community and national economy and society as a whole. Being a socially responsible company does not only mean fulfilling legal obligations, but also includes investing in human capital, the environment and in relations with stakeholders (Milisavljević, Todorović, 2000, 194).

Corporate social responsibility implies that for the profit they make, companies are not only responsible to shareholders, but also to individuals and groups to whom the profit is reflected in any way. An equally important aspect of social responsibility concerns the employees themselves, improving their skills, developing teamwork, motivation and morale within the organization itself. Most of the socially responsible business initiatives, related to the community or the environment, come from the employees themselves. The media and the government are important incentives for social responsibility in the company's operations, and internal public relations at the macro level can potentially be more important than external ones due to the large number of employees who need to form a sense of belonging to the company. Therefore, vertical two-way communication that includes informing and motivating employees, their placement in appropriate jobs, as well as their continuous improvement is aimed at creating a good corporate culture that results in an appropriate corporate identity and image in the external public.

Corporate social responsibility, understood in the way described above, aims to develop mechanisms that encourage positive or reduce the negative effects of the global economic crisis on the development of business entities, as well as the economy as a whole. When evaluating the business of a company, the following characteristics must be taken into account (Ristić, 2008, 94):

1) external appearance of the company and infrastructural elements: possibility of free parking, access to the business facility, proximity to shopping centers, cultural and historical sights, etc;
2) condition of the building, as well as its complete functioning;
3) lighting in all parts of the facility that contributes to the safety and comfort of employees;
4) the existence of handrails (handrails) on the stairs and paths (in the garden and in the parking lot), ramps for people with disabilities;
5) hygiene of the business facility;
6) appearance, clothing, behavior, kindness and competence of management and staff;
7) organization, information and manner of work;
8) structure of employees (miles, atmosphere, eminence);
9) affection towards children, families and disabled persons expressed through the equipment intended for them, as well as the behavior of employees;
10) conducting environmental protection policy.

Classification in a certain category related to the corporate social responsibility is done with respect to the overall impression of the company or its equipment, services, space intended for the use of free time, as well as its management.

1.1. Trends in corporate social responsibility

Since the last industrial revolutions, economic activity has been used as a process that involves the exploitation of natural resources, processing them, creating them in the final or semi-finished product, distribution, use and disposal. Such a model of attachment is recognized as a linear model of the economy that implies that waste, as a by-product of the production process, is disposed of in the environment. The concept is based on the principle of take, make, use, reject and transform the infinity and easy availability of material resources (Stojanović et al., 2019, 37).

This concept of economic development leads to the memory of economic performance, but also by nature, natural resources, as well as human life and health. However, economic development without the preservation of natural resources and the environment can be neither economically, nor socially justified nor acceptable. Therefore, it is necessary to apply a new development model that was stable, efficient, cost-effective but also sustainable in the long run. Consequently, sustainable development is today accepted as a universal development paradigm applicable to all countries of the world. It is a multidimensional concept that represents the weight to create a better world, to balance economic, social and environmental factors in order to preserve natural wealth for future generations. The first big step in changing the way of thinking in the direction of sustainable development is recycling and waste treatment. Some countries, such as Germany, the Netherlands and Denmark, have made a significant step forward and used a strategy to implement a (circular) circular economy (Stojanović et al., 2019, 36).

1.2. The importance of corporate social responsibility

Based on Germany's many years of experience in introducing a circular economy, 5 phases have been defined in the process of improving the waste management system, such as waste disposal, waste collection, waste sorting, recycling and the use of raw materials obtained through recycling.

Online sales of non-food products online account for 24.1% of UK purchases in 2017 (Stojanović et al., 2019, 35). The convenience of online shopping means that consumers buy in the form of several different packages delivered to their homes, so the packaging must be adequately designed to enable products to be delivered to consumers through different channels. In addition to helping brands be competitive, packaging to prevent product damage can be easily recycled when the product expires.

As these changes in product packaging become part of everyday life, recycling systems must be adapted to be able to ensure the collection of packaging for recycling. Packaging designers and suppliers, local authorities and the recycling sector must work together to ensure that packaging can be easily recycled and thus contribute to the circular economy. There is already disposable packaging, a hard-to-recycle recyclable packaging material such as cardboard, which in the UK accounts for 82% of the total recycling of all recyclable materials. The challenge is to maintain and improve recycling by users, given that retailers take advantage of the possibilities of recycling cardboard packaging of well-known brands and brands (Stojanović et al., 2019, 36).

1.3. Communicating social responsibility through integrated marketing communications

In the modern business world, there are many examples of how companies can see how they communicate with their consumers through integrated marketing communications within the norms of social responsibility. The world-famous company H&M (Hennes and Mauritz) is the world's leading fashion company with more than 3,600 stores worldwide and online shopping in 23 countries. The H&M range consists of 6 independent brands, such as H&M, COS, Monkey, Weekday, Cheap Monday and Other Stories, with almost 4,000 stores in its sales network. H&M is working on a strategy based on a 100% circular economy. The company collects and recycles old clothes in its stores, and since 2013, the H&M Company has collected more than 55,000 tons of reusable materials to produce new clothes. As a global partner of the Ellen McArthur Foundation, H&M is intensifying its cooperation with the Foundation in the coming years, in order to explore new possibilities for applying the

principles of the circular economy throughout the organization. H&M is currently working on updating sustainability strategies so that it can fully adapt its business to the principles of the circular economy. Including only recycled or other materials with sustainable sources in its production, the company strives to become a core company, which makes and uses its clothes in the circular economy (Ellen MacArthur Foundation, 2017).

During 2013, H&M introduced a clothing collection system in stores around the world and this way, the company collected over 28,000 tons of clothing and textiles by the end of 2016, which greatly helps to expand the disposal of textiles in landfills. The collected clothes, after that, can be reused, as used on a foundation. A large part of the clothes is recycled, and a cleaning cloth or insulating material is obtained as a base coat, and fabrics for new clothes are produced from individual collected clothes. In 2014, H&M managed to make the first clothes with 20% recycled cotton. During 2015, H&M increased the number of such products by 300% to over 1.3 million units (Ellen MacArthur Foundation, 2017). However, at this time, it is not possible to use more than 20% recycled cotton per product, without losing quality and durability. H&M hopes that in the coming period it will successfully respond to all challenges and therefore actively promote innovations in recycling by directly investing in new solutions in the field of circular economy.

1.4. The role of ethics in modern business

Ethics in modern business is a set of rules and standards of conduct that must be adhered to by employees in the company to which the code applies to consumers and businesses. Accordingly, the business entity will be understood as a socially responsible business entity. If they do not adhere to the ethical codes of business, companies are not socially responsible and therefore it is considered that the implementation of business ethics management in the business of economic entities is the main condition for building a business environment that will be socially responsible. Companies that have accepted the respect of the principles of business ethics in most cases have a code of ethics that represents the expected and standard rules of conduct for employees, in order to implement the business policies of specific companies. The code of ethics itself must contain general guidelines for achieving the goals of the organization in the prescribed manner. Drawing up a code of ethics is a good way to instruct the responsible person in certain guidelines on ethically correct conduct in making decisions concerning the overall business. The code of ethics of the organization is most often promoted by the person who is at the head of the business entity, and he is also in charge of rewarding ethical and punishing unethical behavior. This, as well as their own business procedures and decisions, provides a positive example for employees.

2. Corporate social responsibility and the domestic market

Corporate social responsibility in the domestic market implies procedures for testing compliance with technical regulations and standards. Some countries and regional economic integrations have enacted product labeling regulations to protect consumer rights, which prescribe a minimum of information that a product label must contain. Sometimes these regulations represent a significant barrier for foreign goods especially when they must contain appropriate signs and the like (Božić et al. 2014, 93).

National designations of origin are a right that protects two types of designations, such as designations of origin and geographical indications. The name of origin is the geographical name of a country, region or locality that serves to indicate the product from which the product originates, whose quality and special properties are exclusively or essentially conditioned by the geographical environment. National designations of origin include natural and human factors that perform production, processing and preparation as a whole in a certain limited area.

A geographical indication is a designation that identifies a particular good as goods originating in the territory of a particular country, region or locality in that territory, where a particular quality, reputation or other characteristics of the goods can be essentially attributed to its geographical origin. Products marked with geographical indications are natural products (stone, marble, wool, glass, etc.), agricultural products (tomatoes, peppers, peas, etc.), food products (cheese, cream, prosciutto, etc.), and handicrafts products (carpet, opanak, and other similar products that are produced by hand), industrial products, as well as home-made products (handmade products). Products with geographical origin are products that differ from other, similar products due to the typicality they received due to the specific

environment from which they originate and which gives them specific characteristics, reputation and reputation that consumers recognize (Veljković, 2010, 106).

A geographical indication points to to the consumers that a particular product has certain characteristics which are such because of the place of origin of that product. A geographical indication is a collective right of local producers and can benefit all producers in the region because it links a specific product to a specific territory. The added value of these products comes from the consumer and can be further strengthened by the legal protection of product names that define a specific quality. A geographical indication is a right that protects two types of designations: the name of the origin and the geographical indication.

3. Methodology

3.1. Systematic review protocol

The methodological basis of this paper is based on a combination of several different methods. In order to satisfy the methodological procedures (generality, reliability, objectivity and systematicity), various scientific research methods were used.

An exploratory research method, ie the use of existing literature and electronic sources, was used to determine the current state and development trends. Adequate integrated marketing communication will use the classification method to identify the basic factors that affect the degree of its implementation.In the development of the paper will use the method of analysis, as well as a comparative method.

The exploratory method will help to determine the current positions in the field of social responsibility and its application in the process of marketing integration, and the classification method will identify differences and compare current, ruling trends in the field of social responsibility. In further analysis of the work and the obtained results, the statistical SPSS method will be used.

A complex methodological approach and the application of several scientific methods is necessary due to the complexity of the problem that is the subject of research in this scientific paper.

5. Results

Table 1. Profitability indicators and reference values

Profitability	Calculation method	Unit	Reference value
Yield on assets (ROA)	ND/TA	ratio	≥0.1
Return on equity (ROE)	ND/SE	ratio	≥0.15

Source: according to Horngren et al., 2012; Waltz, 2003.

For the purposes of comparative analysis of the impact of social responsibility in the field of integrated marketing communications, companies are divided into two groups.

The first group consists of companies that respect the principles of social responsibility, and the second group consists of companies that are in the system of marketing integration.

The study was based on a sample of 20 companies, which were divided into two independent groups of samples, 10 from each group. The analysis of the profitability of companies was conducted in the period April - July 2020. The following table shows descriptive statistics for ROA and ROE profitability indicators at the group level made up of companies from both analyzed groups.

Table 2. Descriptive statistical analysis at the group group level

	ROA				**ROE**			
	April	**May**	**June**	**Julz**	**April**	**May**	**June**	**July**
Social Responsibility								
Significance	-0.099	-0,011	-0,012	-0,010	-0,316	-0,039	-0,041	-0,043
Minimum	-0,129	-0,117	-0,516	-0,168	-0,139	-0.776	-1,754	-0,406
Maximum	0,165	0,186	0,172	0,104	0,371	0,370	0,453	0,372
Standard deviation	0,093	0,081	0.188	0,074	0,402	0,314	0,618	0,194
Variance	0,009	0,006	0,005	0,006	0,170	0,115	0,410	0,039
Marketing Integration								
Significance	0,053	0,079	0,077	0,088	0,143	0,209	0,339	0,385
Minimum	0,007	-0,116	-0,029	0,002	0,011	-0,538	-0,105	0,018
Maximum	0,386	0,217	0,205	0,346	0,769	0,922	1.709	0,649
Standard deviation	0,099	0,086	0,052	0,099	0,204	0,378	0,498	0,213
Variance	0,008	0,006	0,007	0,009	0,048	0,148	0,253	0,047

Source: SPSS author's calculations

Table 3. Statistically significant difference in the level of ROA between companies that respect the principles of social responsibility and marketing integration

Source	Type III sum of squares	DF	Square	F	Sig.
Interceptions	0,029	I	0,029	2.218	0,138
Principles of social responsibility	0,169	I	0,169	10.073	0.002
Fault	0,289	14	0.012*		

Source: SPSS author's calculations

4. Disscusion

Comparing the social responsibility of companies and their degree of marketing integration, ie hether they generate net profit or net loss, it can be seen that a number of companies, which respect the principles of social responsibility, managed to operate positively in the period April-July 2020. In the period from April to July 2020, all companies from the sample of the group social responsibility made a net profit. Based on the previous facts, the following tasks are set:

1) To examine whether there is a significant difference in the level of profitability between companies that respect the principles of social responsibility and marketing integration;

2) To identify the causes of these differences, if there are significant differences in the level of profitability among participants.

In accordance with the needs of the research, and having in mind that profitability is most often measured on the basis of two analytical indicators, ROA and ROE, the following hypotheses were set:

H1: There is no statistically significant difference in the level of ROA between companies that respect the principles of social responsibility and marketing integration;

H2: There is no statistically significant difference in the level of ROE between the principles of social responsibility and marketing integration.

Differences in profitability of participants within the respect of the principle of social responsibility were examined using the statistical method ANOVA. For companies that respect the principles of social responsibility and marketing integration, profitability is measured based on ROA and ROE indicators for a period of four consecutive months. The results of the statistical test show whether there is a statistically significant difference in the level of profitability between the two groups of participants, in this case companies that respect the principles of social responsibility and the sphere of marketing integration. The results of ROA measurements indicate that companies from the group of social responsibility have a higher level of average profitability compared to companies that belong to the group in the field of marketing integration. In accordance with the established research program, a statistically significant difference in the level of ROA between companies that respect the principles of social responsibility and marketing integration is tested using statistical methods by re-measurement using the ANOVA test.

5. Conclusion

Modern marketing integrated business systems represent a place of socially responsible behavior that allows companies to invest part of their profits in the market economy system in activities related to long-term social responsibility. Requirements from different stakeholder groups, external and internal stakeholders for responsible activities of a particular business system make the system complex but also flexible. In this way, business systems are forced to implement in their business part of the tasks related to respecting the well-being of the entire community. In addition to the implementation process, the management of a particular company must regularly control and audit part of the business and tasks related to the part of the business aimed at respecting standards and rules in the field of social responsibility. In the process of their business, companies are obliged to apply the ISO standard which refers to the respect of the principle of social responsibility, as well as the HACCP standard which regulates the area related to the food safety system. By adopting and respecting the mentioned principles and standards, companies are enabled to operate efficiently, profitably and profitably, which aims to meet the needs of employees, interest groups (stakeholders) and the community as a whole. Effective and efficient business requires the management of the company to operate effectively and efficiently, regularly monitoring that will warn him in time about the social consequences of business decisions. Making related business decisions and their implementation requires long-term training in the process of making a profit, because, recently, the market has become extremely demanding in terms of respecting the proper conduct of companies and their social responsibility.

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Lekcije iz liderstva: Kubanska revolucija i stvaranje mita zvanog *Če Gevara*

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Apstrakt: Ideje i pojmovi koji omogućavaju analizu geneze i puta Ernesta "Če" Gevare kao ikone prvenstveno su postavili Panofski, Martin Kemp i Bart. Prvi razume ikonologiju kao značenja određene slike u odnosu na različite socijalne, istorijske i geografske kontekste onoga ko je posmatra. Po Martinu Kempu, ikonu možemo definisati kao pojavu koja je dosegla izvanredan stepen prepoznatljivosti i rasprostranjenosti, koja je je zadobila raznovrsne i brojne konotacije kroz različite epohe i kulture, transcendirajući svoja originalna značenja i funkcije. Koncepti denotacije i konotacije, naročito onako kako ih je Bart razvio, predstavljaju važnu alatku u otkrivanju značenja koju je lik Če Gevare vremenom dobijao.

Cilj analize savremenih mitologija je prema Bartu pokazati da je ono što se predstavlja kao "prirodno" zapravo jedan od mogućih "pogleda" na stvari u skladu sa određenom ideološkom predstavom sveta, koja je proizvod specifičnih istorijskih okolnosti. Dobro je poznato da ikona kao što je lik Če Gevare može imati različita značenja za različite osobe u različitim epohama. U nastavku ovog teksta, istrazivaće se trag svih značenja koja je lik Ernesta Gevare zadobio u različitim kontekstima i kako bi se videlo kako ta značenja nisu nešto "prirodno" već predstavljaju kreaciju konkretnih ljudskih aktera, čiji je interes bio da pošalju konkretne poruke, da stvore određeni imidž kako bi legitimisali svoje političke i verske aktivnosti, ili da ga apsorbuju u vrednosti i stavove konzumističke kulture u cilju sticanja dobiti.

Keywords: Mit, ikona, Če Gevara, liderstvo

Leadership lessons: The Cuban Revolution and the Creation of a Myth called *Che Guevara*

Abstract: Ideas and concepts that enable us to analyze the genesis and path of Ernest "Che Guevara" as icons were primarily set by Panofsky, Martin Kemp and Bart. The first understands iconology as the meaning of a certain image in relation to the different social, historical and geographical contexts of the observer. According to Martin Kemp, the icon can be defined as a phenomenon that has reached an extraordinary degree of recognizability and prevalence, which has acquired diverse and numerous connotations through different epochs and cultures, transcending its original meanings and functions. The concepts of denotation and connotation, especially as Bart developed them, represent an important tool in discovering the meaning that the character of Che Guevara gained over time.

