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INNOVATION AS AN INITIATOR OF THE DEVELOPMENT
"INNOVATIONS IN THE FUNCTION OF DEVELOPMENT"

International Thematic Monograph – Thematic Proceedings

Digital Edition

I N N O V A T I O N S



December 3rd
Belgrade, 2020

University Business Academy in Novi Sad
Faculty of Applied Management, Economics and Finance Belgrade

MEFkon 2020

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FOREWORD

This year, as well as the previous five, innovations are our driver of development and an occasion to make a new contribution to this inexhaustible and challenging topic. Nurturing tradition imperatively obliges us to be better for each new conference in terms of the quality of papers, their number, and breadth. At the same time, changed life circumstances impose the topicality of the moment. Innovations both mark and generate the future, but they begin in the present that must be illuminated, analyzed, and considered. Faculty of Applied Management, Economics and Finance, for the purpose of socially responsible business and health care due to the pandemic, organized a conference this year only on the basis of the submitted papers, without the physical presence of the participants. However, the authors showed interest despite the difficult situation and the spread of the Covid 19 virus, and the number of papers received is a confirmation of that. The impact and consequences of the spread of the virus have been elaborated and researched in several papers from different angles: tourism, the digital transformation of work and work environment, agriculture, innovation sector, then from the medical aspect that is immanent to the epidemic. In addition, the socio-economic consequences of the virus, the impact on management, but also on the trade balance in the European Union, as well as retail communication, were analyzed. This list is thematically complemented by the luxury industry and Industry 4.0 technology. Such a comprehensive thematic aspect is proof that we are keeping up with the times. This further implies that innovation is all around us.

This paradigm of diversity that innovation carries, imposes, and emphasizes the further thematic spectrum that is present among the articles. Thus, not only did the impact and consequences of the coronavirus capture the attention of the participants, but they were also inspired by other aspects and issues.

Appropriate to the topic "Innovation as the initiator of development" and the goal of the scientific conference, two sessions were established: Session I: Innovations in the function of development (Thematic Proceedings – Thematic Monograph) and Session II: Innovations as the key to business success (International conference proceedings). The choice of the topic of the meeting and the ubiquity of innovations, as well as the offered number of thematic areas, influenced the works of many

eminent university professors, prominent researchers, experts, and scientists, both from Serbia and abroad.

Proceedings of the international conference, as a result of the conference, are in the form of a digital edition and will be available to the general scientific public. The papers published in these collections significantly contribute to establishing the unbreakable link between innovation and development. At the same time, we have shown that the field of innovation is definitely no longer related only to technical - technological progress. Accordingly, the papers can be useful to both the scientific and professional public and all those interested in the impact of innovation on development.

Belgrade,
December, 2020

Editors
Darjan Karabašević, PhD
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Exploring students' attitudes towards green behaviour

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Abstract: *Social and environmental issues have become crucial for achieving organizational success in the contemporary business environment. Sustainable Human Resource Management is a discipline that promotes “green” activities within organizations and refers to the use of HR policies and practices to promote sustainable use of resources. This paper aims to explain the importance and benefits of incorporating the concept of sustainability in HRM practices. Authors conducted empirical research through an online survey among 514 students of the University of Belgrade, and their responses were used to assess students' attitude towards the environment, in-role and extra-role green behaviour, as well as their natural and acquired green competences. The results have shown that the majority of students have a positive pro-environmental attitude, while there was a difference in students' green behaviour. Having in mind that students' activities resemble employees, it may be concluded that developing more sustainable HR practices helps to ensure healthy and happy employees, who will perform better.*

Keywords: sustainable human resource management, green human resource management, human resource management, sustainability, employee, environment

JEL: M59, O15, Q56

1. INTRODUCTION

Nowadays, organisations are becoming increasingly aware of the importance to achieve ethical, social and environmental goals (Chams & García-Blandón, 2019). Vukotić and Mirčetić (2020, p. 470) point out that “global trends enhance healthy lifestyles, turning back to nature and preservation of the environment”. Sustainable development is concerned with meeting the needs of people today without compromising the ability of future generations to meet their own needs (Mandip, 2012).

Sustainability means that something that is done today should have a positive effect on the future. The rapid growth of organisational sustainability has begun two decades ago and has become an important strategic aspect of doing business.

Recent studies have analysed the influence of the human capital on sustainable development (e.g. Pfeffer, 2010; Speth, 2010). Having in mind that the role of human resource management (HRM) is to manage employees effectively to make an essential contribution to achieving organisational success, sustainability issues need to be incorporated in HRM. Since employees represent an integral part of the implementation of environmentally-friendly practices in organisations (Renwick, 2020), it is not possible to implement these actions without the contribution of human resources. Roscoe *et al.* (2019) suggest that environmentally-friendly human resources management, such as hiring, training, appraisal, and incentivisation, encourage the development of the facilitators of green organisational culture.

Scholars have conducted numerous studies that investigate how environmentally-friendly human resources management activities improve the company's green performance (Jabbour & Santos, 2008; Daily *et al.*, 2012; Arda, Bayraktar, & Tatoglu, 2018). Training can be considered as an essential human resource management practice to prevent mistreatment and improve civility (Walsh & Magley, 2020). Employees' green behaviour includes both in-role green behaviour and extra-role green behaviour (Bissing-Olson *et al.*, 2015), while employees' green competencies refer to natural and acquired ones.

This paper aims to explain the importance as well as the benefits of incorporating the concept of sustainability in human resource management practices. In order to achieve this, empirical research was conducted among the students of the University of Belgrade to investigate their attitudes towards environmentally-friendly practices, as well as to evaluate their in-role and extra-role behaviour, and their natural and acquired competences. Based on the literature review, we propose the Adapted green competencies conceptual model, which, unlike previous models, includes a new component - the individuals' willingness to use his/her green competencies.

2. SUSTAINABILITY AND HUMAN RESOURCE MANAGEMENT

2.1. Defining Sustainable (Green) HRM

According to Ehnert (2011), there are different labels used for explaining the relationship between sustainability and HRM, such as 'Sustainable HRM' (Ehnert, 2009; Zaugg, 2009; Chams & García-Blandón, 2019) or 'Green HRM' (e.g., Renwick *et al.*, 2008).

There are different explanations of the concept of Sustainable HRM. According to Thom and Zaugg (2004, p. 217) Sustainable HRM refers to ‘those long-term oriented conceptual approaches and activities aimed at socially responsible and economically appropriate recruitment and selection, development, deployment, and downsizing of employees’. (p. 217; translated by Ehnert, 2009, p. 73).

Sustainable HRM is ‘the pattern of planned or emerging human resource management strategies and practices intended to enable organizational goal achievement while simultaneously reproducing the HR base over a long-lasting calendar time and controlling for self-induced side and feedback effects of HR systems on the HR base and thus on the company itself’ (Ehnert, 2009, p. 74).

The role of Sustainable HRM is to nurture the development and reinforcement of employees and HRM practices for today and future needs (Ehnert, 2011). The responsibility for Sustainable HRM is jointly shared among employees, companies and society, while all of them should have an advantage from sustainability (Zaugg, 2009). Therefore, sustainable HRM is expected to create a competitive advantage for companies, sustainable employability for employees and a financial value for the shareholders.

Renwick, Redman, & Maguire (2013, p. 1) refer to green human resources management as human resources management aspects of environmental management, and Kramar (2014, p. 1075) defines it as human resources management activities that have positive environmental results.

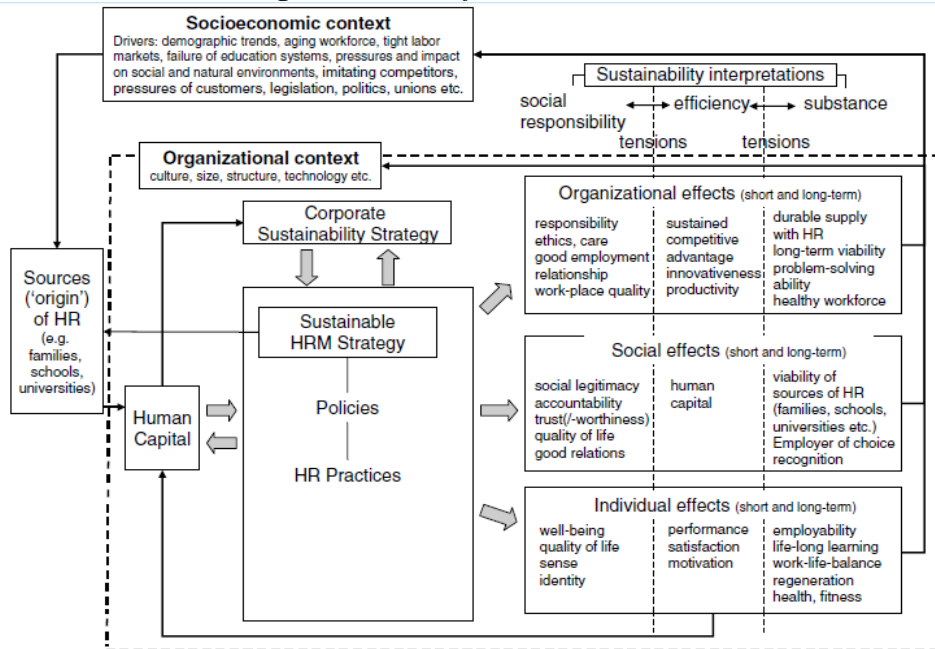
Some authors (Siebenhüner & Arnold, 2007; Wolf, 2013; Jaramillo *et al.*, 2018; Wong *et al.*, 2018) point out that Green human resource management proposes a practical way for companies to develop human capital that can improve the green performance and sustainable development of the company.

According to Zaugg (2009), the aims of sustainable HRM should include fostering competitive advantage through attracting skilled and motivated employees to support well-being, employability, work-life-balance as well as a better quality of life, while continuously balancing with economic, social, and environmental requirements.

2.2. Model of Sustainable HRM

Ehnert (2009) introduced a model of Sustainable HRM extending the integrative model of Strategic HRM (by Martín-Alcázar *et al.*, 2005). The model of Sustainable HRM is shown in Figure 1.

Figure 1. Model of Sustainable HRM



Source: Ehnert (2009, p. 172)

Comparing to previous models of Sustainable HRM, this model focuses the attention to the sources (origin) of human resources (such as family, schools, universities) and adds the drivers of socio-economic context (demographic trends, social, legal, political system, etc.). The model also provides examples of possible organizational (e.g. long-term supply of workforce, healthy employees), social (e.g. viability of sources of human resources, quality of life, good employer brand), and individual (employee well-being, work-life balance, health, employability) effects of Sustainable HRM, both short and long-term. According to the model, there are key tensions and paradoxes between the efficiency and substance-oriented rationality, as well as between the social responsibility and efficiency-oriented rationality.

2.3. Implementing Sustainability in HR Practices

Usually, when 'greening' the company is thought of, it is rarely thought primarily of HR practices. However, HRM plays an essential role in implementing sustainable organisational practices. It has the aim of promoting environmental sustainability. Green HRM practices make a positive impact on a company's green performance through various activities (Jabbour, 2015) and can also improve employees' green behaviour to enhance a company's performance voluntarily (Kim *et al.*, 2014; Pham *et al.*, 2019).

Having in mind that globalisation impacts all aspects of modern living and business (Mirčetić *et al.*, 2019), in the contemporary business environment

organisations around the world face many challenges, such as stress, employee burnout and many other work-related health problems. Employees experiencing stress caused by the working environment have been shown to develop different health problems (Colligan & Higgins, 2006); therefore, stress can negatively impact employee effectivity. Promising approaches to decrease stress can be flexible working hours and creating a more positive and pleasant working environment (Ivanović *et al.*, 2020). According to Zaugg (2009), Sustainable HRM focuses on the following issues: the shortage of skilled and motivated workforce, work-related health problems and absenteeism, and the relationship between HRM and the environment. Sustainable goals are achieved by the integration of innovative sustainable strategies and through the adoption of new environmentally-friendly practices by employees (Chams & García-Blandón, 2019).

Difficulties in balancing private and work life have become a prevalent issue nowadays. Therefore, as De Prins *et al.* (2014) argue, incorporation of sustainability into HRM could bring humanity back in managing human resources. Companies should reconsider their traditional policies and management styles and discover different, more constructive methods to work with different generations because Millennials are more likely to leave their jobs if they are not satisfied compared to Baby Boomers or Generation X (Ivanović & Ivančević, 2019).

Organisational sustainability affects employee morale, loyalty, work engagement and productivity positively. Some scholars concluded that there is a gap in research on the relationship between organisational culture and a company's green performance (Jackson *et al.*, 2011; Renwick *et al.*, 2013; Jackson *et al.*, 2014; Dubey *et al.*, 2017). Sustainable HR practices should be promoted within organisations to increase awareness of existing employees and their commitment to sustainability issues. Additionally, promoting sustainability as a core value of an organisation can also help to attract top talent among prospective employees. Many of the most talented job candidates are interested in working for companies that put ethics over profit. Particularly, members of younger generations in the workplace, Millennials and Generation Z, seek employment in socially and environmentally responsible organisations, which reflect their individual beliefs and values. This imposes new responsibilities for HR professionals to find appropriate ways to design job descriptions, plan, recruit, select, train and develop employees who share the same pro-environmental values as the organisation. After they employ such individuals, HR professionals should make sure that sustainability is embedded in new employees' vision of the company from the process of their orientation and onboarding.

Having in mind that Sustainable HRM refers to the use of HR policies to promote sustainable use of resources within the organisation, HR can encourage

sustainable practices, for example, through the use of HR information system (HRIS), electronic filing, job-sharing, telecommuting, virtual interviews and meetings, recycling, online training, energy-efficient office space (Mandip, 2012). This can also be done through engaging employees in environmentally-friendly programs, such as reducing the use of paper, car-sharing, reducing waste and recycling, which should result in greater efficiency, lower costs and increased employee satisfaction, engagement and retention.

3. GREEN BEHAVIOUR AND GREEN COMPETENCIES

Companies are often challenged with different green problems. Past studies reported that human activities had caused about 40% of environmental problems (Grunert, 1993; Gan *et al.*, 2008). Some scholars (Kinnear *et al.*, 1974; Grunert, 1993; Gan *et al.*, 2008) have associated a worsening global natural environment with economic development all over the world and human activities. Companies should systematically approach these problems and have various green strategies that include increasing employees' environmental consciousness and developing of their competencies.

Competencies are the behaviours and attitudes required of employees to perform their tasks effectively (Wood, 1997; Brownell, 2008; Zopiatis, 2010). Some literature proposes that professional competencies include individual attributes, behaviours, skills, knowledge, attitudes, self-reflection, personal circumstances, values and opinions (Jeou-Shyan *et al.*, 2011). Competencies contribute significantly to career success (Birdir & Pearson, 2000; Jeou-Shyan *et al.*, 2011).

Subramanian *et al.* (2016) conducted an empirical study that was integrating environmental consumer behaviour literature with traditional skills and competencies literature to help companies to choose the appropriate individuals to accomplish their environmental goals, and they examined the impact of green competencies of individuals on organizations' green practices and performance.