Keywords: myth, iconic, Che Guevara, leadership

1. Introduction

Ernesto Guevara became famous for his participation in the Cuban Revolution, which he joined as a member of the guerrillas commanded by Fidel Castro, which aimed to overthrow the hated dictatorship of Fulgencio Batista (1956-1959). In that war, Guevara became *Che*, he received the rank of a commander. Even then, revolutionaries understood the importance that images had and their meanings for the revolution. So, they were called to give interviews and to be photographed for the most read and most prestigious world magazines of that time: *The New York Times, Time, Life, Le Monde, Corriere della Sera*. The CBS documentary celebrated the rebels, calling them Robin Hoods from Sierra Maestra, a mountain range where Castro, Raul, *Che* and other rebels set up camps and from where they

managed the war against the dictatorship (Sebreli, 2010: 73). It is important to remember that in the beginning, until its triumph, the revolution had significant support, both domestic and international.

Under the Batista dictatorship, 80 percent of the best land was owned by American companies, and Cuba was a center for sex tourism of North Americans, as well as for the activities and realization of the mafia interests of this nation. Batista's government was characterized by corruption and brutal methods in dealing with the opposition. The revolution was initially nationalistic, popular and radical, and Fidel and the "July 26 Movement" had the sympathy and support of the American media. Fidel himself said in one of his tours of the United States that the revolution was against any form of totalitarianism be it fascism, Peronism or Communism. The leader of the revolution did what was in his power to distance his movement from communism, trying to get military aid from the United States, even after the triumph over the dictatorship. (Anderson 2007: 384-390).

2. The figure of Che turning into an icon of revolution

Understanding this context is very important to understand the figure of Che, his actions and the tragic end. First, because Guevara made a paradigm out of his experience in the Cuban guerrilla that was important for everything that was called the Third World at that time. The fact that 82 rebels who arrived in Cuba from Mexico on the yacht "Granma" defeated the superior military apparatus was the result of a complex set of circumstances. One of them was the dominance of the United States and Batista's dependence on that hegemony, which enabled Castro and the Cuban rebels to invoke the national feelings of the population. Second, the "guahiros" (guajiro-Cuban peasant) of the Sierra Maestra were brutally exploited poor peasants, oppressed by the dictatorship. This led to the guerrillas swimming among them like fish in water, to use Mao's metaphor to explain the relationship between the guerrillas and the people. At the same time, the "July 26 Movement" had a large network of contacts and support in large cities.

All this, together with the favor of the people, especially by other Latin American countries, but even by the United States, which did not suspect that Fidel was a Marxist, were the main objective factors that led the rebels to defeat the superior professional military force. But Che concluded from his experience in the Cuban guerrilla that a well-trained guerrilla, with physically and mentally strong and prepared soldiers, could start a revolution even when there are no objective conditions, since the guerrilla itself can create them. (Guevara, 1961: 3-4).

Another factor that contributed to turning Guevara into an icon of revolution during his lifetime was his travels on which he represented the new revolution in Europe, Africa and Asia. Che was received with great sympathy, thanks to the reforms carried out by the revolutionary government. Cuba was a political, social and cultural paradigm in the 1960s and 1970s, especially in Third World countries. Cuba was seen as a nation waging a just war to defend its sovereignty and against U.S. hegemony.

In addition, reforms have been implemented that have favored marginalized groups such as poor peasants and wage earners, who have now been given land or jobs in cooperatives and state collectives. Education and health have become free and accessible to all. These victories contributed to turning the revolution into the desired model, worthy of being emulated by much of the Latin American left of the time. After the Revolution, Guevara was at one time (from January to November 1959) the supreme commander and judge of *La Cabana*, police and associates of the repressive apparatus, journalists and entrepreneurs associated with the dictatorial government were convicted and executed. This part of Guevara's life, which came to light in new biographies, showed the other side of his personality, creating other meanings in relation to his character, at least for those in the middle, who are between those who want to uncompromisingly maintain the myth of Che and those who have always considered him a villain, and that the Cuban community has fled to the United States and much of the proponents of neoliberalism. Che's more serious biographers agree on the dark side of Che.

The Calvinist and Jacobin zeal in Che in different ways when it comes to executions. From a psychological point of view, can be cited the comment of one of Che's childhood friends, who said that Che had one sublime side and one evil side. Guevara witnessed how the CIA and the United Fruit Company, together with the military leadership of Guatemala, planned and carried out a coup in 1954 that overthrew the government of Jacobo Arbenz, who tried to implement agrarian reform that would affect the interests of landowners and American companies. This experience convinced him that, when

it came to defending the revolution, there was no room for mercy and that any weakness was dangerous (O 'Donnell, 2010: 107-109).

Regardless of the combination of various reasons, countless testimonies clearly show that the executions of people who were within the category of "dangerous or probably dangerous to the revolution", which he personally carried out or ordered, did not present him with any ethical dilemmas. After a period of command over La Cabana, Guevara was appointed director of the National Bank and minister of industry. From a fierce supporter of the USSR, Che became its critic for several reasons. One of them was his belief in the need for a hard model of a centralized economy and moral incentives that would be superior to material ones. He was critical of Lenin's New Economic Policy which allowed certain private companies and farmers to keep part of their surplus to use it for further commercialization) and of post-Stalinist attempts by Russia and other communist countries to approve certain market mechanisms to increase production of some products.

In addition, Che was deeply disappointed with the USSR because of Khrushchev's behavior during the 1962 missile crisis. As is well known, Khrushchev negotiated with Kennedy behind the backs of the Cuban government. In addition, Guevara believed that the international relations of the USSR and other communist countries were based more on economic interests than on solidarity with Third World countries. He openly criticized communist countries for buying raw materials from Cuba and other developing countries at market prices, and selling machines and technology at high prices. In that way, those countries became accomplices in the imperialist exploitation of the Third World. Finally, Che believed that communist countries should not sell weapons to countries fighting for independence from colonialism or imperialism, but that they should give them away (Giraldo, 2012: 30:40). Che's participation in the events in Congo, and especially in the defeated Bolivian guerrilla, was the subject of intense debate. There is no doubt that Che's ideas regarding the economy were not shared by the main officials of the Communist Party of Cuba, so Fidel began to listen to the opinions of expert economists. In addition, the open criticism that Guevara addressed to the USSR put Cuba in a conflict situation.

However, it can be said that the decisive factor was played by the different roles and characters of Fidel and Che. The first was a realistic politician, interested in personal survival as well as the survival of the revolution. He knew that after the reforms, expropriation and break with the United States, they could not afford something similar with the USSR. He was completely convinced that the solution to the world's problems was behind the Iron Curtain. He fervently believed in a quasi-apocalyptic vision of the struggle between evil - represented as American imperialism and European colonialism) and the good - Third World revolutionaries and their allies, the USSR, the Soviet bloc and China (Anderson, 2007: 533-540).

3. The image of Che transforming from a dangerous revolutionary to a saint and an object of consumerism

It should be remembered that the historical and ideological context in which Ernesto Guevara became Che was the context of the Cold War and the bloc conflict. In that context, Guevara believed that the model for solving the problems of Latin America and the Third World lay in the model of the USSR and China. His Marxism was not a renewed version of this theory and ideology, as was the case with Gramsci or Benjamin but an orthodox and pure version of his Leninist and Stalinist variant with Maoist connotations in mind. Guevara unequivocally accepted the dictatorship of the proletariat as Lenin understood it, and despite formal criticism of communist countries, did not question the main features of the system created in the countries of the so-called communist bloc, but emphasized their economic and technological successes.

In November 1966, Che secretly entered Bolivia and a few months later began a guerrilla war with Cuban and Bolivian guerrillas in the southeast. The goal was to launch an armed struggle in Bolivia that would extend to Peru and its homeland of Argentina. This struggle for the freedom of Latin America would force the United States to intervene, so the conflict would grow into a conflict between the Latin American peoples and the imperialism of the United States. There would be an international conflict, as in the case of Vietnam, which put pressure on the USSR and China to support the liberation struggle against imperialism (Anderson, 2007: 645).

The difference between Guevara's plans and Bolivian reality was huge. The Bolivian government managed, through propaganda, to convince the local population of the region where the guerrilla war was fought that the guerrillas were communist occupiers whose goal was to take away their land. Elsewhere, the Bolivian Communist Party did not support the guerrillas. Only a small number of members remained and fought alongside Che and Cuban soldiers. The cause of the behavior of Bolivian communists, as well as other communist parties on the Latin American continent, lay in the policy of peaceful coexistence of the USSR, which did not support the armed struggle in Latin America (Giraldo, 2012: 28:44).

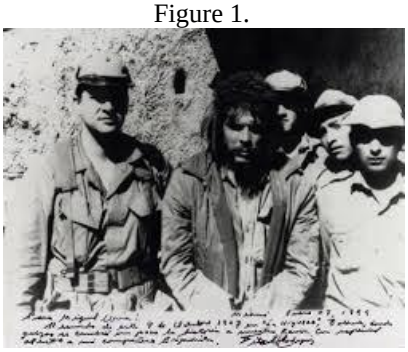
As previously stated, Castro was economically, politically and militarily dependent on the USSR and could not publicly reject the official policy of peaceful coexistence of the communist government and openly support Guevara who became a persona non grata for the leadership of the Kremlin and communist parties. As a result, Guevara and his people did not receive the support of either the Bolivian Communists or the local population. At the same time, communication and support from large cities, another important factor for guerrilla success, was weak or non-existent (O'Donnell, 2010: 89).

However, when the Americans discovered that Guevara was in Bolivia, they sent instructors of special units and modern weapons for the Bolivian army that was fighting guerrillas. In a short time, a small group of guerrillas was surrounded and attacked by well-trained and equipped soldiers. It was a completely unequal struggle in which at its very end (October 1967) on the one hand there were 17 guerrillas and on the other 2000 well-armed and fed soldiers. In the last battle near Quebrada del Yuro, Guevara was captured, transferred to the nearby town of La Higuera and shot the next day.

The guerrilla war in Bolivia denied Guevara's idea of using the Cuban experience as a model, at least his version of that experience. It was obvious that a group of experienced and well-trained guerrillas could not replace the lack of popular support, support from big cities and international support, and especially the lack of military support of the USSR or China, which was absolutely necessary in Bolivia. From a social, political and military point of view, the Bolivian experience was a complete debacle, culminating in an epic in which a small group of starving and wounded guerrillas clashed with a much superior army.

However, as Jorge Castañeda, a top Mexican academic and politician, pointed out, these same Bolivian soldiers contributed to the rise of Che to the pedestal of an immortal icon. (Castañeda, 1997). The confidentiality mark was removed from many photographs of the captured or executed Che only 30 years after the creation of the myth (Giraldo, 2012: 9:50). This is also the case with the Figure 1 seen below. Che Guevara is sick, tired, wounded, dirty, torn, worried and defeated, when he is escorted by Bolivian soldiers and a CIA agent in the uniform of a Bolivian commander.

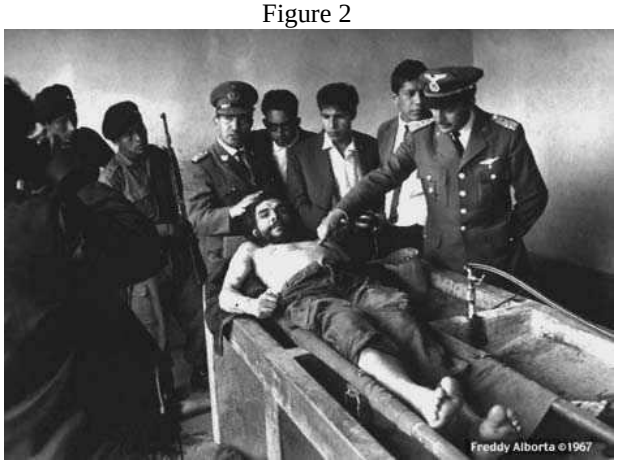
Figure 1.



These and other photographs of Che were not available to his followers and admirers in the 1960s and 1970s immediately after his execution.

For all those who are familiar with the Christian tradition, the photo of the dead Che (Figure 2) Guevara in the hospital could not but be interpreted within the framework of the most powerful and widespread mythology of the Western world – Christ.

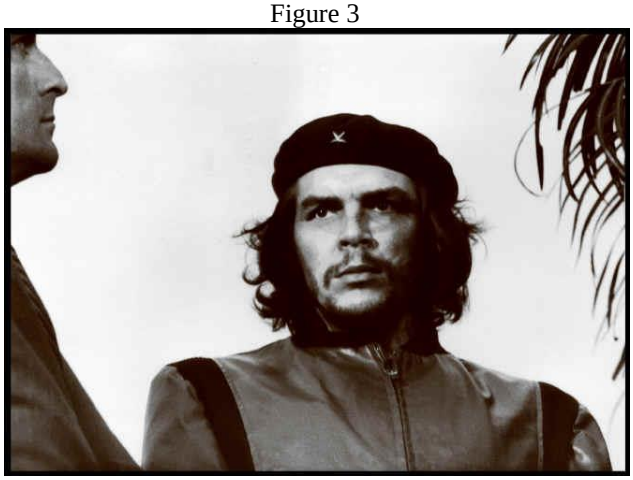
Figure 2



The blissful and calm face of the dead with open eyes and a calm look, makes the soldiers who take photos with him, touching his wounds and sharing his personal belongings (pipes, Rolex watches), they actually look like primitive fools, like the Roman soldiers who surrounded the cross. This is the background of the religious meaning and interpretation of the character of Che Guevara, who was created among the peasants and the poor people of the area where he fought and where he was executed.

These meanings are further reinforced in the works of Latin American artists and poets like San Salvador poet Roque Dalton, creator of artistic and academic narrative that connects Che to Jesus Christ. Photographs of the lifeless body of the assassinated Guevara alarmed the spirits and ignited the imagination of hundreds of thousands of admirers of revolutionaries, especially in the Western world. One effect of the wave of outrage over Guevara's execution and the abuse of his corpse was the mass printing of another photograph, even more significant in the creation and spread of the myth of Che. It is an image that appears on millions of posters, placards and murals. We are talking about a photo (Figure 3) by Cuban photographer Alberto Diaz Korda.

Figure 3



Before the revolution, Korda was a photographer of social events and fashion. After the triumph of the Revolution, he became a photographer of revolutionary fashion. This photo is probably the most famous and most widespread of the last century.

4. Photo - symbol of protests and political activities, deciphered from another side

This photo is the symbol that the generations of the 60s and 70s of the last century wore as a symbol of their protests and political activities. A random photo taken seven years before his violent death. Guevara is seen in a black leather jacket with a zipper and black straps on the shoulders. A beret with a

star representing his rank of commander. Long hair and beard. A sad, but at the same time determined look. Analyzing the meaning of the image in more detail, it can be noticed that the leather jacket does not correspond to the usual appearance of Che; more often he was in uniform, which was the clothing of all the leaders of the revolution; nor was the beret something that revolutionaries often used, their favorite hats. The jacket and beret are signs of Che's careless elegance. The beret is associated with some military uniforms and special units, but it is also a symbol of French bohemianism. The Red Star was used by Russian and Chinese communists. Long hair in men was associated with rebellion, and was at odds with the ideal image of a man represented with short hair, and in the 1960s was associated with hippie, anti-authoritarian, anti-war, anti-materialist and liberal culture.

It can be concluded that this photograph by Corda emphasizes the connotative chain associated with Che's character, which goes from revolutionary to careless elegance, recalling the paradoxical combination of a modest military uniform and a Rolex watch, through a bohemian and a rebellious young man. Another very important aspect should be added. Many people who knew Che spoke about his charisma and magnetic attraction that sprang from his penetrating and seductive gaze (Anderson, 2007: 537). The photograph taken by Korda at one historical moment, best described these features, expressing them in a unique visual way, incredibly convincing. Korda's photo became known around the world due to the Italian publisher Giangiacomo Feltrinelli.

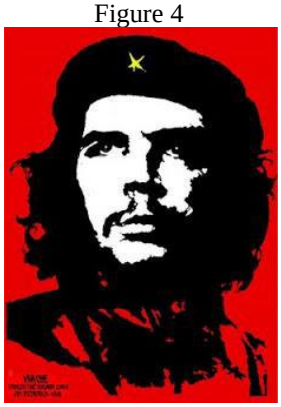
This Italian magnate and leftist was involved in the release of Regis Debray. During his visit to Cuba, Feltrineli received, without any compensation, two copies of Korda's photo as a personal gift. He made a poster of them, which he sold in 2 million copies within 6 months after Che's death. In addition, Feltrineli published Che's diary from Bolivia with a famous photo on the front page, which quickly became a bestseller. Korda was not mentioned when publishing the poster or the diary (Martin Kemp, 2012: 183). The Italian publisher and tycoon was initially associated with the Communist Party of Italy and later with the ultra-left, which advocated armed struggle. Feltrinelli represented the “Italian way” that celebrated Korda’s photography, although this in turn received no economic benefit.

5. Che's face - turning into a world icon - gaining huge profits

There was another "Irish way" which also significantly contributed to turning Che's face into a world icon. Jim Fitzpatrick, an Irish Marxist, made a poster of Korda's photo (Figure 4), using some of the techniques used to paint cultural icons, such as what Andy Warhol did from Marilyn Monroe's paintings. With Fitzpatrick's approval, the poster began to be used by students, turning it into an icon of the '68 rebellion and protest.