Since the 1970s, some scholars (Kinnear *et al.*, 1974; Dunlap & Van Liere, 1978; Zhao *et al.*, 2014) have strived to identify the characteristics of consumers that understand the environment through their ecological attitude-knowledge. Kinnear *et al.* (1974) first proposed the concept of perceived consumer effectiveness (PCE). In their study of characteristics of environmentally conscious consumers in Canada, they found that personality variables were more reliable predictors than the socioeconomic variables. Other scholars (Chan, 2001; Fraj & Martinez, 2007; Gan *et al.*, 2008) discovered the importance of individual personal opinions and beliefs in terms of their purchases in predicting green behaviour.

Ramayah, Lee, & Mohamad (2010) and Zhao *et al.* (2014) point out that the attitudes and values of individuals are essential factors that impact green competencies. Green Competencies are the requisite ecological knowledge, skills and other socioeconomic behaviour an individual has to help him/her behave and act rightly and responsibly toward the overall well-being of his/her immediate environment (Subramanian *et al.*, 2016, pp. 154). Green competencies are influenced by many factors, such as environmental knowledge, attitudes and values of individuals (Ramayah, Lee, & Mohamad, 2010; Zhao *et al.*, 2014).

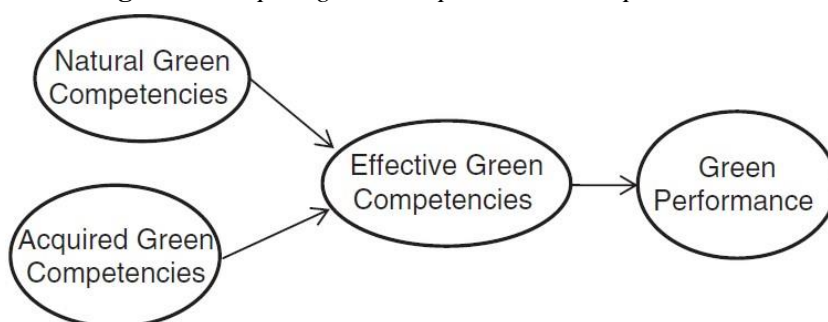
Existing green behaviour research is mostly based on two grounded theories: the theory of reasoned action (Ajzen & Fishbein, 1980) and the theory of planned behaviour (Ajzen, 1991). Roberts (1997) proposed classifying competencies in four categories: 'natural,' 'acquired,' 'adapting' and 'performing' competencies.

Robert's (1997) framework of competencies was adopted to the green setting by Cousins (2002). National green competencies (NGCs) are considered to be traits and beliefs formed at their formative stages. Acquiring green competencies of employees leads to integrating positive environmental reasoning into the human resource activities of the company (Pellegrini *et al.*, 2018).

Measurement of green behaviour could be beneficial for HRM because it could determine the level of employee's green performance. Employees with developed green competencies persist motivated through performance measurement and reward methods that focuses on providing opportunities for green performance improvement (Attaianese, 2012; Renwick *et al.*, 2013).

Subramanian *et al.* (2016) proposed Green competencies conceptual model, as shown in Figure 2. In this model, effective green competencies represent a combination of natural green competencies and acquired green competencies, while green performance is the final output of all competencies.

Figure 2. Adapted green competencies conceptual model



Source: Subramanian *et al.* (2016, p. 159)

Table 1 presents the sublimation of constructs and definitions of different types of green competencies, natural and acquired, and as well as green performance. Representative authors and scholars proposed mentioned constructs and definitions that were used in this article.

Table 1. *Definition of constructs*

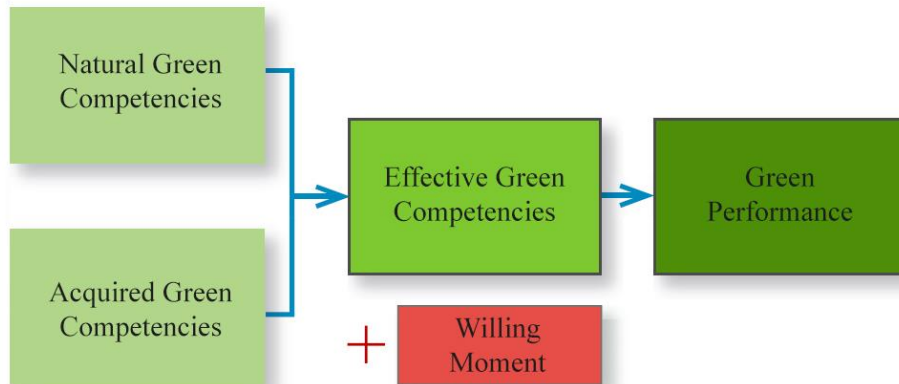
Construct	Definition	Source
Natural Green Competencies	The NGCs are defined as individuals' underlying traits and personality dimensions derived from observations and mentoring received at the formative stages on the dominant green behavior of their immediate social groups.	Yeung (2004), Kim & Choi (2005), Roberts (1997)
Acquired Green Competencies	Acquired GCs are the green knowledge and skills that an individual has accumulated through previous experiences on environmental issues that lead to individual's strong conviction and feeling toward acting in an environmentally friendly manner.	Cousins <i>et al.</i> (2008), Fryxell & Lo (2003), Roberts (1997)
Effective Green Competencies	The combination of natural and acquired GCs of people.	Roberts (1997)
Green Performance	Green performance is the final output or observable behavior resulting from the combination of natural, acquired and adapting competencies.	Follows & Jobber (2000), Tan (2011), Mainieri <i>et al.</i> (1997), Kaufmann <i>et al.</i> (2012)

Source: Subramanian *et al.* (2016, p. 155)

In addition to the Green competencies conceptual model developed by Subramanian *et al.* (2016), the authors propose the Adapted green competencies conceptual model (Figure 3). The proposed model differs from the basic model by adding the new component of the individual to use his/her green competencies – the willing moment.

A person can have excellent natural green competencies and advanced level of acquired green competencies, which gives him/her effective green competencies, a prerequisite for green performance. However, if an individual is not willing to use his/her effective green competencies, the authors consider that green performance can not be achieved.

Figure 3. *Adapted green competencies conceptual model*



Source: Authors

Green behaviour can be observed as in-role green behaviour and extra-role green behaviour. Daily environmentally friendly behaviour is considered to be in-role green behaviour (Zhang *et al.*, 2019). Employees complete their tasks in a pro-environmental way (Bissing-Olson *et al.*, 2015). Extra-role green behaviour refers to proactive pro-environmental behaviour (Bissing-Olson *et al.*, 2015), which means that employees take actions in a green manner.

4. SURVEY: STUDENTS' ATTITUDES TOWARDS GREEN BEHAVIOUR AND GREEN COMPETENCIES

4.1. Methodology and measures

In order to investigate green behaviour and green competencies (natural and acquired) as well as the willingness moment, we decided to conduct empirical research among the university students, having in mind that the activities of university studies are considered similar to employees' activities (Salanova *et al.*, 2010; Van Beek, 2014). The online questionnaire was distributed among the students of the University of Belgrade, Serbia, in October 2020. The questionnaire contained four major sections: demographic information, in-role and extra-role green behaviour (4 items), attitude towards the environment (4 items), natural green competences (5 items), and acquired green competencies (5 items). Respondents were asked to indicate how often they engaged in a specific behaviour on the 5-point Likert scale (1 - never, 5 - always). In-role and extra-role behaviour was measured through the scale adapted from Bissing-Olson *et al.* (2015), with two items for in-role and two items for extra-role behaviour, while natural and acquired green competences were measured on the scale adapted from Roberts (1997).

4.2. Sample

Totally 514 respondents filled in the questionnaire. Among them, 66,3% (341) are female, and 33,7% (173) male students. The majority of respondents were born between 1999 and 2001 – with 47.5% of respondents being 3rd-year students, while 49,8% 2nd-year students.

4.3. Results and discussion

Regarding in-role green behaviour, the majority (83,5%) of respondents agreed that they perform their study-related activities in a way which does not damage the environment. In comparison, 78,4% of respondents stated that they perform their daily activities in an environmentally-friendly way.

In terms of extra-role green behaviour, only 25,1% of respondents stated that they were actively involved in environmental protection, while 64,8% indicated that they took the initiative often or always to perform their daily activities in an environmentally-friendly way.

Analyzing students' green behaviour through in-role and extra-role green behaviour, the results have shown the difference in students' green behaviour – more students involve in in-role than in extra-role green behaviour. Referring to Bissing-Olson *et al.* (2015) and Zhang *et al.* (2019), it can be seen from the results of the research that even though students tend to preserve the environment while performing their daily activities, they are not as likely to engage proactively in environmental protection.

Regarding natural green competences, 61,2% of respondents stated that their parents had addressed attention to the importance of environment; 65,8% of respondents agreed that they had listened a lot about the importance of protecting the environment in their childhood; 43,8% often watched informative programmes related to environmental protection or read/listened about the issue while growing up. Also, 39,3% of respondents stated that their friends mostly influenced positively their attitude towards environmental protection, while 38,75% agreed that their university colleagues took care of the environment and influenced positively their attitudes towards the environment.

In terms of acquired green competences, 57,4% of respondents stated that their previous experience had affected significantly their knowledge and skills related to the environment; 35,8% of respondents had courses in their previous education which provided them knowledge about environmental protection; while 23,6% of respondents have actively studied environmentally-related issues. Totally 96,1% of respondents are confident that it is necessary for each one of us to take care of the environment, while 89,7% of respondents feel upset when they see someone or something polluting the environment.

The willing moment was studied through students' attitudes towards environmental protection. In terms of their attitude towards the environment, 44,1% of respondents consider that they took more care of the environment during the state of emergency than before. Fewer students, 42,2% of respondents believe that they take more care of the environment after the state of emergency than before it; 43,85% of respondents believe that e-learning is more environmentally-friendly compared to classroom learning. At last, 92,2% of respondents think that it is crucial to take care of the environment while performing business tasks.

4.4. Limitations and suggestions for future research

This article is limited in several aspects, and it should be addressed in future research. Firstly, the survey was undertaken in a particular context, and it is related only to the students of the University of Belgrade. This context provides us with crucial information regarding students' green behaviour attitudes; however, it remains unclear whether our results can be generalisable to the students from other universities and countries. Secondly, even though we consider that the survey is very representative because 514 respondents filled in the questionnaire, the sampling could have been more extensive; therefore, the collected results would be more representative. Thirdly, the research was conducted in a specific period, during the pandemics; therefore, the current circumstances could have influenced the results.

Our suggestions should help scholars and practitioners and provide them with directions on what can they do to breach limitations and improve the impact of this study. The survey can be conducted in other universities in Serbia, or even in different countries to examine and analyse green behaviour attitudes of different cultures, which will add more diversity to the research. Similar research can be undertaken with a larger sample size so to gain more representative results.

In addition, this research can be conducted periodically to see if there are any changes or correlations because that would also provide clear insights into the influence of circumstances caused by pandemics.

CONCLUSION

The research has shown that university students are involved in environmental protection, while their attitudes and knowledge about the preservation of the environment differ. However, a lot more may be done to increase awareness of students about this topic of crucial importance. In this sense, both students themselves and the universities should engage more effectively in fostering environmentally-friendly behaviour (both in-role and extra-role) as well as green competencies, which should result in achieving green performance.

Every forward-looking organization should consider integrating sustainability in its processes in order to develop growth strategies for the future. For example, a survey that included 2800 global companies around the world concluded that 70% of them defined achieving sustainability as one of their main strategic goals in their strategic plans (Kiron *et al.*, 2012).

The UN 2030 Agenda for sustainable development, which is referred to as “an Agenda of the people, by the people, and for the people – and this will ensure its success” (United Nations, General Assembly, 2015), includes 17 sustainable development goals grouped into three dimensions of sustainable development - economic, social, and environmental. The goal of the Agenda is to establish “sustainable, innovative, and people-oriented” economies that improve employment opportunities, while the organizations should tend to ensure that their employees are healthy and well educated.

Many organizations have already realized that Sustainable HRM has to become a business imperative and that the concept of sustainability needs to be incorporated in HRM of every organization focused on achieving success in the future. Having in mind that the role of HRM is to manage employees effectively in order to make an important contribution to achieving organizational success, HR can and should encourage the implementation of sustainable practices.

HR practices can have a significant impact on achieving the sustainability of a company. Many organizations have realized that Sustainable HRM has to become a business imperative (Mandip, 2012). This should lead to rethinking and redesigning HRM through incorporating sustainability in its activities, in order to prepare the employees for the challenges in the future. This is especially important today in a highly competitive environment characterized by high employee turnover, as developing more sustainable HR practices will help to ensure healthy and happy employees, who will perform better and stay within the company for a longer time.

Also, sustainable organizations are viewed more favourably by the public, which can add value to the employer brand and enable attracting high-qualified and talented individuals who possess the same environmentally-friendly values as the organization itself.

Therefore, sustainable HR practices should be promoted within the organizations to increase the awareness of existing employees and their commitment to sustainability as well as to prospective employees. Sustainable organizations are viewed more favourably by the public, which can improve employer brand and increase the possibility to attract high-qualified, talented individuals who possess the same pro-environmental values as the organization itself.

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Examination of the influence of the characteristics of an organization on its activities and the successfulness of their implementation by strategic management

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Abstract: Accelerated changes and technological progress have conditioned ever more dynamic circumstances, in which organizations do business today. Once the term “strategy” was introduced, the term “strategic management” was also introduced, its main task being to enable an organization to timely react to changes in the environment in which it conducts its business activity. The correct application of the strategic management concept in an organization may help it achieve and maintain its competitive advantage. Today, to make an adequate choice of the management strategies that provide the basis for building a competitive advantage is of utmost importance. The organization that applies the strategic management concept with the aim of timely reacting to the changes being made in the environment has to use certain concepts, techniques, methods and management tools. Only with the help of them does the strategic management concept generate results, and is a successful concept used to manage an organization. For the said reasons, this paper is aimed at examining the influence of the characteristics of an organization on its activities and the successfulness of their implementation by strategic management.

Keywords: strategic management, organization, characteristics of an organization, business strategy, business excellence

JEL: L10, M21

1. INTRODUCTION

Extremely quick changes and technological progress have conditioned ever more dynamic circumstances in which organizations perform their activity today. In order for an organization to do business successfully, it is necessary for it to have an adequate business strategy. A strategy is a general plan for the achievement of the mission and goals of an organization through one of the five

components in the “mission – goal – strategy – structure – organization functioning” chain (Brzaković & Karabašević, 2019; Dželetović *et al.*, 2017; Adžić *et al.*, 2013). All these components are interconnected and interdependent, and they all have a bidirectional influence, one exerting an influence on another through feedback, indirect and direct connections.

The main benefit of the application of strategic management reflects in the formulation of a “sound” strategy by applying a more systematic, more logical and more rational approach. Generally speaking, a well-defined strategy requires the engagement of all employees in achieving a mission, so the whole strategic management process is a good way to motivate both an organization’s employees and all the managers working in it. So, the application of strategic management and the choice and implementation of an appropriate strategy are of great significance for an organization (Brzaković & Karabašević, 2019). In that context, multicriteria decision-making methods are often used to solve the problem of the choice of a strategy (Urošević *et al.*, 2018; Karabašević *et al.*, 2020; Stanujkić *et al.*, 2020; Janovac *et al.*, 2018; Maksimović *et al.*, 2016). First of all, strategic management contributes to a better communication inside an organization, and its employees are made familiar with what the organization does, what it aspires to and how to achieve the goals and generate greater value; generally viewed, greater commitment is achieved. Employees and managers become considerably more creative and more thorough, and the organization will finally succeed, first of all thanks to the efforts made by all of its employees (Barney & Hesterly, 2010).