The version of Che's character that Fitzpatrick processed became so widespread that it began to appear on various useful items, from T-shirts to backpacks, cans, cigars, and even condoms. As a historical paradox, the icon of the anti-capitalist revolution brought huge profits to North American companies such as the Burlington Coat Factory, which, despite protests from the Cuban community, continued to sell T-shirts with Che's face, which was even used in commercials. Moreover, fashion has taken on new negative connotations of the character, and one online company "Shirtcity" sells T-shirts with ironic and comic depictions of this revolutionary.

Figure 4



6. The image and its paradoxical meanings - conclusion

In its original Latin American context, Che's image is closely linked to the Cuban revolution of the 1960s and 1970s, with all its anti-colonial, anti-imperialist and anti-capitalist meanings. As a revolutionary icon, Che was and remained for some members of that generation associated with the positive achievements of the Cuban Revolution. The same goes for the insurgency and the re-examination of the social system, which were the central values of the '68 generation. In the context of the critique of capitalist societies and Western colonialism, Che was and remained for individuals a figure who built the meaning of his existence in the fight against the aforementioned phenomena. His courage, generosity, courage, consistency and self-discipline were and remain fascinating. Just like his egalitarianism and honesty. In a sense, Guevara is an illustration of the gospel maxim that says "lose your life to save it."

However, the parallels drawn between the person of Jesus and Che are not sustainable. As it is had already mentioned, Guevara was a crusader of the revolution, its triumph and defense justified all means, including the use of weapons and the execution of suspicious persons or opponents of the revolutionary project, and even the sacrifice of an entire nation: Cuban during the missile crisis. Guevara's last project, the armed struggle in Bolivia, was a great failure.

However, the incompetence in the communication of the Bolivian army, and on the opposite side the ability of Che's supporters in Europe, significantly contributed to the creation of the myth. Pictures of Che in torn clothes, humiliated and captured were not published until several decades later; as well as those cruel ones on which he lies dirty and bloody after being executed associating immediately the image of the dead Che and the whole set scenario with Christian mythology.

On the other hand, the Italian publisher and tycoon celebrated Korda's photo around the world, selling millions of posters. It is not a photo of the defeated, dirty and humiliated Che, but one in which Korda portrays him as brave, sad, rebellious and defiant. A photo edited by Fitzpatrick similar to images of cultural icons such as Marilyn Monroe made by Andy Warhol was created afterwards. These posters made Guevara an icon of the ’68 generation in Europe and the United States, as well as young Latin American revolutionaries in the late ’60s and’ 70s. New studies have linked new meanings to Che's painting.

This is, for example, a fact that has to do with his Leninist, Stalinist and Maoist beliefs. Guevara sharply criticized Lenin's New Economic Policy, which introduced some of the capitalist mechanisms to start the communist economy. His conception of a strictly collectivist economy was closer to Stalinist collectivism of the late ’20s and early’ 30s. His personal and political asceticism resulted in contempt and disrespect for the material needs of ordinary people. Guevara also publicly emphasized that he was an admirer of Stalin.

The works of writers, poets, singers and cinematographers made Che an immortal icon of Latin American and world culture. Consumer culture has long exploited the meanings of the character of Che Guevara (protest, rebellion, courage) in order to increase sales of clothing and various items. In recent years, consumer culture has exploited even the negative, ie ironic meanings of Che's character. It can be concluded that Guevara became a true icon that over time gained a large number of different meanings in politics, art and consumer culture.

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Integrisano upravljanje otpadom u skladu sa „ISO 31000“ standardima za upravljanje rizicima i „Nacionalnom strategijom održivog razvoja“ u Republici Srbiji

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Apstrakt: U današnjoj eri globalizacije i svih prisutnih rizika od klimatskih promena neizbežni su promenom i preusmeravanjem koncepta globalne ekonomije. Visoko razvijene zemlje poput SAD-a, Japana, Nemačke i Holandije usvojile su strategije za primenu kružne ekonomije, dok druge poput Velike Britanije, Švedske, Kine i Brazila realizuju prelazne pojedinačne programe i projekte koji vode ka uspostavljanju kružne ekonomije. Sledeći taj trend, nesumnjivo je da je Republici Srbiji, njenom bližem balkanskom okruženju, potrebna nova verzija razvoja zasnovana na projektima „pametnih“ gradova, praćena reindustrijalizacijom i smanjenjem zagađenja, održivom potrošnjom zasnovanom na domaćoj ekonomiji i jačanjem opšta svest o društvenoj odgovornosti i potrebi za uključivanjem ranjivih grupa stanovništva.

Ključne reči: upravljanje otpadom, upravljanje rizicima, Republika Srbija

Integrated waste management in accordance with the „ISO 31000“ risk management standardand and „National sustainable development strategy “ in the Republic of Serbia

Abstract: In today’s era of globalization and all-present risks from climate changes is inevitable by change and redirection of concept of global economy. Highly developed countries such as USA, Japan, Germany and Netherlands have adopted strategies for implementation of circular economy, while others such as Great Britain, Sweden, China and Brazil are realizing transitional individual programs and projects that lead towards establishment of circular economy. Following that trend, it is without doubt that Republic of Serbia, its closer Balkan environment, is needed new version of development based on projects of “smart” cites, followed by reindustrialization and reduction of pollution, sustainable consumption based on domestic economy and strengthening of general awareness on social responsibility and need for inclusion of vulnerable groups of population.

Keywords: waste management; risk management; Republic of Serbia

1. Introduction

In today’s age of globalization and all-present risks from climate changes is unavoidable by change and redirection of concept of global economy. Highly developed countries such as USA, Japan, Germany and Netherlands have adopted strategies for implementation of circular economy (OSCE), while others such as Great Britain, Sweden, China and Brazil are realizing transitional individual programs and projects that lead towards establishment of circular economy. Following that trend, it is without doubt that Republic of Serbia, its closer Balkan environment, is needed new version of development based on projects of “smart” cites, followed by reindustrialization and reduction of pollution, sustainable consumption based on domestic economy and strengthening of general awareness on social responsibility and need for inclusion of vulnerable groups of population.

Republic of Serbia has adopted National Sustainable Development Strategy as one of the most important development documents for establishment of new vision of its development. In accordance with document of the United Nations from 2012, adopted on the Conference "RIO+20" (Sustainable development), guidelines through National Strategy of Republic of Serbia are given for further action in the field of sustainable development. With this document is recommended to national authorities to approach to sustainable growth and new alternative strategies through green economy, by its capacities.

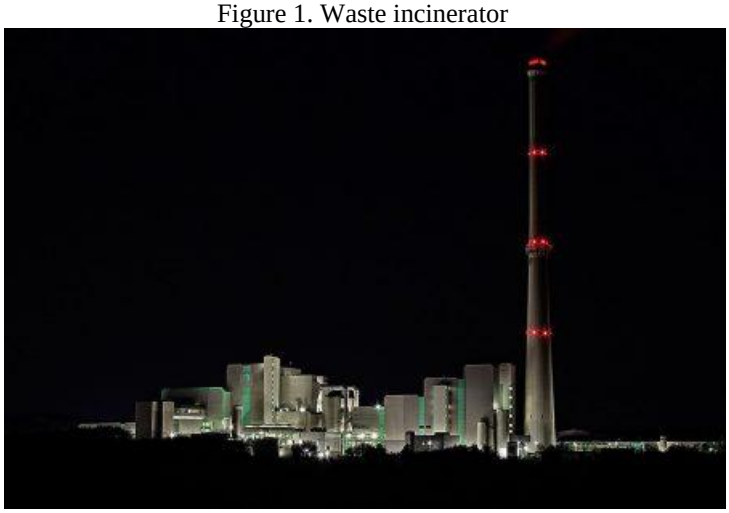
Development of Circular economy, as instrument for realization of sustainable development objectives, is followed by different risks that can lead to slowing down or failure of the project. Those risks can be divided into those that appear in the waste construction process for recycling, up to those which follow process of its exploitation. These risks have harmful effect on lives and health of people, economy and broader social community. All of them have in common financial risks for which we can say that follow both phases (construction and exploitation).

As we can observe risk management as integrated process of identification, analysis, evaluation and risk control, so waste management can be observed integrated as process of preventive production, exploitation and processing of waste. Synergy of these two processes creates effective system of Circular Economy, as project of future and sustainable development of social community. Circular economy closes the entire circle "product-waste-product" and means long-term investment in raw and energetic efficiency, with reduction of harmful emissions, change of fossil fuels by renewable sources and production and trade by sustainable products with objective of effective waste management.

According to the report by the Agency for Protection of Live Environment (SEPA) on waste management in the period of 2011-2017, it was generated 2.15 million tons of waste in total, out of which municipality public-utility companies collected 1.80 million tons or 83,7%. Average daily amount of waste storage on landfill per capita was 0.84 kg, and annual 0.30 tons. These data do not include around 20% of generated waste which ends up on wild dumps. In EU, out of average 487 kg of waste, 480 kg are processed in some way – in 2017, in average 30% of waste has been recycled, 17% composed, 28% burned out of which the biggest part was used for obtaining energy and 24% of waste is storage on landfill.

In Serbia, from produced 306 kilograms of waste per capita, only 257 kg has been treated, out of which even 256 kg ended up on the landfills, and one kilogram per person is used for obtaining secondary raw materials. Reviewing these devastating data, recommendations have been given to representatives of industry and local community in order to, in line with its capacities, adopt and apply models of sustainable production and sustainable consumption. Step in the right direction could be announced project for establishment of primary waste selection in fourth regions (Uzice, Pancevo, Pirot and Sremska Mitrovica) during 2019 and 2020, funded from the EU funds. For planned plant in Vinca in the future is expected to be part of solution for waste which is not possible to recycle, to be more precise, waste that stays after recycling and waste that cannot be treated by operations of re-use. For such waste, incineration in a plant for the production of electricity and heat from waste is envisaged

Figure 1. Waste incinerator



Source: Barcelona.com

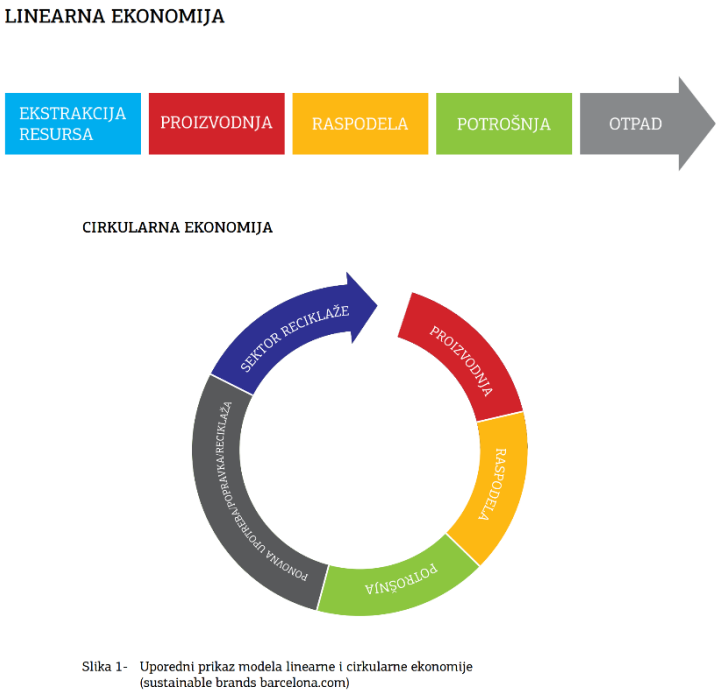
Other facilities in Serbia can be part of this solution as well, which is why Fiscal Council consider that in the construction of a plant for mechanical-biological treatment (MBT) and production of fuel from waste (solid recovered fuel SRF and refuse derived fuel RDF) in Novi Sad and Nis should invest total of around 30 million of EUR. It is expected that these capacities will enable that in Belgrade (Vinca) burns (and gains energy from) around 340.000 tons of waste and in Novi Sad and Nisu mechanical-biological treats around 200.000 tons of waste and products fuel. Fiscal Committee considers that plant in Belgrade can start with work around 2025 and other two around 2030 bearing in mind that its implementation has not begun yet.

With sustainable development strategy of Republic of Serbia (Vlada Republike Srbije) are defined development policies that foster effective development while there is prediction that realization of projects of “smart cities” improve new investments and open new green work places. By this approach, life standard and satisfaction of Serbian citizens is improved.

2. Waste management in the service of “Sustainable development” and “Circular economy”

When we are talking about sustainable development, we have to make a parallel with the term “Circular economy” as model of future development of local communities. All-present globalizations contribute to the fact that today developed European countries are going far away from the model of linear economy based on the principle “make-use-postpone”. This model in Republic of Serbia has been used during expansive economy growth, when use of resources was uncontrolled, energy use by product high, while pressure on living environment was not measured. This way, big amounts of waste have been created which have been inadequately treated and postponed. Difficult decisions and investments in the living environment have been moved for some other times, while pressure on living environment has grown with big amounts of historical waste that stayed in local communities and companies which went bankrupt. As consequence of long-term business based on the linear economy Serbia today has more than 3.500 wild dumps while on the annual level material with value of 50 million of EUR is disposed on more than 150 unsanitary landfills.

Figure 2. Linear and Circular economy



Slika 1- Uporedni prikaz modela linearne i cirkularne ekonomije (sustainable brands barcelona.com)

Source: Barcelona.com

Close future brings us growth of resource prices, growth of energy expenses, growth of population needs and migration towards cities, but especially it brings setbacks in the climate environment which

on the Western Balkan represents area of middle-high risk. Circular economy offers new model „product-waste-semi product “. The main source of economic growth is the higher reuse of materials from products that ended its „life cycle “and less use of new resources. It is necessary to strengthen awareness of citizens in order for them to start thinking about how product is designed, how much is it recyclable and how much is friendly for the environment.

Products are designed so it can be reused, divide, fix or recycle. Accordingly, in production renewable sources of energy are used. Assessment are that with introduction of circular economy in Serbia there will be 30.000 new job places opened and which will enhance competitiveness of the economy by which Serbia could become regional leader in development and investments.

Circular economy implies to re-question our relation towards natural resources. Recycle is process of extraction materials from waste and its re-use in the same or similar purposes. Process includes collection, extraction, processing and making new products from used materials. It is important to sort waste according to its type since many waste materials can use again if they are collected separately. All that can be used again without throwing it away present recycle with whom following objectives are achieved:

- Savings of raw resources (all materials are from natural origin and can be found in the nature in the limited amounts);
- Energy savings (there is no spending of energy in the primary processes, as well as not in the transport following those processes, while with combustion of non-used materials additional energy is received);
- Protection of living environment (waste materials degrade living environment, while with recycle living environment is protected);
- Opening of green working places (processes in recycle and eco product design require knowledge and work which creates needs for new working places).

In a manner of possibilities of re-use materials can be:

- Recyclable: can be used again with return to the production process;
- Non-recyclable: they cannot be returned to the production process; are used for getting energy by burning or are storage on the ecologically safe way.

Almost all materials can be recycled: paper, plastics, glass, aluminum, copper, iron, ceramics, electronic and electrical waste. Serbia today is successfully implementing process of packaging waste and special waste streams, recycle total amounts of generated tires and batteries and in packaging waste are achieved predicted National goals (SEPA, 2015).

Risks of uncontrolled storage of dangerous waste on communal or sanitary landfills can lead to different harmful effect on the health of population and living environment.

Unprocessed dangerous waste cannot be storage together with communal waste. If unprocessed dangerous waste is collected and storage with communal waste, especially on the locations which are not predicted for that, threat on population’s health is increased multiple times.

Risks of uncontrolled storage of dangerous waste are:

- Seepage water into ground water or rivers,
- Contaminated circumferential waters (from the surfaces – land and water intakes),
- Uncontrolled fires,
- Migration of gas into land and air,
- Waste slippage,
- Insects and rodents,
- Dust and stench.

Bad technology of waste storage leads to risk:

- Damage to health – workers, population and collectors,
- Damage to flora,
- Explosions and fires.

Also, there are some risk phases on which attention should be drawn while organization of dangerous waste storage:

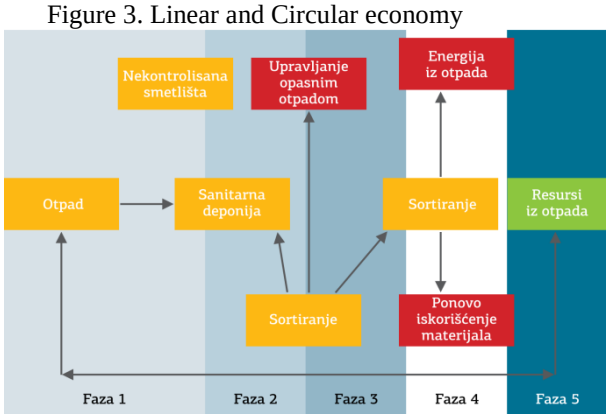
- Choice of location,
- Choice of forms for landfill design,
- Construction and object management,
- Control of landfill functioning,
- Monitoring and insurance of object while closing it.

All mentioned phases should be organized so that protection of living environment is secured: groundwater and surface water, health of population, flora and fauna, air quality, securing while working on the landfill, exclude negative impact on the food chain etc. time of transfer should be as short as possible, that there are protection measures in case of leak or fire and to define concrete type and amount of waste which will storage there. Form on which landfill will be designed depends of: type and amount of dangerous material that needs to be storage, planned length of landfill use, in its working shape, topography of field and characterizes of land on which landfill is located, climate characteristics of area, presence of ground water on the chosen location as well as possible impact on natural environment etc.