So, strategic management consists of the analyses, decisions and activities undertaken by an organization so as to create and maintain competitive advantages, while simultaneously attention should be focused on the two elements: the first, in accordance with which strategic management includes three processes, namely analyzing, decision-making and acting; and the second, in accordance with which the essence of strategic management implies studying the problem of why some organizations are more successful than others. One of the main questions connected with the evolution of strategic management itself as a new paradigm at the very beginning of 21st century is how to keep up with the dynamics of competition in the conditions of the accelerated formation of postindustrial society (Prahalad & Hamel, 1994; Lowendahl & Revang, 1998). What is the most important here is to make an adequate choice of the management strategies that provide the basis for building a competitive advantage. Strategic management in an organization is, to a great extent, influenced by the organization’s characteristics and the manner in which organizations adopt knowledge, i.e. in which they become learning organizations.

The characteristics of an organization and the experience of an organization have an influence on its further development and learning inside the organization, so it is important to study the context of the organizational climate, as well, which has an influence on the organization's experience. This context relates to the characteristics of the organization, especially its "structure, culture, technology, identity, memory, goals, incentives, and strategy" (Argote & Miron-Spektor, 2011). It also includes the environment that consists of "organizational competitors, clients and regulators" (Argote & Miron-Spektor, 2011). Although this context determines how an organization acquires knowledge, "this knowledge modifies the context as the organization is adapting to it" (Argote & Miron-Spektor, 2011).

The cultural context of learning that was initiated by a leader inspired the key research into "whether an organization has a direction towards learning or performance" (Bunderson & Sutcliffe, 2003), but it is also connected with the "environment of psychological safety" (Edmondson, 1999), the "superordinate group identity" (Kane *et al.*, 2005) and "group dynamics" (Contu & Willmott, 2003). The investigation of those concepts, such as Edmondson's study (1999), shows that the organization that operates under a context "promotes curiosity, information exchange and the psychological safety that encourages organizational learning" (Edmondson, 1999). Understanding the dynamics of group learning is coming into an ever-greater focus, since the work based upon group learning is becoming more and more frequent. "Groups share, generate, evaluate and combine knowledge while working together" (Argote, 2012).

Therefore, the paper is aimed at examining the influence of the characteristics of an organization on the activities and the successfulness of their implementation by strategic management. For that reason, the paper is structured as follows: Section One deals with introductory considerations, whereas Section Two is a literature review; in Section Three, the materials and methods are presented, and in Section Four, the results of the research with the accompanying discussion are given. Ultimately, the conclusions are presented at the end of the paper.

2. LITERATURE REVIEW

This part of the paper will focus on organizational learning, organizational culture and national culture as the important elements that influence the characteristics of an organization.

Organizational learning "includes the process through which organizational units (e.g. groups, departments, sub-departments) change as a result of experience. An example of organizational learning is also the learning of a hospital surgical team how to use the new technologies that will increase efficiency" (Nitingale, 2018).

Organizational learning represents the way in which an organization creates and organizes the knowledge related to their functions and culture. Organizational learning takes place in all the activities of an organization at different speeds. “The goal of organizational learning is to successfully adapt itself to a changeable environment, adapt itself in conditions of uncertainty and increase efficiency” (Dodgson, 1993). In his study, Argote (2012) points out the fact that managers in production facilities have become aware of the significance of organizational learning when they found out the ways to enable some workers to acquire greater expertise, improve the technology, tools and outlooks of the organization, improve the structure of the organization and determine the strengths of the organization.

Culture is considered to be equal to the strength of an organization’s members. “Culture brings the representation of the past and is the instrument of communication throughout the organization” (Schein, 1984).

“Organizational culture encompasses the values and behaviors that contribute to the unique social and psychological environment of the organization” (Needle, 2010). Yet, Needle (2010) highlights the fact that organizational culture represents “the organization’s members’ collective values, beliefs and principles, and represents the product of different factors, such as history, a product, a market, a technology, a strategy, the type of the employed, a management style and national culture. Culture includes the vision of the organization, the visions, values, norms, systems, symbols, the language, assumptions, the environment, the location, beliefs and habits” (Needle, 2010).

Ravasi and Schultz (2006) expressed their attitude that “organizational culture is a set of the group assumptions that direct what is going on in organizations by defining an appropriate behavior in different situations.” It is also a form of collective behavior and assumptions, which new the organization’s new members learn as a manner of perception, even thinking and feeling. Therefore, organizational culture influences the way in which people and groups themselves communicate with their clients and with interested parties. Apart from that, organizational culture can also influence the degree to which employees identify themselves with an organization (Knein *et al.*, 2020).

“Organizational culture can influence the manner in which people set their personal and professional goals, perform their tasks and administer resources in order to achieve them” (Lok & Crawford, 2003). “Organizational culture influences the manner in which people consciously and subconsciously think and make decisions, and finally the manner in which they perceive, feel and act” (Hansen & Wernerfelt, 1989). Peter and Waterman (1982) suggest that organizational culture “can exert a significant influence in organizations, particularly in the fields such as performances and commitment.” The researches

investigating organizational cultures have also proposed different forms or types of cultures. For example, Goffee and Jones (1998) identified four forms of organizational cultures (networked, mercenary, fragmented and communal).

National culture represents a system of the values, assumptions, beliefs, norms and attitudes that those belonging to a single nation have regarding the key questions and problems specific for the historical past of that nation. “Pursuant to that, national culture is an important determinant of leadership styles, since the leadership style that will prove to be the most efficient depends upon the assumptions, attitudes and ways in which those belonging to one single nation perceive leaders and their behavior (Vasilić & Brković, 2017).

At the conceptual and empirical levels, serious research into cultural differences in an organization and the management of the same is simultaneously both enabled and inhibited by the existence of the manifold and frequently confronting model of national culture (Nardon & Steers, 2009).

“Culture determines the uniqueness of a human group in the same manner in which one’s personality determines the uniqueness of an individual. The term *culture* is usually brought into connection with societies (operationalized as national states or ethnic or regional groups inside such national states or including a larger number of them)” (Mojčić, 2007). Basically, the term can be applied to any human collectivity or category whatsoever, considers Hofstede (2001): be it an organization, a profession, an age group, or a family.

This Dutch researcher in the management field has made the greatest contribution to the development of the national culture concept (Smale *et al.*, 2019). Hofstede has made a significant contribution to the studying of national culture. In the field of national culture, he is one of the most prominent scientists. He defines national culture “as the collective programming of the mind, based upon which one group of people differ from another group of people” (Hofstede, 2001).

3. MATERIALS AND METHODS

The research study was being conducted in the period lasting from March 15th, 2018 to April 30th, 2018. The research study encompasses the respondents in managerial positions (i.e. managers and leaders) in the business entities in Serbia. A survey questionnaire was especially created for the need of the research study. The research sample is based upon a base of 187 survey questionnaires correctly filled out, i.e. on a sample of 187 respondents. The questionnaire initially encompassed a sample of 211 respondents, but in total 187 such questionnaires were correctly completed, which thus were accepted for further consideration.

The data were processed by the SPSS 23.0 Software Package. Apart from the basic demographic characteristics, such as the sex, the age group and the professional qualifications, the respondents also expressed their attitudes by applying a 5-degree Likert Scale (1 – absolutely disagree; 2 – partly disagree; 3 – neutral; 4 – partly agree; 5 – absolutely agree). The research study is founded upon the following assertions/statements that were the subject matter of the respondents' evaluation:

- The individual characteristics of the management have an influence on the behavior of the employees in the organization.
- The characteristics of the organization are influenced by the activity and the successfulness of the application of the strategic management concept in the organization.
- The individual characteristics of the management have an influence on the motivation and initiative of the employees in the organization.
- The management provides clear and unambiguous instructions for the execution of the jobs in the organization.
- As a special form of the rules and norms in the organization, organizational culture contributes to the successful implementation of strategic management.
- National culture has an influence on organizational culture, thus simultaneously influencing the business characteristics of the organization themselves.
- National culture has an influence on organizational culture, thus simultaneously influencing the implementation of the set strategies of the organization as well.
- Organizational learning contributes to a better coordination of activities and the successful application of the defined strategies of the organization.
- The management acknowledges the employees' competences and qualities.
- The management allows a certain autonomy while the employees do their jobs.
- The management takes into consideration the employees' proposals and ideas.

As one of the most significant multivariate techniques, the factor analysis was used to process the results.

4. RESULTS AND DISCUSSION

Further in the paper, the research results accompanied by a discussion will be presented.

Table 1. *The descriptive statistics of the influence the organization's characteristics have on the activities and the successfulness of their implementation by strategic management*

	Absolutely disagree	Partly disagree	Neutral	Partly agree	Absolutely agree	Average	Standard deviation
1.1. The individual characteristics of the management have an influence on the behavior of the employees in the organization.	1.1 %	1.1 %	7.0%	42.8 %	48.1%	4.3 6	0.75 1
1.2. The characteristics of the organization are influenced by the activity and the successfulness of the application of the strategic management concept in the organization.	2.1 %	0.0 %	13.4 %	49.2 %	35.3%	4.1 6	0.81 2
1.3. The individual characteristics of the management have an influence on the motivation and initiative of the employees in the organization.	0.0 %	1.1 %	3.7%	34.2 %	61.0%	4.5 5	0.62 3
1.4. The management provides clear and unambiguous instructions for the execution of the jobs in the organization.	1.1 %	5.3 %	27.8 %	29.9 %	35.8%	3.9 4	0.97 4
1.5. As a special form of the rules and norms in the organization, organizational culture contributes to the successful implementation of strategic management.	1.1 %	1.1 %	17.1 %	36.4 %	44.4%	4.2 2	0.84 2
1.6. National culture has an influence on organizational culture, thus simultaneously influencing the business characteristics of the organization themselves.	2.1 %	7.5 %	32.1 %	28.3 %	29.9%	3.7 6	1.03 1
1.7. National culture has an influence on organizational culture, thus simultaneously influencing the implementation of the set strategies of the organization as well.	2.1 %	8.6 %	33.7 %	28.3 %	27.3%	3.7 0	1.03 0
1.8. Organizational learning contributes to a better coordination of activities and the successful application of the defined strategies of the organization.	1.1 %	1.1 %	11.8 %	32.6 %	53.5%	4.3 6	0.81 4
1.9. The management acknowledges the employees' competences and qualities.	0.5 %	6.4 %	18.2 %	32.6 %	42.2%	4.1 0	0.95 1
1.10. The management allows a certain autonomy while the employees do their jobs.	1.6 %	5.9 %	22.5 %	39.0 %	31.0%	3.9 2	0.95 5
1.11. The management takes into consideration the employees' proposals and ideas	0.5 %	5.9 %	21.9 %	33.2 %	38.5%	4.0 3	0.94 4

Source: Authors' own calculations

Table 1 shows the influence of the characteristics of the organization on the activities and the successfulness of their implementation by strategic management. More than 95% of the respondents (with the average grade 4.55 and the standard deviation 0.623) agree upon the established fact that the individual characteristics of management have an influence on the motivation and initiative of the employees in the organization. More than 85% of the respondents (with the average grade 4.36 and the standard deviation 0.814) agree with the established fact that organizational learning contributes to a better coordination of the activities and the successful application of the defined strategies of the organization. More than 80% of the respondents (with the average grade 4.16 and the standard deviation 0.812) agree with the established fact that the characteristics of the organization are influenced by the activity and the successfulness of the application of the strategic management concept in the organization. Over 80% of the respondents (with the average grade 4.36 and the standard deviation 0.751) agree with the established fact that the individual characteristics of management have an influence on the behavior demonstrated by the employees in the organization. Slightly over 80% of the respondents (with the average grade 4.22 and the standard deviation 0.842) agree with the established fact that, as a special form of the rules and norms in the organization, organizational culture contributes to the successful implementation of strategic management. The respondents' attitudes reveal that the characteristics of the organization have an influence on the successfulness of their implementation by strategic management.

The analysis of the main components of the influence of the characteristics of the organization on the activities and their successful implementation by strategic management

Table 2. *The descriptive analysis of the variables*

	Average grade	Standard deviation	Number of the analyzed var.
1.1. The individual characteristics of the management have an influence on the behavior of the employees in the organization.	4.36	0.751	187
1.2. The characteristics of the organization are influenced by the activity and the successfulness of the application of the strategic management concept in the organization.	4.16	0.812	187
1.3. The individual characteristics of the management have an influence on the motivation and initiative of the employees in the organization.	4.55	0.623	187
1.4. The management provides clear and unambiguous instructions for the execution of the jobs in the organization.	3.94	0.974	187

1.5. As a special form of the rules and norms in the organization, organizational culture contributes to the successful implementation of strategic management.	4.22	0.842	187
1.6. National culture has an influence on organizational culture, thus simultaneously influencing the business characteristics of the organization themselves.	3.76	1.031	187
1.7. National culture has an influence on organizational culture, thus simultaneously influencing the implementation of the set strategies of the organization as well.	3.70	1.030	187
1.8. Organizational learning contributes to a better coordination of activities and the successful application of the defined strategies of the organization.	4.36	0.814	187
1.9. The management acknowledges the employees' competences and qualities.	4.10	0.951	187
1.10. The management allows a certain autonomy while the employees do their jobs.	3.92	0.955	187
1.11. The management takes into consideration the employees' proposals and ideas	4.03	0.944	187

Source: Authors' own calculations

Table 2 shows that the following assertions are given the highest average grade when the characteristics of the organization are concerned, namely: The individual characteristics of the management have an influence on the motivation and initiative of the employees in the organization; Organizational learning contributes to a better coordination of activities and the successful application of the defined strategies of the organization; The individual characteristics of the management have an influence on the behavior of the employees in the organization; The characteristics of the organization are influenced by the activity and the successfulness of the application of the strategic management concept in the organization. The dispersion (standard deviation) ranges from 0.6 to 1, so it is clear according to Table 1 that, based upon the standard deviation, the respondents are homogenous with respect to the answers regarding the established facts: National culture has an influence on organizational culture, thus simultaneously influencing the business characteristics of the organization themselves; National culture has an influence on organizational culture, thus simultaneously influencing the implementation of the set strategies of the organization as well; The management acknowledges the employees' competences and qualities, and The management allows a certain autonomy while the employees do their jobs, whereas they are not homogenous with respect to the answers to the other statements. A total of 187 subjects were analyzed.