Based on the long-year experience of Germany in introduction of circular economy, 5 phases[4] have been defined in the process of improvement of the waste management system:

Phase 1 – waste storage on uncontrolled landfills.
Phase 2 – Reliable waste collection and improvement of landfills.
Phase 3 – introduction of separate waste collection and its sorting.
Phase 4 – improvement of recycle industry.
Phase 5 – circular economy – waste as material and energetic resource.

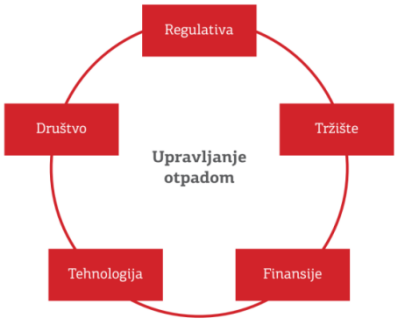
Figure 3. Linear and Circular economy



Source: German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, 2016

With aim of establishment of integrated risk management on the waste management systems, it is necessary to take into consideration elements such as law regulations, social factors, available technologies, financial aspects and conditions on the market.

Figure 3. Waste management cycle



Source: German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, 2016

Integration of waste management with risk management in production and product consumption present measures that are support to the regulation of waste management hierarchy, especially to prevention of waste creation and risk prevention in waste management. A number of measures is prescribed in the framework of strategic documents as well as number of independent measures that represent significant support to prevention of waste creation. Those measures concern design, production and consumption of products. Objective of these measures is impact on reduction of waste creation in the early phase of product production through lengthening of living cycle of product, reduction of dangerous materials within as well as through enabling “easier return” of product into life cycle after it becomes waste. Prevention principle presents one of the most significant pillars of circular economy and sustainable development at all.

Synergy of integrated waste management with integrated risk management helps us to see main problem in establishment of sustainable system and to give answers on question of how they can be overcomed. Choice and control of sustainable development initiator and integrated waste management, as well as application of multi-criteria analysis in this process requires good knowledge on principles of sustainable development, as well as areas of waste management. Initiators and its indicators are needed to be directly harmonized and checked. During choice of initiation, comparison of ecological, technical and investment factors is conducted. Generally, conducted activities should help in review of real condition in waste management in Republic of Serbia and broader, as well as to present model for integrated waste management system (Nikolić, 2012).

With new politics new priorities in waste management hierarchy are introduced, so called preparation for re-use. This priority supports number of independent measures which organizations included in waste management have to take and which concern introduction and strengthening of reparation product system. Preparation for re-use means return of products or part of products that became waste into life cycle with minimal investment. In practice number of independent measures has been introduced which relate to the improvement of volume and quality of recycle through establishment of separate waste storage system as well as number of measures that have to be elaborated in more detailed manner with strategic documents and which are related to the reduction of storage of biodegradable waste on landfills by encouragement of composing and anaerobic digestion. Term of “nusproducts” has been introduced as well as “end of waste status” which means return of materials into production, or to be more precise, return of waste into life cycle.

3. Risk management according to the standard ISO 31000

Risk in inevitable part of every organization’s business which is why it is part of quality management system (International standard ISO 9001). Risk reduction presents true challenge for organization. Way on which organization is facing with this challenge can be the key for its success. Without any doubt, best results show those organizations which manage to threats for business, challenges, transform into chances and possibilities for business improvement and conquering new markets. When risks are identified in a real way, it is possible to take activities for damage mitigation if potential risk appears and ISO standards have big benefits for organizations which implemented them. International standard ISO 31000 (iso.org) helps organization to develop risk management strategy which will help them in effective identification and risk reduction and will help them in achievement of organization objectives. This international standard for risk management ensured guidelines and principles in identification, analysis and risk assessments. It refers to the biggest number of business activities that include

planning, management operations and communication processes. Objective of ISO 31000 standards is development of risk management culture by which management, employees as well as other interest parties become aware of the significance of monitoring and risk management.

Theoretically, risk management includes its four basic elements: identification, analysis, validation and control, financing. Risk identification gives us answers on core questions: What are potential risks? How to they become? What consequences do they have? Where and on which location do they occur? In order to do correct risk identification, we have to conduct start survey forms, using survey tools, questionnaires, observations as well as overview of current practice in relation to the existing policies, procedures, appeal and forms for reporting on incidents or accidents.

When risks are identified, it is necessary to analyze them in order to determine: How often can they occur? How much could it cost? How dangerous consequences could be? With risk analysis we define possibilities of risky events and its impact on population, economic and social-political community, on its local and national – transboundary plan. With establishment of risk matrix, we give quantitative and qualitative parameters of risk impact values.

When risks are identified and analyzed, it is necessary to consider how they are valued and controlled. Questions arise that seek for answers: How risks can be eliminated? How risks can be dodged? How possibility for its appearance can be mitigated? How its expenses can be reduced?

Risk financing: even when practical measures with aim of elimination are undertaken or with aim of risk reduction, there is always some risk percentage that remains with which should be faced and take control over. Organizations then have to consider how to finance risk management.

Risk management creates value for organization not only by helping organization to identify potential dangers for business but also by enabling recognition of potential possibilities. ISO 3100 stands enables identification and control of risks that can jeopardize achievement of primary and key goals of each organization. Introduction of ISO 3100 standard helps:

- To formulate and correctly apply strategies and solutions for improvement and protection of organization needs;
- To establish effective risk assessment to balance economic gain in relation to uncertainty and losses.

Standard ISO 3100 is intended for organizations of all types and sizes which face with internal and external factors as well as impacts which lead them to uncertainty regarding achievement of set objectives. Therefore, it can be applying in small and big organizations, in private and public sector, all kind of associations. It is not intended for one specific field of work, rather its use is possible in one industrial areas and business sectors. Most of organization manages with risks in specific measure, but by introduce of ISO 3100 standard specific principles are established that have to be respected in order to have effective risk management.

Categories which receive benefits from implementation of risk management system are:

- Responsible for development of policies on risk management system,
- Responsible for risk insurance and effective management,
- Responsible for informational security,
- Project managers (risk management on the project),
- Managers of business finances.

There are numerous advantages of systematic approach to risk management in the company, some of the most significant are:

1. Higher possibility for achievement of goals.
2. Encouragement of proactive management.
3. Rising awareness on the need of identification and risk management on the level of all organization.
4. Improvement of opportunities and threats identification.
5. Improvement of relevant legal and regulatory demands.
6. Improvement of control.
7. Improvement of operational effectiveness.

8. Improvement of prevention of losses and incidents management.
9. Improvement of operative effectiveness.
10. Establishment of reliable ground for decision making and planning.
11. Reduction of costs through correct risk management.
12. Increase of trust with interest parties.

Standard ISO 3100 has 3 main chapters connected with the synergy of interaction and those are: principles, framework and processes.

II. Principles – maintenance of dynamic and continued improvement od risk management system which considers different human and cultural factors.

III. Framework – higher management leads proactive integration of risk management on all levels of the organization.

III. Processes – open communication and reporting on risks that are identified, analyzed and evaluated continuously.

In order for organization to have effective business, it has to accept and act according to specific principles. There are 11 principles of risk management in line with the ISO 31000 standard:

1. Risk management established and maintains value.
2. Risk management is integrated part of all organizational processes.
3. Risk management is part of decision making.
4. Risk management explicitly addresses uncertainty.
5. Risk management is systematic, structural and on time.
6. Risk management is based on the best available information.
7. Risk management is customized.
8. Risk management takes into consideration human and cultural factors.
9. Risk management is transparent and inclusive.
10. Risk management is dynamic, interactive and reacts to changes.
11. Risk management enables continuously improvement of organization.

Success of risk management depends on effectiveness of management framework:

- It helps in effective risk management through application of risk management processes.
- Ensured adequate reporting on risk information which come from risk management process.
- Ensures that this informationis used as ground for decision making and responsibility on all relevant organization levels.

We can conclude that framework of standard ISO 3100 grounds on Demingo’s PDCA cycle while main element of framework is:

Plan – Design of framework for risk management – in this part of total process of risk management is approached towards definition of context, risk assessment, planning of risk treatment and acceptance of the remaining risk.

Implementation – implementation of structure and program for risk management; Check-Monitoring and overview – continued supervision of structure and effectiveness of management system.

Act – Constant improvement – maintenance and improvement of risk management process.

Risk management process, according to the ISO 3100 includes:

1. Communication and consulting – with all interest parties are necessary in all phases of the risk management process. ISO 3100 standard suggests formation of team, development of communication plan, secure information in risk identification, defining timeframes for deadlines and resources, defining of specific context etc.
2. Determination of context – determination of model elements that define basic parameters of risk management and secure areas of application and criteria for remaining process.
3. Risk identification – includes: where, when, how and why events could postpone, mitigate, prevent of rise achievement of goals.

4. Risk analysis – includes establishment of connection between possibility that some danger will occur and seriousness of consequences that could occur with that opportunity.

Objective of risk analysis is to:

- Separate acceptable from non-acceptable risks.
- Predict volume of consequences.
- Ensure measure that will help with handling risks and its solution.

Risk analysis can be quantitative and qualitative.

- Quantitative risk analysis aims to with use of methods and techniques in analysis of identified risky events determine impacts and consequences that specific risky events can have on the organization objectives. This analysis offers data on possibilities of repeat and size of impact of risky events.
- Qualitative risk analysis uses different quantitative methods in determination of risky events and its impact on organization objectives. Qualitative risk analysis enables determination of priority risks list.

Risk evaluation – sets up comparison of assessed risk levels with previously determined criteria and considers balance between potential benefits and unfavorable results. Risk evaluation depends on: ways of thinking, nature of results and forms of result interpretation.

Risk treatment – present creation and application of specific strategies and plans for increase of potential benefits and reduction of potential costs.

Monitoring and re-questioning – activities in the process of risk management have to be followed and documented, it is necessary to follow effectiveness of all risk management steps. Recording ensure base for improvement of methods and process.

All components of standard ISO 31000, principles, frameworks and processes reciprocally are connected and it is necessary to observe them in that manner. Risk management by recommendations of ISO 31000 standard offers bigger chances for realization of planned objectives with fewer losses. Risk acceptance in accordance with structured approach towards risk management means use of processes that help in identification and minimization of risks and at the same time, possibility to focus on key competences.

4. Conclusion

Effectiveness of every system is achieved through integration and synergy of its processes and sub-systems. Integrated waste management represents one of the pillars of sustainable development and circular economy of developed social community, which our Society aspired. Strong control of process of production, exploitation and correct storage of its waste to process of recycle or final destroy in line with principles of Circular economy, present scientific challenge today. This integrated process cannot be seen without framework of integrated risk management process that occurs in all levels of waste management.

These risks constantly threaten to health of people and living environment so its management have to consider very responsively. In order to conduct this process correctly from its beginning until its end, it is necessarily to follow rules, principles and procedures in accordance with international standard for risk management ISO 31000. This international standard helps us to define methodological and terminological framework for risk management, its reduction on acceptance level.

Waste management on the platform of sustainable development and circular economy of social community includes preventive control of creation of product, its consumption and its final storage or recycle with aim of going back to the beginning of this cycle or even to the final destroy with production of heath of electric energy. Risk management presents integrate cycle of its identification, analysis, validation and financial control of established corrective measures. With comparison of this two integrated processes we see that there are similarities in preventive approach in both directions, which achieves towards even bigger effectiveness in achievement of goals of sustainable return and circular economy.

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Predviđanje prodaje na platformi e-trgovine, korišćenjem data mining modela

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Apstrakt: U ovom radu primenjen je algoritam za prodaju twinning proizvoda sa e-commerce web platforme. Kako bi se utvrdili relativno homogene grupe proizvoda u trgovinskom lancu na internetu tokom prethodne godine potrebno je bilo formirati prediktivni matematički model. Nakon izdvajanja objekata i određenih atributa iz MySQL baze podataka, određivanja skupa relevantnih varijabli koje će reprezentovati obeležja grupe, primenjeni su K-means algoritam u Python programskom okruženju, Market Basket model i Vector Distance model. Na osnovu analize izvornih i veštačkih promenljivih, predložen je broj klastera, koji je tokom izvršavanja algoritma fiksan, a u cilju detekcije razdvojenosti i kompaktnosti klastera, korišćen je Silhouette indeks. Na osnovu podele po klasterima, urađeni su modeli koji predviđaju slične proizvode i analizirala se verovatnoća kupovine. Dobijeni rezultati mogu se koristiti u smislu planiranja prodajnih kampanja, optimizacije troškova marketinga, predlaganja novih programa lojalnosti, kao i boljeg razumevanja ponašanja potrošača sa ciljem zadržavanja postojećih i povećanja broja novih kupaca. Rezultati su izdvojeni u dve grupe - predloge koje treba ponuditi kupcima i predloge koje treba ponuditi prodavcima.

Ključne reči: Klaster analiza; PCA; Market Basket analiza; Vector Distance model; segmentacija tržišta

Sales prediction on e-commerce platform, by using data mining model

Abstract: In this paper we applied twinning algorithm for product that are sold via e-commerce platform. To establish relatively homogenous product groups that were on sale on this e-commerce platform during the last year, it was necessary to form predictive mathematical model. We determined set of relevant variables that will represent group attributes, and we applied K-means algorithm, Market Basket model and Vector Distance model. Based on analysis of basic and derived variables, fixed number of clusters was introduced. Silhouette index was used for the purposes of detecting whether these clusters are compact. Using these cluster separations, we created models that detect similar products, and try to analyze probability of sales for each product. Analysis results can be used for planning future sales campaigns, marketing expenses optimization, creation of new loyalty programs, and better understanding customer behavior in general.

Keywords: Cluster analysis; PCA; Market Basket analysis; Vector Distance model; marketplace segmentation

1. Introduction

Motive for research that is described in this paper is improving sale through rate of "Limundo/Kupindo" online e-commerce platform, which offers both buy-now marketplace and auction model for product buying/selling. Said improvements should be achieved by researching through the data on buyer/seller behavior collected over the course of several years, and by implementing advanced technologies and algorithms from this area.

"Limundo" and "Kupindo" are established in the year 2006, they currently have over million registered and verified customers, they have more than two million products on "Kupindo" marketplace and additional one million auctions that are initiated on Limundo auction platform every month. Around

two hundred thousand people visit these two platforms every day.

Based on analysis of selected product attributes from MySQL database of these e-commerce platforms, we proposed product grouping in nine clusters. Products in this clusters have common characteristics, and they evoke similar customer behavior and responses (Cheng and Chen 2009), (McDaniel and Gates, 2014).

1.1.Research background

Paper (Ismail et al., 2015) showcases procedure of data extraction from the e-commerce databases, including three usual algorithms: association, clustering and prediction. Authors highlight advantages of e-commerce related datamining in the sense of merchandise planning, sales prediction, shopping carts analysis, customer relations management and market segmentation, which can be achieved with three datamining algorithms. The paper also highlights challenges that can be faced during datamining, such as crawler identification and data transformation.

Paper (Rachid, 2015) points out that companies must have good insight into their data to be able to make the right decision and keep up with the competition and fulfill their customer needs. Author presents case study of LRFM model (length, recency, frequency, monetary) and clustering technique in the area of e-commerce, with the goal of evaluating customer value on the Moroccan ecommerce websites. Two-stage clustering method was implemented, which generated nine clusters based on L, R, F and M values. Bejju (2016) points out evaluation and improvement suggestions for traditional price strategies by using datamining techniques from e-commerce websites. Suggested strategy can be implemented by optimizing decision trees in iterative process and by using historical data on buyers' transactions. Paper (Nur and Ayvaz, 2018) describes analysis of online shopping baskets data acquired from big hardware retail company. Apriori and FP-Growth algorithm were used. Data were split into two sets, correctness of rules extracted from the first set was compared to rules extracted from the second set. Kubiak and Weichbroth (2010) presented cross-selling and upselling marketing techniques in e-commerce.

Their goal was to increase the value of single sale transaction and trust, and to lessen risk of losing customer to competition. Paper presents iterative model of customer service, which demonstrates separate roles of cross-selling and upselling techniques in processes of automatization integration of marketing in the context of customer relationship management.

1.2.Data description

MySQL (Percona fork) is being used as relational database management system. It is hosted on four physical server – two slaves and two masters in multimaster replication. Software coding was done in R programming language in R Studio, and in Python programming language in Jupyter environment.
Following tables were processed:

- Table *AuctionItems*, which contains detailed data on all auction items listed after 25.07.2018.
- Table *AuctionHistory*, which contains history of product flow (listing, relisting, selling, cancelling)
- Table *BidProxy*, which contains history of buyer bids for every product
- Table *FieldSchemaSelected*, which contains systematized data on each auction item characteristics (color, size, manufacturer, etc.)

Data from these starting tables were merged into new table ItemBidFieldAuction by using ETL process. ItemBidFieldAuction contains columns: ID, AuctionItemID, CategoryID, SubCategoryID, SubCategoryID2, AuctionCloseDate, BidHighPrice, NumberOfBids, SelingPrice, FieldSchemaValueID, Value, FieldSpeciesID, StartingPrice, Sold, TopCategorySelected, PurchasedImmediately. Some of the source tables contained historical data, so maximization and aggregation of data was necessary in those cases.