Table 3. *The correlation matrix between the variables*

Variables	P_1.1	P_1.2	P_1.3	P_1.4	P_1.5	P_1.6	P_1.7	P_1.8	P_1.9	P_1.10	P_1.11		
CORRELATION	P_1.1.	1.000	0.208	0.288	0.154	0.249	0.116	0.077	0.050	0.087	0.033	0.029	
	P_1.2.	0.208	1.000	0.043	0.331	0.320	0.205	0.165	0.402	0.029	0.099	-0.126	
	P_1.3.	0.288	0.043	1.000	0.151	0.086	0.086	0.074	0.027	0.101	0.111	0.061	
	P_1.4.	0.154	0.331	0.151	1.000	0.396	0.136	0.208	0.380	0.273	0.203	0.101	
	P_1.5.	0.249	0.320	0.086	0.396	1.000	-	-	0.385	0.155	0.109	0.140	
	P_1.6.	0.116	0.205	0.086	0.136	-	1.000	0.875	0.128	-	0.048	0.030	-0.086
	P_1.7.	0.077	0.165	0.074	0.208	-	0.875	1.000	0.118	-	0.086	-0.052	-0.139
	P_1.8.	0.050	0.402	0.027	0.380	0.385	0.128	.118	1.000	0.246	0.169	0.027	
	P_1.9.	0.087	0.029	0.101	0.273	0.155	-	-	0.246	1.000	0.559	0.356	
	P_1.10.	0.033	0.099	0.111	0.203	0.109	0.030	0.052	0.169	0.559	1.000	0.563	
	P_1.11.	0.029	-	0.061	0.101	0.140	-	-	0.027	0.356	0.563	1.000	

Source: Authors' own calculations

Table 3 presents the second step, which implies a pre-accession test for the analysis of the main components, which is performed by checking the correlation between the variables for the characteristics of the organization. The level of the coefficient of the dependence between the variables for this analysis is over ± 0.3 .

The methodology of the analysis in the following step leads us to an advanced analysis through which a fact will be established whether the coefficients given in the prior table are statistically significant.

Table 4. *The pass-through tests for the analysis (KMO and Bartlett's test)*

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.611
Bartlett's Test of Sphericity	Approx. Chi-Square	633.247
	df	55
	Probability	0.000

Source: Authors' own calculations

The value of the pass-through test (*Kaiser-Meyer-Olkin Measure of Sampling Adequacy*) is greater than 0.6, but the second pass-through test (*Bartlett's Test of Sphericity*) is significant at the 0.000 error level. The *Kaiser-Meyer-Olkin Measure of Sampling Adequacy* test confirms the fact that the coefficients are significant for prediction, whereas the *Bartlett* test confirms the fact that the coefficients are statistically highly significant.

Following the prior checks, the methodology leads us to the calculation of the common variation the variables have between themselves through the so-called variance extracted. The maximum variation tends to 1, which means that the values closer to it have more in common with respect to variation with the other variables.

Table 5. *The calculation of communality for each variable*

Name of the variable	Initial	Variance extracted
1.1. The individual characteristics of the management have an influence on the behavior of the employees in the organization.	1.000	0.657
1.2. The characteristics of the organization are influenced by the activity and the successfulness of the application of the strategic management concept in the organization.	1.000	0.560
1.3. The individual characteristics of the management have an influence on the motivation and initiative of the employees in the organization.	1.000	0.634
1.4. The management provides clear and unambiguous instructions for the execution of the jobs in the organization.	1.000	0.522
1.5. As a special form of the rules and norms in the organization, organizational culture contributes to the successful implementation of strategic management.	1.000	0.581

1.6. National culture has an influence on organizational culture, thus simultaneously influencing the business characteristics of the organization themselves.	1.000	0.921
1.7. National culture has an influence on organizational culture, thus simultaneously influencing the implementation of the set strategies of the organization as well.	1.000	0.928
1.8. Organizational learning contributes to a better coordination of activities and the successful application of the defined strategies of the organization.	1.000	0.628
1.9. The management acknowledges the employees' competences and qualities.	1.000	0.611
1.10. The management allows a certain autonomy while the employees do their jobs.	1.000	0.760
1.11. The management takes into consideration the employees' proposals and ideas	1.000	0.644

Source: Authors' own calculations

There is a common variability between the indicators, which is explained by absolute variation through the variance.

The analysis is conducted for the purpose of determining the indicators that essentially frequently vary, thus actually correlating until they reach a new dimension, which forms a group of the same factors that influence some phenomenon. This further implies the use of the test that will calculate a common variability, i.e. the amount of the same, by using the Kaiser criterion, through which such common variability is extracted, which on its part is declared by a grade greater than one.

Table 6. *The matrix of the rotated components with their saturations*

Factor	The basic equivalents of variance – latent			Extracted summed-up variability of the components		
	Total	% of variance	Cummulative %	Total	% of variance	Cummulative %
1	2.667	24.245	24.245	2.667	24.245	24.245
2	2.130	19.363	43.608	2.130	19.363	43.608
3	1.453	13.205	56.813	1.453	13.205	56.813
4	1.199	10.896	67.708	1.199	10.896	67.708

5	0.761	6.916	74.625			
6	0.710	6.455	81.080			
7	0.626	5.693	86.774			
8	0.578	5.258	92.032			
9	0.453	4.115	96.147			
10	0.312	2.838	98.985			
11	0.112	1.015	100.000			

Source: Authors' own calculations

Table 6 allows us to see which indicators are retained in the analysis only to be decided after the application of the so-called factor space rotation with the aim of facilitating the interpretation of the results. By applying said factor space rotation, the indicators that will be retained in the analysis are detected.

A total of the four factors that explain the largest scope of the variance and that do not simultaneously correlate with themselves are extracted from the previous table. The first factor explains the largest scope of the variance (24.2%), whereas the second (19.4%), the third (13.2) and the fourth factors (10.9%) are expressed in the percentages of the total variance, which is 67.7% of the explained variability when the characteristic of the organization is in question. The remaining variability of 32.3% is explained by some other phenomena. All the four factors are retained in the analysis, given the fact that the Kaiser criterion is greater than one.

Figure 1. *A scatter diagram*

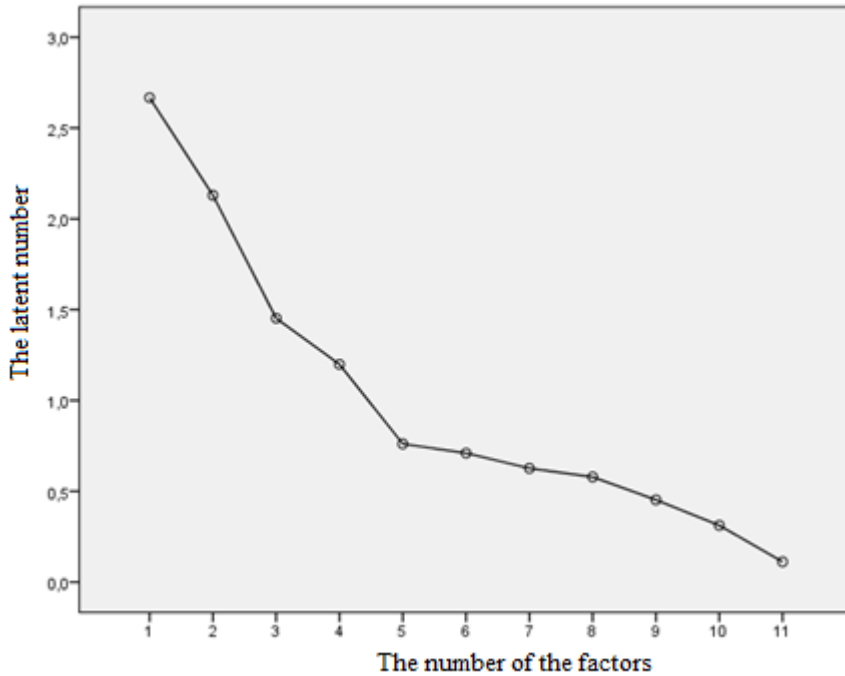


Figure 1 shows a factor scatter diagram, which allows us to notice a clear break point after the fourth component (factor). The four components (factors) generated through the factor analysis are retained in the further course of our consideration of the research results, which components (factors) are observed as the four dimensions, i.e. subscales.

The methodology of the analysis also includes the correlation matrix for the four factors so as to learn from the same which of the variables has the greatest factorial saturation correlating with the factor – which means closer to one.