After working table *ItemBidFieldAuction* was formed, it was necessary to perform preprocessing which consists of scrubbing, auditing, wrangling, munging, outlier detection, extreme values detection, data limits detection and data validation. Applied techniques resulted in duplicate purging, invalid data elimination, and incomplete data detection. Also, database stability, data validity and data quality were

checked on regular basis. At one stage, database was reformatted by creating procedures for complex data structures. At some places damaged data was repaired, to ensure richer database content.

Some of the aforementioned variables were artificially produced through IF-THEN-ELSE recoding, and some were aggregated from source tables. Most of the variables were used directly from source tables. *CategoryRootID* is variable that was created empirically and it can have nominal value between 1 and 9. This value is generated by recoding ID values from source table. ID value represents code for basic category of product (clothing, footwear, furniture, machines, electronics etc.). Since there are more than 40 different codes, we aggregated them to total of 9 target codes by setting the same *CategoryRootID* for similar product types.

After preprocessing the data from the final database, modelling table had more than 500.000 records. Final table contains selection of following variables: *AuctionItemID, BidHighPrice, NumberOfBids, StartingPrice, CategoryRootID, ParentSequenceID, SetOfValues, Visits*.

Database is represented through a collection of objects (records) defined as $D = \{R_1, ..., R_n\}$ where each record is defined as $R_i = \{d_1, ..., d_n\}$, d_i are variables/features. Each record is a product that is represented through its characteristics, mathematically it is a tuple $d_i = (id(i), maxbid(i), numberbid(i), startprice(i), idroot(i), parent(i), values(i), visits(i))$ where vector coordinates are aforementioned variables.

First algorithm that was implemented in the model is cluster analysis, which finds groups of objects where objects in the same group are similar or connected, while objects in different groups are disparate or unconnected. Cluster analysis methods are divided into two basic groups: agglomerative methods and divisive methods (Hastie et al., 2009), (Anderson, 2003). Cluster analysis methods are also divided into: hierarchical methods; which are usually presented by special diagram – dendrogram, and nonhierarchical methods (Bishop, 2006), (Jain, 2010).

In this paper we applied nonhierarchical partitional clustering n observation in k clusters, with the goal of dividing data sets (products) into groups with the nearest midpoint. Cluster centers are used for data model-ling, but k-means clustering tends to find clusters of similar spatial size, while expectation maximization mechanism allows clusters to have different shapes. Nonhierarchical method generates classification by partitioning data set, producing set of non-overlapping groups that have no hierarchical relationships between them. In this paper non-overlapping subsets are constructed in such way that each data is contained in exactly one subset. Suggested clusters are based on center, which means that cluster represents set of objects where any object in the given cluster is closer (or more similar) to that clusters center than to any of the other clusters center. Cluster center is usually centroid (average of all points in the cluster) or medoid (the most representative point in the cluster), often starting centroid is chosen in a random way (Celebi et al., 2013), (Stefanović et al., 2018), while number of clusters are defined before running the algorithm execution (Nayak et al., 2016), (Wang et al.. 2014).

During the partitional clustering implementation, we used model with the prototype, where starting centroids were chosen randomly, and each data from the set was assigned to cluster with the closest centroid. In each iteration we recalculate centroids for all clusters. Number of clusters was set to fixed value, which does not change during the algorithm execution, while data are iteratively sorted with the goal of achieving maximal cluster homogenization. As a measure for similarity we used Euclidean distance, and as a measure of separation (cluster compactness) we used Silhouette index (The MathWorks, Inc., 2020).

Second analysis we used is Market Basket analysis, this algorithm is used in sales to detect connections between products. Algorithm searches through combination of products which are frequently appear together in transactions Basis for this algorithm contains rules of grouping to explore connections and rules that appear in transactions. Frequencies are statistical parameter from which this kind of analysis starts. After establishing frequencies, we calculate parameters such as support, confidence and lift. For a model to have statistically relevant results it is necessary to analyze thousands of transactions. Purchase order represents unique event that customer generated. Purchase order array is a data structure that was necessary to create for Market Basket analysis. Tracking purchase order through time allowed separation of statistically important products.

Market Basket analysis answers the questions on average number of purchase orders per buyer, trending of average purchase orders per customer during time, average number of unique products per purchase, average size of purchase, most popular products sales, least popular products, average purchase size by specific dimensions (geography, payment method, shipment method, time of the year etc.). Since we didn`t observe this problem through the focus on buyers and sellers but exclusively through products, we modified Market Basket algorithm. This decision was made because in this particular case most of the buyers are buying only one product, and in the most cases sellers sell one product.

In this algorithm we applied association rule mining method, which finds patterns, associations, correlations and causal structures amongst sets of items in transactions. This analysis is frequently used in classical data analysis, cross-marketing, catalogue planning, loss analysis, web logs analysis, fraud detection, etc.

Vector Distance model is original model that was used in result optimization. Auction Items are defined by their characteristics, which are aggregated into string variables *ParentSequenceID* and *SetOfValues*. Characteristics and catalogue subgroups for each product are represented by their respective IDs, and they are formatted as string variables.

This model is based on the two-vector distance. If we have Euclidean n-dimensional space, and two vectors $\vec{u}, \vec{v} \in \mathbb{R}^n$, then the distance between vectors is given as:

$$d(\vec{u}, \vec{v}) = \|\vec{u} - \vec{v}\| = \sqrt{(u_1 - v_1)^2 + (u_2 - v_2)^2 \dots (u_n - v_n)^2}$$

Algorithm descriptions, choosing relevant variable set and visualization of generated clusters are shown in chapter two. In chapter three we show segmentation of products on diagrams that illustrate connections be-tween number of sales, total value of sales and product type. In concluding chapter, we present possibilities of proposed algorithm usage, and further optimizations in terms of future research.

2. Product segmentation description

Method we used in this research consists of the following algorithms:

- Cluster analysis
- Cluster separation and compactness detection
- Market basket analysis
- Vector distance model

2.1.Cluster analysis

First algorithm we applied is K-means algorithm.

Primary goal of cluster analysis grouping is separation of objects into two or more groups based on the similarity of certain features, represented by cluster variables (Jain, 2010). Homogeneity inside the cluster means that all the data in the given cluster are as similar as possible, while heterogeneity between different clusters means that the data belonging to different cluster must differ as much as possible. The concept of similarity is determined depending on the actual data. In this paper we used Euclidean distance between data as the measure of similarity, and buyer data were used for grading to ensure reasonable distance value ranges. Centroids that represents centers of the clusters does not need to be the data from source data set, because they represent points that are calculated by averaging of parameters belonging to points in given clusters (Kanungo et al., 2002). As an output data we also get to which of the K clusters each data belongs.

Based on analysis of the attributes from MySQL database of the given e-commerce platform, we generated the proposal of grouping the products that have similar characteristics and excite similar behavior in customers in nine *CategoryRootID* categories. Since the given e-commerce platform sells wide variety of products, we had to create initial product groups having in mind similarities between products, and each product was given his own *CategoryRootID* identifier. After that, clustering model was applied to every group separately.

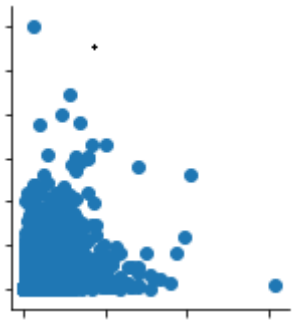
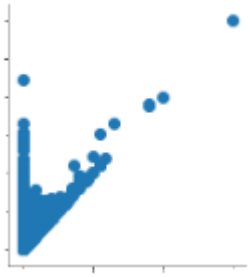
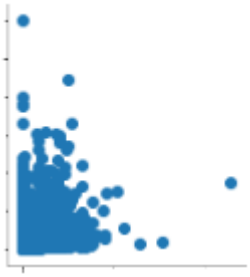
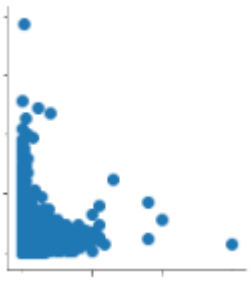
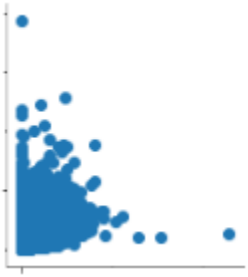
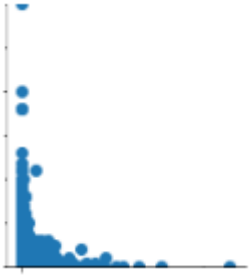
CategoryRootID:

1. clothing, footwear
2. accessories
3. babies, pets
4. body care, sport
5. art, hobbies
6. for house
7. machines, technics, cars
8. computers, mobile phones
9. services, real estates

Variables for clustering were defined based on scatter plot and Principal Component analysis.

Scatter plot diagram represents graph with scattering, and it uses cartesian coordinates to show values for typically two variables. Data are dot sets, and each dot has a value of one variable. Diagram is used for clustering model preparation, having in mind simple visualization of variable couples' correlation.

Table 1. Scatter plot diagrams

 BidHighPrice – Visits	 BidHighPrice – StartingPrice	 BidHighPrice – NumberOfBids
	 Visits – StartingPrice	 Visits – NumberOfBids
		 StartingPrice – NumberOfBids

Although K-Means result is not too disturbed by correlated variables, they need to be eliminated. However, if we eliminate wrong variables or if we do it in a wrong way, we can disrupt information, or to artificially bring closer points that are not close in general population. That is why we use PCA analysis which compress data dimension and thus eliminate correlated data while preserving data variance. Variance should be normalized before analysis to avoid mistakenly removing variables only because they have different range in their values. PCA assumes orthogonal base, so if we encounter

data with variance in non-orthogonal direction – these data will not be correctly clustered with K-Means algorithm.

PCA (*Principal Component Analysis*) is statistical procedure with which we map the set with possibly correlated variables into a set of uncorrelated variables. Each of the attributes from the new set is called principal component, and they are all linearly uncorrelated. When own values and vectors are calculated using preprocessed data table, we choose first k sorted own vectors whose own values are different than 0. If we work on such formed own vectors, we will not lose information.

k <= min(n–1, m), where M(m, n) is a matrix of own vectors with m rows and n columns. To perform PCA analysis efficiently (and later on cluster analysis as well), we need to standardize data by the principle of z–score formula over all variables:

$z = (x - \mu) / \sigma$

PCA analysis is applied on final table with 4 variables of numerical type: *Highest Bid*, *Number of bids*, *Starting price* and *Number of visits*, and on the combination and pairs of these variables. Largest variance was found in variable pairs of *Starting price* and *Number of bids*.

Axis shows vectors that starts from the center, Variables *Starting price* and *Number of bids* are used in PC1 with their highest values giving most information on the data from the sample. PC3 and PC4 explain small percentage of total variance, so they are not too informative for detecting of the apparent patterns.

Table 2. Importance of Components

	PC1	PC2	PC3	PC4
Standard deviation	1.5237	1.0799	0.59997	0.39030
Proportion of Variance	0.5804	0.2915	0.08999	0.03808
Cumulative Proportion	0.5804	0.8719	0.96192	1.00000

As a conclusion, PCA and Scatter plot showed that interesting attributes are *Starting price* and *Number of bids*.

At the start we created two new tables, from the final table. They represent train and test set. Sets are di-vided by using random sample method. Cluster analysis was done for all 9 tables, and we ran them through distribution check for aforementioned variables, to adjust variable metrics as a part of basic preprocessing. Next procedure is using Elbow method to determine optimal number of clusters. Based on the results of this method, we chose to have 3 clusters for each group, with most of 15 clusters per iteration. Elbow method uses *wss* procedure to explain homogeneity inside the cluster. *Wss* measure is being drawn in relation to the recommended number of clusters, so we call it in iterations.

Preparation of train and test set was the next phase in this part of algorithm. Both sets were formed from the final preprocessed set of data, by the principle: 75% train set – 25% test set, based on random choice.

Cluster analysis is performed on mean value metrics, which means that centroids are calculated with the function *mean()*, based on all elements in cluster group. This model was applied on train set of data, and when we got satisfactory data, we put test set through verification, and it also yielded satisfactory results. One of the first result was calculating the distance from centroid for each of the elements in the cluster, is the distance of all products from the cluster centroid. Centroid is not one exact product, but the mean value of *Starting price* and *Number of bids* columns of all elements within the cluster.

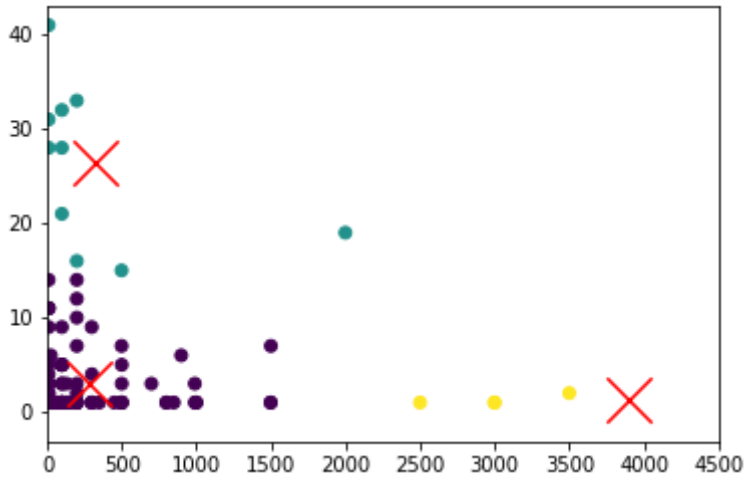
Since we formed 9 groups and we defined 3 clusters, the result is 27 different non-overlapping cluster groups.

When the seller wants to list his product on website for sale, he has a product with certain array of properties which he chooses from predefined set of properties, and his only dilemma is what starting price for his auction he should choose. So, the role of this research should be to make it easier for seller to choose the right starting price. Our goal is to recommend the starting price to seller, based on the

existing data and with displayed data of historical bids on similar products in relation with starting price.
Besides starting price, second important parameter in this research is the *Number of bids*. Auction with large *Number of bids* value will have bigger final price (seller satisfaction will be increased) and website as a whole will have more visitors.

Based on these assumptions, *Starting price* /*Number of bids* relationship was chosen for clustering. For cluster separation in three clusters on test set with one hundred products we got the following data (show on Figure 1):

Fig. 1 Sample Clustering



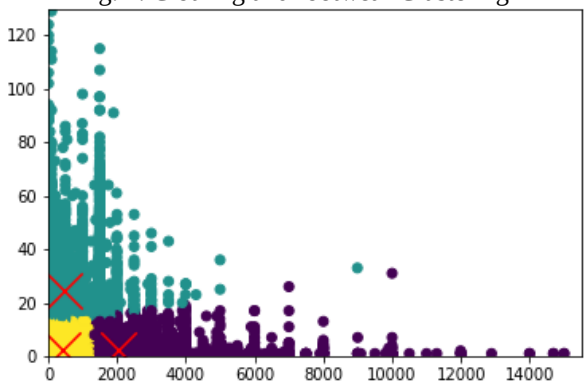
We can see three different clusters:

- yellow – products with large starting price and small number of bids
- purple – products with small starting price and small number of bids
- green – products with small starting price and large number of bids

This kind of clustering is repeated during the algorithm execution on real data, as will be shown below. Clustering method is being applied on 9 tables, each separated in 3 clusters, to keep cluster within their *CategoryRootID* properties.

Product group, Clothing and footwear

Fig. 2. Clothing and footwear Clustering

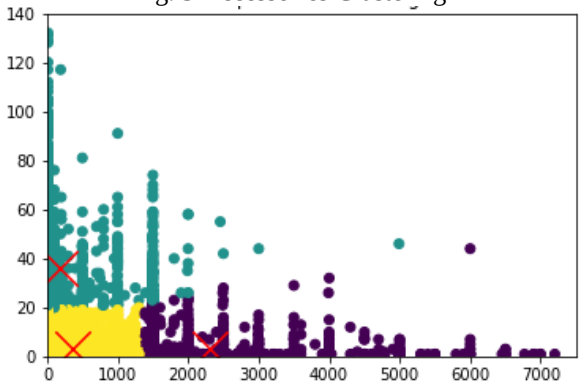


Centroids for Clothing and footwear:

- Starting price=405.86, Number of bids=2.55
- Starting price=2052.83, Number of bids=2.65
- Starting price=439.94, Number of bids=24.43

Product group accessories

Fig. 3 Accessories Clustering

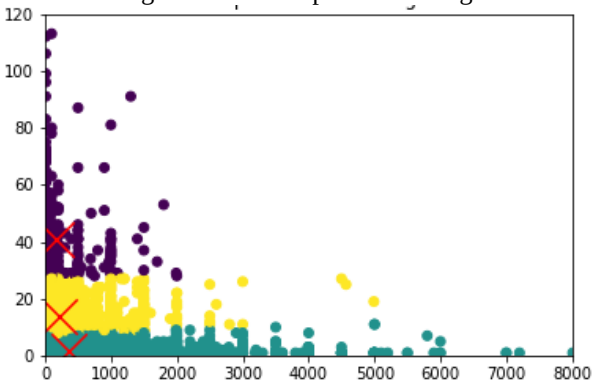


Centroids for Accessories:

- Starting price=2309.50, Number of bids=3.3
- Starting price=173.81, Number of bids=36.2
- Starting price=362.39, Number of bids=3.34

Product group Babies and pets

Fig. 4 Babies and pets Clustering

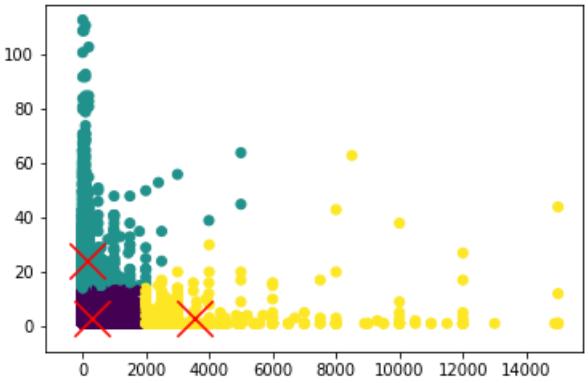


Centroids for Babies and pets:

- Starting price=212.13, Number of bids=13.63
- Starting price=356.6, Number of bids=1.78
- Starting price=167.5, Number of bids=40.7

Product group Care and sport

Fig. 5 Care and sport Clustering

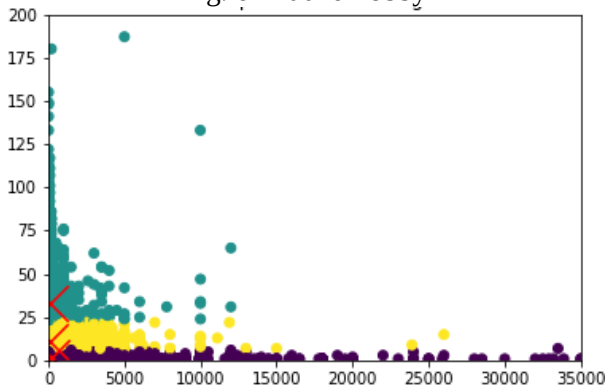


Centroids for Care and sport:

- Starting price=318.24, Number of bids=3.12
- Starting price=151.35, Number of bids=24.33
- Starting price=3551.1, Number of bids=2.69

Product group Art and hobby

Fig. 6 Art and hobby



Centroids for Art and hobby:

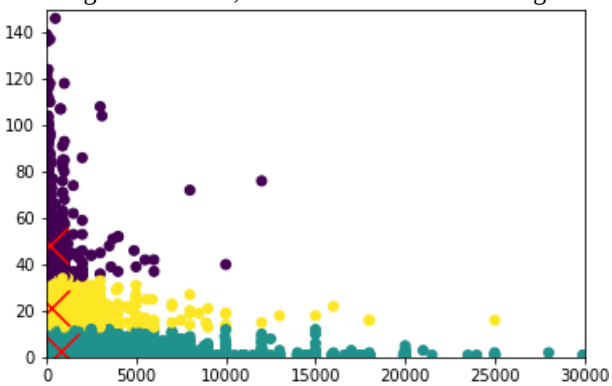
- Starting price=129.24, Number of bids=11.14
- Starting price=159.45, Number of bids=1.77
- Starting price=148.32, Number of bids=31.99

Product group House items

There is one product group which is segmented as *CategoryRootID*=6. This group represents home products (for house). Since there was no valid data in the timeframe, this group was not included in further modeling. This is the reason, why this group did not position itself in clustering.

Product group Machines, technics and cars

Fig. 7 Machines, technics and cars Clustering

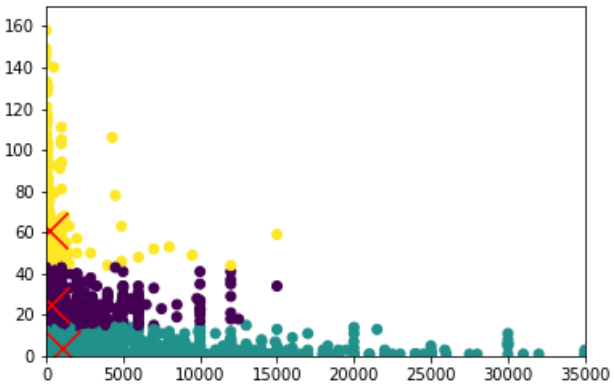


Centroids for Machines, technics and cars Clustering:

- Starting price=798.9, Number of bids=3.06
- Starting price=281.21, Number of bids=21.58
- Starting price=191.06, Number of bids=49.69

Product group Computers and mobile phones

Fig. 8 Computers and mobile phones Clustering

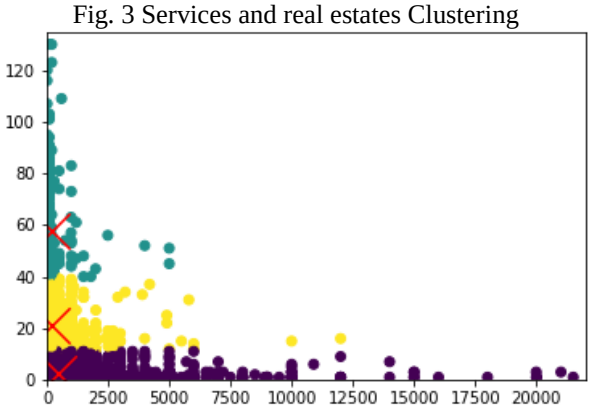


Centroids for Computers and mobile phones:

- Starting price=1032.19, Number of bids=3.46
- Starting price=341.54, Number of bids=23.7
- Starting price=217.85, Number of bids=57.41

Product group Services and real estates

Fig. 3 Services and real estates Clustering



Centroids for Services and real estates:

- Starting price=453.44, Number of bids=2.55
- Starting price=223.54, Number of bids=22.02
- Starting price=187.16, Number of bids=60.01

We confirmed that cluster distribution is the same for sample data and for data separated by CategoryRootID.

2.2. Cluster separation and compactness detection

To detect separation and compactness of our clusters, we used Silhouette index, S. If $X\tau=\{X_1, ..., X_N\}$ is data set, then $C=(C_1,...,C_K)$ represents clustering of that set on K clusters. $d(X_k, X_l)$ is distance between X_k and X_l. If $C_j = \{X_1^j, ..., X_{m_j}^j\}$ is j cluster, $j=1,...,K$, then $m_j=|C_j|$. Mean distance a_i^j between i-th vector in cluster C_j and other vectors in the same cluster is defined by the following formula:

$$a_i^j = \frac{1}{m_j - 1} \sum_{\substack{k=1 \\ k \neq 1}}^{m_j} d\left(X_i^j, X_k^j\right), i = 1, \ldots, m_j \quad (1)$$

Minimal mean distance between *i*-th vector in cluster C_j and all vectors from clusters C_k, $k=1, ..., K$, $k \neq j$, is defined with:

$$b_i^j = \min_{\substack{n=1,\ldots K \\ n \neq j}} \left\{ \frac{1}{m_n} \sum_{\substack{k=1 \\ k \neq 1}}^{m_n} d\left(X_i^j, X_k^n\right) \right\}, i = 1, \ldots, m_j \quad (2)$$

where d represents the distance, which can be calculated as Euclidean distance, Minkovski distance, Manhattan distance etc. (Anderson, 2003). Silhouette width of *i*-th vector from cluster C_j is defined as:

$$s_i^j = \frac{b_i^j - a_i^j}{\max\left(a_i^j, b_i^j\right)} \quad (3)$$

based on that we get that $-1 \leq s_i^j \leq 1$. Silhouette width for cluster C_j is defined as:

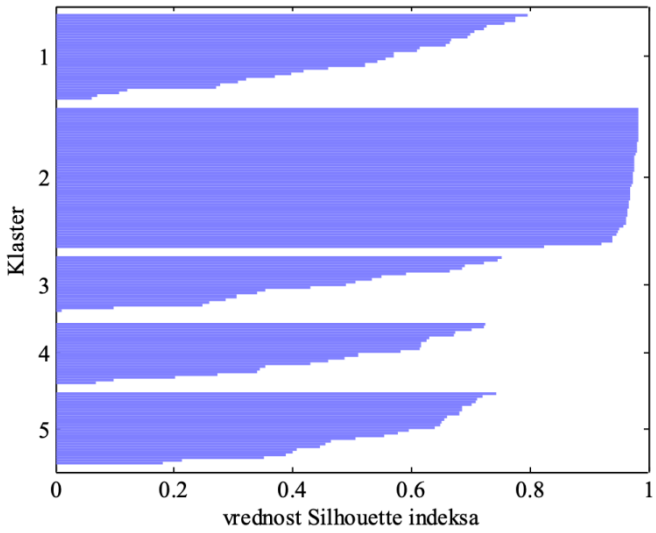
$$S_j = \frac{1}{m_j} \sum_{j=1}^{m_j} s_i^j \quad (4)$$

while global Silhouette clustering index is defined as:

$$S = \frac{1}{K} \sum_{j=1}^{K} S_j \quad (5)$$

Consequence of that is that cluster width, as well as global Silhouette clustering index, have values between -1 i 1. Silhouette index value calculated by using silhouette function in MATLAB programming environment (The MathWorks, Inc., 2020) for suggested clusters, is shown on Fig .10.

Fig. 4 Silhouette index value for chosen clusters



Visual representation of clusters, with mean value of relevant parameters, is shown on Fig.2, Fig.3, Fig.4, Fig.5, Fig.6, Fig.7, Fig.8 and Fig.9.

2.3. Market Basket analysis

Second algorithm we applied was the Market Basket algorithm. We have collection of objects as in the be-ginning: $D = \{R_1, ..., R_n\}$ where each record is noted as $R_i = \{d_1, ..., d_n\}$ and where d_i are variables (features). Each record is a product which is represented through its characteristics, mathematically it is a tuple $d_i = (id(i), maxbid(i), numberbid(i), startprice(i), idroot(i), parent(i), values(i), visits(i))$. Within

this collection of objects, we added another feature we called "Cluster", which is derived from clustering from previous step. Clustering is calculated on nine tables, and for each product group we have three clusters.

The point of this model is to count and compare characteristics from *ParentSequenceID* and *SetOfValues* for each *AuctionItemID*. Ratio of products count from some *ParentSequenceID* to total product count varies from 0.002‰ (when there are just one product for the given *ParentSequenceID*, like 26!!!1129, 11!!!43, 6!!!144, 26!!!1129!!!1140), to 2,94%, (as is the case for *ParentSequenceID*=35!!!1214!!!31).

Model result is to identify the products which are similar through *ParentSequenceID*, with the goal of finding the product similar to one buyer already bought or put in his wish list.

For example, by making query for *ParentSequenceID*=5!!!1282!!!1633, over the set of data in table *Final*, we would get 312 products, and the product recommended to buyer would be the one with the closest finishing time.

Products are being found and separated based on matching *ParentSequenceID* data and matching the data values from *SetOfValues*.

For purposes of testing the model and quick separation of products which are similar with the given product (for example, with the product seller is entering), we first created table with the columns: *AuctionItemID*, *ClusterID*, and the product distance from the center of the cluster. This table remains connected to the original data table. We than constructed appropriate SQL query which for any value from *SetOfValues* and for any *CategoryRootID* returns the list of products that are similar to the given product, sorted descending by the distance from centroid. First on the list is the product with the similar properties to the given product and with the smallest distance to centroid, which can be then shown to the seller when he is entering starting price for his product.

Following are examples of finding the products with the same or similar parameters as a given new product, which are closest to the cluster centers, accompanied with our conclusions:

Example 1: New product which has *ParentSequenceID*=5!!!359!!!428 and whose data set contains values 10547 and 8603, has the following similar existing products (products closest to the cluster center):

- For cluster 0, AuctionItemID = {70626333, 72267701}
- For cluster 1, AuctionItemID = {68290377}
- For cluster 2, AuctionItemID = {69694565, 68475485}

Product description for each cluster:

- Products from the cluster 0 had medium starting price (450 din) and 3 bids each
- Product from the cluster 1 had big starting price (4699 din) and 1 bid.
- Products from the cluster 2 had small starting price (99 din) and 36 bids each.

Conclusion: For new product, recommended starting price is 99 din.

Example 2: New product which has *ParentSequenceID*=5!!!26, has the following products from previous auctions (which are closest to the cluster center):

- For cluster 0, AuctionItemID = {69999289, 68625913, 69309753, 71842385}
- For cluster 1, AuctionItemID = {65331265}
- For cluster 2, AuctionItemID = {69168109}

Product description for each cluster:

- Products from the cluster 0 had medium starting price (450 din) and 3 bids each.
- Products from the cluster 1 had big starting price (4607 din) and 1 bid.
- Product from the cluster 2 had small starting price (99 din) and 37 bids.

Conclusion: For new product, recommended starting price is 99 din.

Example 3: New product which has *ParentSequenceID*=36!!!1283!!!1289, has the following products from previous auctions (which are closest to the cluster center):
- For cluster 0, AuctionItemID = {71007505, 70295133, 71755825}
- For cluster 1, AuctionItemID = {71975677}
- For cluster 2, AuctionItemID = {70518725, 70221645}

Product description for each cluster:
- Products from the cluster 1 had smaller starting price (199 din) and 24 bids.
- Products from the cluster 0 had medium starting price (2000 din) and 3 bids each.
- Products from the cluster 2 had bigger starting price (400 din) and 3 bids.

Conclusion: For new product, recommended starting price is 199 din.

Example 4: New product which has *ParentSequenceID*=29!!!1263!!!584, has the following products from previous auctions (which are closest to the cluster center):
- For cluster 0, AuctionItemID = {70870433 }
- For cluster 1, AuctionItemID = {70733609, 70962033}
- For cluster 2, AuctionItemID = {69548173}

Product description for each cluster:
- Product from the cluster 0 had small starting price 99 din and 41 bid.
- Products from the cluster 1 had bigger starting price 350 din and 2 bids each.
- Product from the cluster 2 had smaller starting price 199 din and 14 bids.

Conclusion: For new product, recommended starting price is 99 din.

Example 5: New product which has *ParentSequenceID*=10!!!73, has the following products from previous auctions (which are closest to the cluster center):
- For cluster 0, AuctionItemID = {71649689}
- For cluster 1, AuctionItemID = {68371893}
- For cluster 2, AuctionItemID = {71219521}

Product description for each cluster:
- Product from the cluster 0 had medium starting price 333 din and 3 bids.
- Product from the cluster 1 had small starting price 199 din and 24 bids.
- Product from the cluster 2 had big starting price 3500 din and 3 bids.

Conclusion: For new product, recommended starting price is 199 din.

Example 6: New product which has *ParentSequenceID*=35!!!1214!!!31, has the following products from previous auctions (which are closest to the cluster center):
- For cluster 0, AuctionItemID = {66797725}
- For cluster 1, AuctionItemID = {68399293}
- For cluster 2, AuctionItemID = {72988029}

Product description for each cluster:
- Product from the cluster 0 had medium starting price 150 din and 2 bids.
- Product from the cluster 1 had small starting price 99 din and 33 bids.
- Product from the cluster 2 had medium starting price 149 din and 11 bids.

Conclusion: For new product, recommended starting price is 99 din.

Example 7: New product which has *ParentSequenceID*=14!!!56!!!289, has the following products from previous auctions (which are closest to the cluster center):
- For cluster 0, AuctionItemID = {69356353}
- For cluster 1, AuctionItemID = {72756249}
- For cluster 2, AuctionItemID = {69717989, 70441877}

Product description for each cluster:

- Product from the cluster 0 had small starting price 10 din and 48 bids.
- Products from the cluster 1 had big starting price 799 din and 3 bids.
- Products from the cluster 2 had medium starting price 199 din and 21 bids.

Conclusion: For new product, recommended starting price is 10 din.

Example 8: New product which has *ParentSequenceID*=31!!!845, has the following products from previous auc-tions (which are closest to the cluster center):
- For cluster 0, AuctionItemID = {69718421}
- For cluster 1, AuctionItemID = {71972929}
- For cluster 2, AuctionItemID = {68733521}

Product description for each cluster:
- Product from the cluster 0 had small starting price 199 din and 25 bids.
- Product from the cluster 1 had big starting price 1000 din and 4 bids.
- Product from the cluster 2 had small starting price 199 din and 61 bids.

Conclusion: For new product, recommended starting price is 199 din.

Example 9: New product which has *ParentSequenceID*=30!!!1785!!!1813, has the following products from previ-ous auctions (which are closest to the cluster center):
- For cluster 0, AuctionItemID = {69465069}
- For cluster 1, AuctionItemID = {71107713}
- For cluster 2, AuctionItemID = {69452041}

Product description for each cluster:
- Product from the cluster 0 had big starting price 500 din and 2 bids.
- Product from the cluster 1 had small starting price 99 din and 58 bids. (In cluster 1, there were no products with *ParentSequenceID*=30!!!1785!!!1813, so we took product with *ParentSequenceID*=30 as an ex-ample for comparison)
- Product from the cluster 2 had starting price of 100 din and 18 bids.

Conclusion: For new product, recommended starting price is 99 din.

Table 3 Example from the resulting table

ParentSequenceID	Number of products	Ratio in tenth of percent (‰)
35!!!1214!!!31	14955	29.39973814
3!!!81!!!622	14651	28.80211057
6!!!118!!!1416	10863	21.35535643
33!!!978!!!982	9606	18.88424504
36!!!1283!!!1289	8750	17.20145161
33!!!978!!!1419	8220	16.15953511

2.4.Vector Distance model

Third algorithm described in twining sales model is the Vector Distance model. We have object collection as in the beginning $D = \{R_1, ..., R_n\}$ where each record is noted as $R_i = \{d_1, ..., d_n\}$ and di are variables (features). Each record is the product which is represented through characteristics, in mathematical notation it is a tuple $d_i = (id(i), maxbid(i), numberbid(i), startprice(i), idroot(i), parent(i), values(i), visits(i))$. This algorithm calculates products which have the same or similar parameters and which are closest to the center of the cluster or to the sold product. The distance is calculated with Euclidean formula:

$$d(p,q) = d(q,p) = \sqrt{(q_1 - p_1)^2 + (q_2 - p_2)^2 + \cdots + (q_n - p_n)^2} = \sqrt{\sum_{i=1}^{n} (q_i - p_i)^2}$$

$p = (p_1, p_2, ..., p_n)$ i $q = (q_1, q_2, ..., q_n)$ are two points in Euclidean space R_n, in cartesian coordinates. Distance vectors were created by comparing coordinates of *ParentSequenceID* vectors for each *CategoryRootID* and for each pair of tuples (records), tuples were sorted by the distance from centroids. We formed the resulting array $r = (r_1, r_2, ..., r_n)$ which contained only values 1 or 0, these values were assigned based on matching of *ParentSequenceID* values (1=successful match, 0=unsuccessful match).

For all cluster members which represents one tuple (product, record) and for all coordinates of *ParentSequenceID* vector and *SetOfValues*, we check whether the product is similar to other products and in what measure, by coordinates. If two products are matched, we set 1 in the resulting vector on appropriate position, and vice versa – we set 0 when there is no match. We must save all possible r vectors, their count is size cluster – 1, which is very large number. For each product we choose the vector with the most 1 on coordinate places.

3. Results of segmentated products

With the goal of finding correlation between variables *StartingPrice* and *NumberOfBids*, we used cluster analysis and segmentation on three clusters, which showed the following:

1. First cluster contains products which had big starting price and small number of bids
2. Second cluster contains products which had small starting price and medium number of bids.
3. Third cluster contains products which had small starting price and big number of bids.

First conclusion is that big starting price bears the risk of small number of bids. Second conclusion is that products with small starting price can have small but also big number of bids.

We suggest that price recommendation system for sellers should be implemented. System should help seller to make a decision on starting price. After the seller enters product data, system will show other products data – for products that are similar to the one seller entered. These products are representatives from three clusters with the smallest distance from the cluster centroid. In that way we can suggest to seller when to expect smaller number of bids for bigger starting price, and when it is good to set smaller starting price to achieve bigger number of bids.

4. Future work

In future work, we can add the following analysis:

- Create cluster analysis and determine the influence of auction duration (time between start and end of an auction) to final price difference (difference between starting and ending price), and then to suggest to seller which is the optimal auction duration in days.
- Collecting and analysis of the data on interest of site customers for auctions.
- Collecting and analysis of the data on buyers who bought more than one product.

5. Conclusion

We introduce e-commerce Recommender System consists of Market Basket analysis and Vector Distance model with Clustering model in this paper. The model is given as a conceptual combination of several algorithms since it tries to pull customers into increasing average order value by offering products that go along with the current purchase.

A Recommender System works like a great salesman who has intelligent decisions for cross selling and upselling. It uses information such as revenues and different counts (purchases, clicks, etc.). These data are various ratings that customers leaves for products that are trained for models. These information provided solution for great customer experience.

The main aim in this model was to properly segment the groups of products that were later used for Clustering, Market Basket and Vector Distance. Products were segmented according to feature *CategoryRootID* variable and the Clustering was applied on every segment with 3 clustering groups.

Vector Distance model was applied further on every cluster group, since the features of product were recoded in numerical values and it was possible to create distances between them.

Based on the data, buyers and website visitors, we can recommend product which are currently on auction in the following ways:

- Based on the data of previous sales, it is possible to find similar active products and recommend them to buyers
- Based on data correlation through *ParentSequenceID*
- Based on correlation of the data from *SetOfValues*
- To use the same algorithm as for finding products similar to the one's customer bought, but to implement it on the data on product buyer is interested in (wishlist for example).

To use the data on buyers who bought more than one product for "Market basket" analysis, and based on that analysis to recommend products from other categories.

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Mikro i mala preduzeća i očuvanje ljudskih resursa u uslovima pandemije

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Apstrakt: Mikro i mala preduzeća, naročito startapovi iz oblasti informacionih tehnologija, kao i mikro i mala porodična preduzeća koja se bave sofisticiranom proizvodnjom baziranom na informacionim tehnologijama i inovacijama, predstavljaju veoma značajan element privrede jedne zemlje. Međutim, u uslovima u kojima je vlasnik najčešće i menadžer preduzeća i kada ne postoji formiran sektor za upravljanje ljudskim resursima, ni posebna pozicija sa zaduženjima u oblasti upravljanja ljudskim resursima, sam proces upravljanja ljudima je uglavnom neformalan, ad hoc i podložan čestim promenama. Problemi upravljanja ljudskim resursima se naročito primećuju u kriznim situacijama kao što je pandemija virusa COVID-19. Ovaj rad se bavi istraživanjem stavova (u vidu intervjua) menadžera i vlasnika malih preduzeća iz oblasti informacionih tehnologija i visokih tehnologija prema očuvanju zaposlenih u uslovima pandemije COVID-19 virusa u prvoj nedelji proglašenja vanrednog stanja u Republici Srbiji i u prvoj nedelji maja, kada je najavljeno ukidanje vanrednog stanja. Iako je uzorak mali, može se zaključiti da su mala preduzeća ovu krizu dočekala nespremno, ali da su u pogledu upravljanja ljudskim resursima, naročito kada su u pitanju očuvanje i nagrađivanje zaposlenih, mala preduzeća u oblasti informacionih tehnologija zbog prirode posla znatno lakše prevazišla krizu od preduzeća koja se bave proizvodnjom (iako su u pitanju visoke tehnologije).

Ključne reči: Mala preduzeća, upravljanje ljudskim resursima, pandemija.

Micro and small enterprises and human resources retention in a pandemic

Abstract: Micro and small businesses, especially information technology startups, as well as micro and small family businesses engaged in production using high technologies, and innovation, are a very important element of a country's economy. However, in conditions where the owner is usually the manager of the company and when there is no established human resources management sector or a designated position with responsibilities in the field of human resources management, the human management process itself is mostly informal, ad hoc, and subject to frequent changes. Human resource management problems are particularly noticeable in crisis situations such as the COVID-19 virus pandemic. This paper examines the attitudes (in the form of interviews) of managers and owners of small businesses in the field of information technology and high technologies towards the retention of employees in the COVID-19 virus pandemic in the first week of declaring a state of emergency in Serbia and in the first week of May, when the lifting of the state of emergency was announced. Although the sample is small, it can be concluded that small businesses were unprepared for this crisis, but that in terms of human resource management, especially when it comes to retention and rewarding employees, small businesses in the field of information technology have been able, because of the nature of their work, to overcome the crisis much easier than companies engaged in production (although they are utilizing high technologies),

Key Words: Micro and small enterprises, human resources management, pandemic.

Introduction

Micro and small enterprises are a very important element of the economy of every developed country, for example in the US more than half of the employees work for small companies (Dessler, 2013). Nonetheless, they are also becoming even more significant in the economy of developing countries (Druică, *et al.* 2017), especially when it comes to micro and small enterprises that apply modern

technologies and innovations (Duplenko, 2013; Apanasovich, *et al.* 2017). Micro enterprises are defined by different authors as the ones with less than 10 or 20 employees and small enterprises are defined as the ones that employ between 10 (or 20) and 50 employees (Vukotić, Cvijanović, Aničić, 2014). In order for these companies to survive and thrive in the conditions of strong competition and globalization, one of the key elements are the people who bring added value with their knowledge, skills, and abilities in order to secure desired position in the market (Melo and Machado, 2013; Shafeek, 2016; Hitka, *et al.* 2018; Končar, *et al.* 2020). Various concepts of quality management state that human resources management is critical factor of any organization (Tomic, 2016), especially when it comes to small and medium enterprises (Cepel, *et al.* 2018), and some micro and small enterprises are starting to develop and implement human resources management policies and procedures (Melo and Machado, 2013).

Micro and small enterprises are prevalent in the Republic of Serbia (Bobera and Bjekić, 2016; USAID. 2017), nevertheless there is not enough extensive research on the implementation of human recourses policies and practices in those companies in order to retain employees, or whether those policies and practices even exist, especially when it comes to the micro and small companies in the field of information technologies and high technologies.

Natural disasters and epidemics can cause disruption of various business processes and can be harmful to people's health and lives. The problems for human resource management are particularly noticeable in the situations such as the COVID-19 virus pandemic. Therefore, risk management strategies have to include plans for safety and protection of personnel. It is essential for micro and small enterprises, where absence of only one key employee can cause a serious damage to business processes. The effect of pandemic on the economy on macro level has been researched in some extent in the shape of reports, reviews and analyses (Sanchez-Duque, *et al.* 2020), nevertheless the effect, especially long-term, of the pandemics on micro and small enterprises has yet to be researched more extensively.

In this paper we shall examine the attitudes (in the form of interviews) of managers and owners of micro and small businesses in the field of information technology and high technologies. The participants have been interviewed soon after COVID-19 virus pandemic in March have started, namely the first week of declaring a state of emergency in the Republic of Serbia (Službeni glasnik, 2020) and in the first week of May, when the lifting of the state of emergency have been announced. The main focus has been given to retention and rewarding employees in pandemic.

1. Human Resources management in micro and small enterprises

Micro and small enterprises, especially in the field of information technologies and high technologies, depend heavily on the technology; nevertheless, new technological solutions can't function without the people (Jerônimo, 2013; Fejfarová and Urbancová, 2016), namely the individuals who have adequate knowledge, skills, abilities, other characteristics, and behaviours. Exceptional skills in human resources management in micro and small enterprises are the key for hiring and keeping the best talent. Almost typical, in these kinds of enterprises, the owner is often also a general manager, and CFO, but also a chief human resources manager. Therefore, it is necessary for some type of human resources management policies to be developed and implemented from the very beginning. A number of micro and small companies can opt for outsourcing this function (Dessler, 2013), or using HRM information systems (Wang, *et al.* 2016), however adopted policies and procedures have to be based on the company's mission and vision in order to be implementable.

It is not unusual for micro, small, and even medium enterprises not to have human resources management department or a separate function. Usually companies larger than one hundred employees tend to employ one person in a human resources function (Dessler, 2013). A research from Check republic has shown that only about 25% of small and about 50% of medium enterprises (Fejfarová and Urbancová, 2016) include some form of human resources function. Nevertheless, micro and small companies in the field of information technologies or high technologies tend to treat their employees as human capital, and not resources (Apanasovich, *et al.* 2017) because of their importance for the success of a company. Nevertheless, one of the often neglected aspects of human resources management in micro and small enterprises is health and wellbeing of the employees (Thrive at Work Wellbeing Programme Collaboration, 2019).

Micro and small enterprises in Serbia in most cases don't have a human resources function at all (Hanić, *et al.* 2016; Lazarević, *et al.* 2018), which is often essential for retaining the best employees. Significant decrease in official unemployment rate (10.4% for the 2019), according to the Statistical Office of the Republic of Serbia (2020), can be misleading, because it is very difficult to recruit and retain the professionals in the field of information technologies and high technologies who are the right fit for organization due to the brain drain and considerable opportunities for informal online employment, especially for the professionals in the field of information technologies (Culkin, Simmons 2018). Sometimes, start-ups are not able to provide the salary, bonuses, and overall working environment that can be attractive for the best candidates, the ones with the experience and interns alike.

2. Human resources management in pandemic

Even though pandemic incidences can't be anticipated, after SARS and H1N1 epidemics, same as epidemics of Ebola and Zika viruses, it is necessary to include policies and procedures for the possible epidemics and pandemics response into risk management and human resources management strategies (Caligiuri, *et al*. 2020). It is of the essence for those policies and guidelines to include the human resources management policies in order to retain talented individuals, because even though small scale epidemics may not be harmful for large enterprises' business processes, the absence of employees in micro and small enterprises, especially if the absent employees are holding key job positions that cover various responsibilities, can cause a serious damage to a company (Tan and Takakuwa, 2011).

Coronavirus Disease 2019 (COVID-19) caused by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) has been first diagnosed in December 2019 in the city of Wuhan in Hubei province in China and has become globally known from the beginning of January 2020. As the virus spread from China, across Japan, South Korea, and Singapore to US, Western, and Eastern Europe, the outbreak has affected more than one hundred countries along with the Republic of Serbia from the beginning of March 2020. World Health Organization (WHO) declared pandemic on March 11 (Lenzen, *et al.* 2020).

Besides the health issues, one of the main problems for the micro and small enterprises is loss of jobs in service and retail sector (da Silva Costa, 2020), because of widespread lockdowns in order to contain the epidemic (Musinguzi and Oppong, 2020) with serious consequences for the retention of employees for the companies involved in sophisticated production. Also, for these companies, the question of post-Covid economic survival is becoming of the essence (Baghiu, 2020; Caligiuri, *et al*. 2020).

Many countries have passed government led programs of aiding the most affected industries, especially through wage subsidies (Joo-Cheong, 2020). Similarly in the Republic of Serbia, Government (Vlada Republike Srbije, 2020) has issued a set of economic measures intended to help private sector coping with the financial consequences of the COVID-19 pandemic. The package has included salary tax and social security contributions on salaries, salary compensations, and personal salaries of entrepreneurs (Vlada Republike Srbije, 2020), especially important for micro and small enterprises.

3. Research

The scope of study and data collection

Objectives

The aim of the empirical part of the paper is to analyze the attitudes of owners and top managers of micro and small enterprises in the field of information technologies and high technologies (sophisticated automated production) toward their ability to retain and reward the employees during (and immediately after) the Covid-19 pandemic.

The interviews have been held from 18th to 20th March (the beginning of the state of emergency) and from 7th to 8th May, 2020 when abolition of the state of emergency has been announced (Narodna skupština, 2020), through semi-structured phone interviews and the answers have been transcribed by the authors.

Survey design

The interviewees have been given two groups of statements with two possible answers (Yes/No) questions. The first group of statements has been developed to investigate whether a company has:

1. The business plan for the 2020 that includes human resources plan;
2. Human resources management function;
3. Human resources management position;
4. Human resources management policies, procedures, and plans;
5. Risk management policies, procedures, and plans;
6. A plan for emergency situations regarding the employees included in the risk management policies, procedures, and plans.

The second group of statements has been developed to investigate whether a company has:

1. The ability to continue the business plan for the 2020;
2. The ability to retain all the employees;
3. The ability to retain the bonuses for the employees
4. The ability to retain regular wages for the employees
5. The ability to retain essential (core) employees during/after pandemic
6. The ability for online business (core bussiness)
7. The ability for enabling the employees to work online during/after the pandemic (administration and management)

Also, the participants have been able to state if their company would be willing to accept some kind of financial assistance from the governement in order to retain employees (March) or if it has accepted financial government's aid package (May). Furthermore, the participants have been given the possility to explain their willinness to accept governments's financial aid. The participants have also been given the ability to present additional remarks on the issues they have considered important, if willing.

Description of the sample

For the purpose of this study, nineteen owners/general managers/chief executive officers of various micro or small companies (fewer than 20 employees) in the field of information technologies and production (using high technologies) have been interviewed. The interviewees have been the owners of the companies that have been active from one to twenty years. Ten of the participants have been from the field of information technologies and nine from the field of high technologies. The demographical data of the sample are given at Table 1.

Table 1. Demographic variables (Source: authors)

Code Name	**Field or sector**	**Position**	**Years active (business)**	**Number of employees**
P1	Information technologies	Owner/General manager	10	7
P2	High technologies	Owner/General manager/Lead engineer	26	9
P3	High technologies	Owner/General manager	5	12
P4	Information technologies	Owner/General manager	5	6
P5	Information technologies	Owner/General manager	3	12
P6	Information technologies	Owner/General manager	4	11
P7	Information technologies	Owner/General manager	5	10
P8	Information technologies	Owner/General manager	4	8
P9	Information technologies	Owner/General manager	2	4
P10	Information technologies	Owner/General manager	2	11
P11	High technologies	Owner/General manager	1	6
P12	High technologies	Owner/General manager	8	16
P13	High technologies	Owner/General manager	7	18
P14	High technologies	Owner/General manager	10	11
P15	High technologies	Owner/General manager	5	8
P16	Information technologies	Owner/General manager	7	3
P17	Information technologies	Owner/General manager	2	4
P18	High technologies	Owner/General manager	6	15
P19	High technologies	Owner/General manager	3	8

4. Results

The first set of statements has been given only in the initial interviewing in March. In regard to business plans all of the interviewees have stated that their companies have a business plan developed for the year 2020. In IT industry most of the participants (80%) have stated that they have a human resources management function, but none has stated that they have a human resources management position.

It is similar for high technologies, where the most of the interviewees (66.7%) have stated that they have a human resources management function, but, again, none has stated that they have a human resources management position.

Most of the companies in the field of information technologies (70%) have written human resources policies, procedures and plans; nevertheless, the most of high technology companies (88.9) do not have written human resources plans, policies and procedures. The most of the companies in both fields don't have risk management plans, policies, and procedures or plans for emergency situations in regard to the employees (80% and 66.7% respectively), most probably because those plans have not been legally bound until recently. Nevertheless, it can be seen that more high technologies companies than information technologies companies include those plans, because of the nature of their business. The results can be seen at Table 2.

Table 2. Human resources and business policies and procedures (Source: authors)

Period		**March**	
Vriables	**Industry**	**Yes**	**No**
My company has the business plan for the 2020 that includes human resources plan	IT	10	/
	HT	9	/
My company has human resources management function	IT	8	2
	HT	6	3
My company has human resources management position	IT	0	10
	HT	0	9
My company has written human resources management policies, procedures, and plans	IT	7	3
	HT	1	8
My company has risk management policies, procedures, and plans	IT	2	8
	HT	3	6
My company has a plan for emergency situations regarding the employees included in the risk management policies, procedures, and plans	IT	2	8
	HT	2	7

In regard to the ability to retain and reward the employees, all of the companies in the field of information technologies in both periods have stated that they have the ability to continue their business plans for 2020. Regarding the high technologies companies, the situation has been entirely different. Only 22.2% of the companies in March and only one company (11.1%) in May have believed in their ability to continue business plans for 2020.

In March, all companies in information technologies field have believed to be able to retain all the employees, with only one that changed the statement in May. In high technologies, 44.4% in March already have believed not to be able to retain all the employees and that percentage decreased even more in May (22.2%).

The most of the information technologies companies (80%) have believed in their ability to retain the bonuses with slight May decrease (70%). And the most of those companies have believed to be able to retain regular wages, namely 90% in May and 90% in May.

Completely different situation has been for high technologies field. Only one interviewee in March (11.1%) have believed that they would be able to retain the bonuses, and in May, all the participants from the field of high technologies have believed that they won't be able to retain bonuses. It is similar for regular wages, 22.2% of interviewees in March and only one in May have believed to be able to retain regular wages.

Understandably, the complete opposite attitudes have been expressed for the online (core) business possibilities, because none of the high technologies companies is able to have exclusively online core business, but all information technologies' companies are.

Similarly, in regard to possibility of management and administration to be able to function online there is a discrepancy. All of the information technologies' participants have believed that their companies are able to continue managerial and administrative functions completely online (both in March and May), it has been different for high technologies companies, where in March 44.4% of participants have stated that they would be able to continue managerial and administrative function online in March, and only one in May. Some of the participants have stated that that their administrative and managerial function requires a lot of physical presence.

The results can be seen at Table 3.

Table 3. the ability to retain and reward the emploees (Source: authors)

Period		**March**		**May**	
Vriables	**Industry**	**Yes**	**No**	**Yes**	**No**
The ability to continue the business plan for the 2020	IT	10	0	10	0
	HT	2	7	1	8
The ability to retain all the employees	IT	10	0	9	1
	HT	4	5	2	7
The ability to retain the bonuses for the employees	IT	8	2	7	3
	HT	1	8	0	9
The ability to retain regular wages for the employees	IT	10	0	9	1
	HT	2	7	1	8
The ability to retain essential (core) employees during/after pandemic	IT	10	0	10	0
	HT	4	5	2	7
The ability for online business (core bussiness)	IT	10	0	10	0
	HT	0	9	0	9
The ability for enabling the employees to work online during/after the pandemic (administration and management)	IT	10	0	10	0
	HT	4	5	8	1

The attitudes toward the acceptance of possible financial governments' aid in March in May have not been changed. None of the participants have stated that they would apply (or has applied) or government's aid.

The results can be seen at Table 4.

Table 4. Government's financial aid acceptance

Period		**March**		**May**	
Vriables	**Industry**	**Yes**	**No**	**Yes**	**No**
My company will accept/has accepted financial government's assistance	IT	0	10	0	10
	HT	0	9	0	9

Because none of the participants have stated that they would be willing to accept the possible government aid, the reasons for that thinking have been further investigated in May interviews. There is a huge gap in the reasons for declining the government's aid package. Information industry representatives have stated that regarding the human resources they are quite capable to overcome the crisis. However, the representatives of high technologies have stated that the government's aid won't help them, because they wouldn't be able to continue even in those circumstances.

The results can be seen at Table 5.

Table 5. Some reasons for not accepting the government's aid

Information technologies companies	**High technolgies companies**
We are able to reward our employees	Our supply chain is disrupted
We are even able to continue with the bonuses	Our market is significantly decreased
Our business has not been affected	We had to dismiss most of our employees
Other companies need more help	We are not able to honour the conditions of the government's aid package

5. Limitations and scope of further research

This research includes the sample that is small, further research is needed and this very important issue calls for larger sample, survey and operation of various statistical methods.

6. Conclusion

Most of the micro and small companies don't have organized human resources management sector or a designated position with responsibilities in the field of human resources management. Moreover, those companies also don't have risk management or human resources management plans that include retention of the employees in crisis situations such as a pandemic.

According to the owners and general managers of micro, and small businesses in the field of information technologies, there is different situation in coping with the retention of the employees between the two industries; even both are based on high end information technologies, high technologies, and innovation. Micro and small companies in the field of information technologies have been, because of the nature of their work, less affected by the disruptions caused by pandemic and the state of emergency, and the micro and small companies in the field of high technologies have not been able to cope with the effects of pandemic because of disruptions in supply chain and loss of a market.

Although the sample is small, it can be concluded that micro and small businesses have been unprepared for this crisis, but that in terms of human resource management, especially when it comes to retention and rewarding employees, micro and small businesses in the field of information technologies have are able to overcome crises much easier than companies engaged in production (although they are utilizing high technologies) and to retain and reward the best talent.

Further research is needed with much larger sample, surveys and statistical analysis to further analyse this important topic.

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Guidelines for the Preparation of Papers for Publication in the Serbian Journal of Engineering Management

Title of Paper in Serbian

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[1] Institution and E-mail address [in this stage leave it empty for the peer review purpose]
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Summary in Serbian: This document is a template for formatting the papers in order to prepare them for printing. This summary provides briefly the information related to the content of the article so that the reader can rapidly and accurately assess its relevance. Authors should explain the goals of research or state the reason (reasons) why they have written the article. Then, it is necessary to describe the methods used in the study and briefly describe the results they have obtained in the research. The abstract should be between 100 and 250 words long.

Keywords: 3-5 keywords for indexing and search purposes

Title of Paper in English

Abstract in English: This document presents a template for preparing the print-ready papers that will be included in the Serbian Journal of Engineering Management. The abstract briefly summarizes the article and gives the reader the opportunity to assess its relevance. The authors should elaborate the goals of the research or state their reason (reasons) for writing the paper. It is additionally required for them to describe the methods used during the research and give a brief description of the results and conclusions of the research. The abstract should be between 100 and 250 words long.

Keywords: 3-5 keywords for indexing and search purposes

1. Introduction

The paper should be written using MS Word for Windows (on Serbian Cyrillic, Latin or English – UK keyboard). The length of work should not be more than 10 pages including text, diagrams, tables, references, and appendices.

The format is **A4**. Use **2 cm** for the lower and upper margin and **2.5 cm** for the left and right margin. The spacing within one paragraph should be one (single), while the spacing between paragraphs is double. To format the text, it is recommended to use font Times New Roman.

2. Structure of the paper

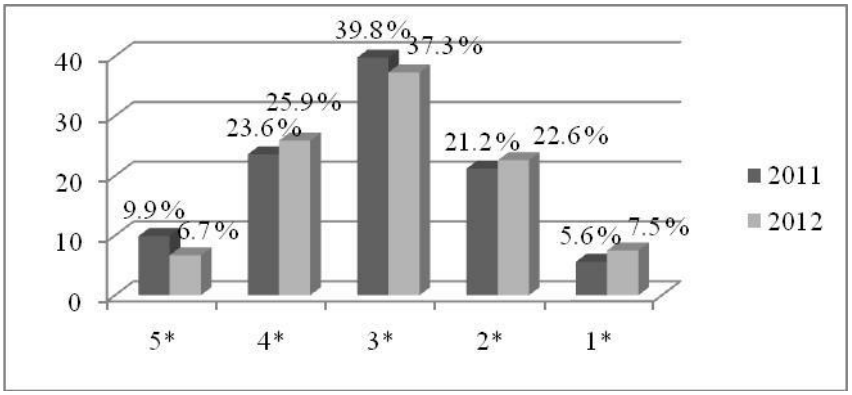
In the first line of the first page the title should be written in Serbian language (16 pt). Under the title of the paper the spaces for name(s) of the author and the names of the author's institutions should be indicated as specified and aforementioned in this Guideline. After the space for the institution of the last author, leave one blank line and write the short summary (10 pt) in Serbian. After the summary, provide an overview of key words. After the paper title you indicated, include the summary and key words in the Serbian language, whereas they should be indicated in English like above.

Numbered subtitles of the first level must be formatted using the font 12 pt bold, a second-level sub-titles should be 10 pt bold. The text, and a list of references should be formatted using the font 10 pt.

3. Graphs, tables and formulae

All illustrations, regardless of whether they are diagrams, photographs or charts are referred to as images. The name and number of images should be displayed as centred.

Figure 1: Accommodation units according to the structure of hotel capacities in 2011 and 2012, written in the form of percentage



Source: (The Ministry of Finance and Economy, 2013)

The title and number of the table should be presented above the table as centred

Table 1: Accommodation units according to the structure of hotel capacities in 2011 and 2012, written in the form of percentage

Category	2011	2012	Number of accommodation units (2011)	Number of accommodation units (2012)
5*	**9,9**	**6,7**	1452	990
4*	**23,6**	**25,9**	3486	3911
3*	**39,8**	**37,3**	5895	5636
2*	**21,2**	**22,6**	3102	3420
1*	**5,6**	**7,5**	1133	1132
total	100	100	15068	15089

Source: (The Ministry of Finance and Economy, 2013)

Submit your article, including tables, images, etc., as a single file. In addition, you should submit all figures and tables (which are entered in black and white) as separate files in TIFF or JPF format with a minimum resolution of 300dpi.

Formulae should be centered on the page and properly numbered, as in the following example. It is recommended that you format the rows with formulae in Microsoft Word (using MathType).

$$PVo = \frac{FVn}{(1+i)^n} \quad (1)$$

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In conclusion, the authors should summarize the results they have obtained in the research.

5. Literature

When quoting the literature, the APA referencing system should be used. For more information, see the Publication Manual of the American Psychological Association (6th ed.).

When quoting within the text, as in the sentence where you mention the author and specify his words, then after the author's name you should indicate the year of publication of the quoted text in parentheses, at the end of the sentence there should be the number of page in which the text should be indicated: according to Čerović (2012) ,,quoted text''(p.10). When the author is not mentioned in the sentence, then his last name, the year of publication and the number of page should be indicated in parentheses at the end of a sentence, and if the quote was created by paraphrasing or summarizing, then data about the page number is not required: (Čerović, 2012). If there are two or more references by the same author, but they were published at the same time in the same year, the referencing should look like this (Harish, 2008a; Harish, 2008b). When two authors wrote the paper together, the surnames of both authors are written as follows (Petković and Pindžo, 2012), or (Tew & Barbieri, 2012). The call for references in the text requires working with more than two authors and should be stated as follows (Luque-Martinez et al., 2007). When citing a source that does not show the number of pages (such as electronic sources) use the author's name and year of publication if the author is known, and if the author is a corporation or an organization, write down the organization name and year of publication (Ministry of Finance and Economy, 2013).

References should be given at the end of the main text in alphabetical order, following the last name of the author. Below are shown examples of using APA style for citations appearing in various forms (books, journal articles, proceedings, electronic resources, etc.).

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When you have multiple authors, all of them are supposed to be mentioned, but as soon as the last surnames are added and if there are more than seven authors, mention the first six and then write … at the end of the last author.

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The sources which were not used in the paper should not be included in the list of references. References should be cited in the language in which they are published without translating them into the language of paper.

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Apstrakt: Ovaj dokument predstavlja obrazac za formatiranje radova tako da izgledaju kao da su već spremni za štampu. Sažetak predstavlja kratak informativni prikaz sadržaja članka koju čitaocu treba da omogući brzu i tačnu ocenu njegove relevantnosti. Autori treba da obrazlože ciljeve istraživanja ili navedu razlog (razloge) zbog koga pišu članak. Zatim, potrebno je da opišu metode korišćene u istraživanju i ukratko opišu rezultate do kojih su došli u istraživanju. Sažetak treba da sadrži od 100 do 250 reči.

Ključne reči: 3-5 ključnih reči za indeksiranje i pretraživanje

Title of Paper in English

Abstract: This document presents a template for preparing the print-ready papers that will be included in the Serbian Journal of Engineering Managment. The abstract briefly summarizes the article and gives the reader the opportunity to assess it's relevancy. The authors should elaborate the goals of the research or state their reason (reasons) for writing the paper. It is additionally required for them to describe the methods used during the research and give a brief description of the results and conclusions of the research. The abstract should be between 100 and 250 words in lenght.

Keywords: 3-5 keywords

1. Uvod

Rad pisati koristeći MS Word za Windows (tastatura za srpsku ćirilicu, latinicu ili engleski jezik - UK). Dužina rada treba da bude najviše 10 strana uključujući tekst, slike, tabele, literaturu i ostale priloge. Format stranice je **A4.** Koristite **2 cm** za donju i gornju marginu, a **2,5 cm** za levu i desnu marginu. Razmak između redova u okviru jednog pasusa je jedan, dok je razmak između paragrafa dvostruki. Za formatiranje teksta preporučuje se korišćenje fonta **Times New Roman.**

2. Struktura rada

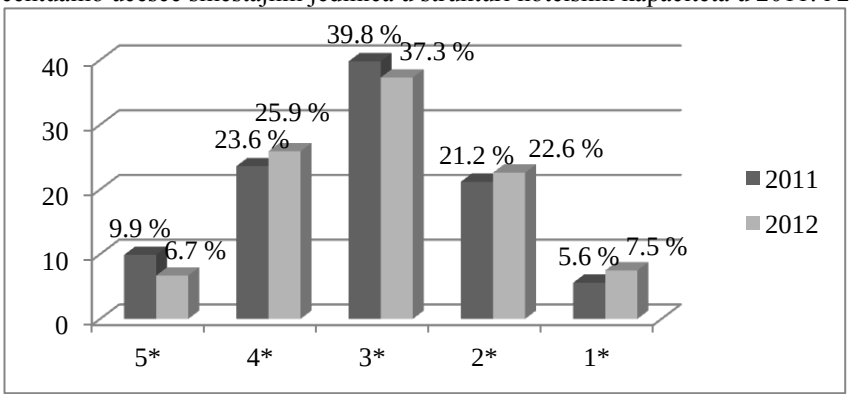
U prvom redu na prvoj strani treba napisati naslov rada na srpskom jeziku (16 pt). Ispod naslova rada treba ostaviti mesto za navođenje ime(na) autora, nazive institucija autora onako kako je naznačeno u ovom Obrascu. Nakon institucije poslednjeg autora, ostaviti jedan prazan red i u sledećem napisati kratak sažetak (10 pt). Nakon sažetka sledi pregled ključnih reči. Nakon prikazanog naslova rada, sažetka i ključnih reči na srpskom jeziku, potrebno je i na engleskom jeziku naznačiti prethodno navedeno.

Numerisane podnaslove prvog nivoa treba formatirati korišćenjem fonta 12 pt boldovano, a podnaslove drugog nivoa 10 pt boldovano. Tekst, kao i spisak literature treba formatirati korišćenjem fonta 10 pt.

3. Grafički i tabelarni prikazi i formule

Sve ilustracije, bez obzira da li su dijagrami, fotografije, grafikoni nazivaju se slike. Naziv i broj slike treba prikazati na sredini reda iznad slike.

Slika 1: Procentualno učešće smeštajnih jedinica u strukturi hotelskih kapaciteta u 2011. i 2012. godini



Izvor: (Ministarstvo finansija i privrede, 2013)

Naziv i broj tabele treba prikazati iznad tabele na sredini reda.

Tabela 1: Procentualno učešće smeštajnih jedinica u strukturi hotelskih kapaciteta u 2011. i 2012. godini

Kategorija	**2011.**	**2012.**	**Broj smeštajnih jedinica (2011)**	**Broj smeštajnih jedinica (2012)**
5*	**9,9**	**6,7**	1452	990
4*	**23,6**	**25,9**	3486	3911
3*	**39,8**	**37,3**	5895	5636
2*	**21,2**	**22,6**	3102	3420
1*	**5,6**	**7,5**	1133	1132
ukupno	100	100	15068	15089

Izvor: (Ministarstvo finansija i privrede, 2013)

Pošaljite svoj rad, uključujući tabele, slike itd, kao jednu datoteku. Pored toga, treba dostaviti sve slike i tabele (koje se unose u crno-beloj tehnici) kao posebne fajlove u JPF ili TIFF formatu sa najmanje 300dpi rezolucije.

Formule treba centrirati na stranici sa numeracijom, kao u narednom primeru. Preporučuje se formatiranje redova sa formulama u Microsoft Word-u (MathType).

$$\mathrm{PVo} = \frac{\mathrm{FVn}}{(1+\mathrm{i})^{\mathrm{n}}} \qquad (1)$$

4. Zaključak

U zaključku autori treba da sumiraju rezultate do kojih su došli u istraživanju.

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