Table 7. *The matrix of the rotated components with their saturations*

Name of the variable	Factor 1	Factor 2	Factor 3	Factor 4
1.1. The individual characteristics of the management have an influence on the behavior of the employees in the organization.	0.203	-0.033	0.022	0.784
1.2. The characteristics of the organization are influenced by the activity and the successfulness of the application of the strategic management concept in the organization.	0.719	-0.124	0.152	0.070
1.3. The individual characteristics of the management have an influence on the motivation and initiative of the employees in the organization.	-0.024	0.121	0.076	0.783
1.4. The management provides clear and unambiguous instructions for the execution of the jobs in the organization.	0.656	0.225	0.153	0.137
1.5. As a special form of the rules and norms in the organization, organizational culture contributes to the successful implementation of strategic management.	0.707	0.080	-0.168	0.215
1.6. National culture has an influence on organizational culture, thus simultaneously influencing the business characteristics of the organization themselves.	0.087	-0.020	0.953	0.069
1.7. National culture has an influence on organizational culture, thus simultaneously influencing the implementation of the set strategies of the organization as well.	0.092	-0.082	0.954	0.042
1.8. Organizational learning contributes to a better coordination of activities and the successful application of the defined strategies of the organization.	0.763	0.136	0.084	-0.141
1.9. The management acknowledges the employees' competences and qualities.	0.211	0.750	-0.052	0.041
1.10. The management allows a certain autonomy while the employees do their jobs.	0.110	0.864	0.044	0.017
1.11. The management takes into consideration the employees' proposals and ideas.	-0.072	0.791	-0.099	0.054

Source: Authors' own calculations

Table 7 shows which variable correlates the most with the extracted factor (factorial saturation). The factor space rotation was performed in order to facilitate the interpretation of the results. The next step represents the evaluation and interpretation of the factors, including the choice of an adequate name as well. Through factorial saturation, the variables which have the most in common with the factor are determined, after which what is mutually common between them, or what they differ from the others in, is observed, upon which observation the name of the factor is determined.

The greatest factorial saturation in Factor 1 is found in the following variables: As a special form of the rules and norms in the organization, organizational culture contributes to the successful implementation of strategic management; Organizational learning contributes to a better coordination of activities and the successful application of the defined strategies of the organization; The characteristics of the organization are influenced by the activity and the successfulness of the application of the strategic management concept in the organization; The management provides clear and unambiguous instructions for the execution of the jobs in the organization.

Based on the extracted variables and what is common for that set of the variables, it is concluded that the name of the first factor reads as follows: **THE CHARACTERISTICS OF THE STRATEGIC MANAGEMENT CONCEPT.**

The greatest factorial saturation in Factor 2 is found in the following variables: The management acknowledges the employees' competences and qualities; The management allows a certain autonomy while the employees do their jobs; The management takes into consideration the employees' proposals and ideas.

Based on the extracted variables and what is common for that set of the variables, it is concluded that the name of the second factor reads as follows: **MANAGEMENT BUSINESS ETHICS.**

The greatest factorial saturation in Factor 3 is found in the following variables: National culture has an influence on organizational culture, thus simultaneously influencing the business characteristics of the organization themselves; National culture has an influence on organizational culture, thus simultaneously influencing the implementation of the set strategies of the organization as well.

Based on the extracted variables and what is common for that set of the variables, it is concluded that the name of the third factor reads as follows: **NATIONAL CULTURE.**

The greatest factorial saturation in Factor 4 is found in the following variables: The individual characteristics of the management have an influence on the behavior of the employees in the organization; The individual characteristics of the management have an influence on the motivation and initiative of the employees in the organization.

Based on the extracted variables and what is common for that set of the variables, it is concluded that the name of the fourth factor reads as follows: **MANAGEMENT AS AN INDIVIDUAL.**

CONCLUSION

Strategic management should enable an organization to be more proactive, rather than reactive, on the market and in the creation and shaping of its own future. Strategic management helps an organization to initiate activities with the aim of achieving and maintaining its competitive advantage and position on the market. As the business doing conditions are becoming ever-more difficult, and competition ever-greater, the advantages of the strategic management concept are being recognized by an ever-larger number of people, irrespective of whether they are smaller-size enterprises or large organizations.

The research study has shown that the characteristics of an organization have an influence on its activities and the successfulness of their implementation by strategic management in the organization. The individual characteristics of management have an influence on the behavior demonstrated by the employees in the organization, as well as the organization's employees' motivation and initiative. The characteristics of an organization are also influenced by its activity and the successfulness of the application of the strategic management concept in the organization, given the fact that management provides clear and unambiguous instructions for the execution of jobs in the organization, acknowledges the competences and qualities of the employed, allows a certain autonomy while employees do their jobs, and takes into consideration the employees' proposals and ideas. National culture exerts an influence on organizational culture, thus simultaneously also influencing the implementation of the set strategies of the organization, where it also influences the business characteristics of the organization themselves. Organizational learning contributes to a better coordination of activities and the successful implementation of the defined strategies of the organization.

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Towards sustainable workforce: the importance of family friendly policies

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Abstract: Family-friendly policies are represented as the policies that enhance work and family life balance (Avey *et al.*, 2006). Due to the increasing work-life conflicts in contemporary society, the need for these policies' introduction is on the rise, both in public and private sector companies. In this regard, the objective of this paper is to present the literature overview of family-friendly policies and the results of the empirical studies examining their impact on employees' productivity, turnover intention, turnover rates, job satisfaction, organizational commitment, as well as job related stress, burnout and absenteeism. Moreover, the paper addresses the factors impacting the proper implementation of these policies. The reason for writing this paper is not only to provide a resource for these policies' potential use, but also to raise awareness of their existence and their beneficial effects. The methods used in the study are a descriptive method and a content analysis method.

Keywords: family-friendly policies, culture, productivity, turnover, job satisfaction, burnout

JEL: M12, J24, J28

1. INTRODUCTION

Family-friendly policies are often represented as the policies that enhance work and family life balance (Avey *et al.*, 2006; Medina-Garrido *et al.*, 2017). As it is shown in a variety of research, they typically lead to higher rates of employee commitment, satisfaction, and performance (Wadsworth & Owens, 2007). Although they have beneficial effects for the entire workforce, the studies show that the majority of parents in particular – both fathers and mothers – find that such policies, covering both the formal and informal sector and conditions at work, greatly impact the well-being of their whole families (Ivančević, Matošević & Ivanović, 2020). Due to their influence on family life and general life satisfaction, they make a relevant factor for choosing a company, and the consequent retention and absenteeism rates (Brandon & Temple, 2016).

However, family-friendly policies and benefits, like paid parental leave (maternal and paternal), breastfeeding pauses, quality child care as well as children subsidies, elder care benefits and such, are the benefits that are present

only within certain companies (Ivančević, Matošević & Ivanović, 2020). In fact, so far, the majority of organizations have adopted only a limited number of family-friendly policies and procedures, but even those are most often not communicated properly (Chou & Cheung, 2013). Public sector does provide obligatory policies in the workplace, and a certain number of companies in the private sector implement those government-prescribed policies and even innovate them in order to achieve best workplace praxis. Nevertheless, these adaptations are not substantial enough to enable the optimal work-life balance employees strive to achieve (Ivančević, Matošević & Ivanović, 2020). Implementing such measures demands synergetic cooperation of governmental and non-governmental institutions, international and domestic companies, and the society in general.

This paper will attempt to address this important topic and, hopefully, raise awareness of its significance. Firstly, an overview of family-friendly policies will be provided. Secondly, the desirable framework for their successful implementation will be illustrated. Thirdly, the paper will show the results of a number of empirical studies confirming the significance of family-friendly benefits and policies in the reduction of the problems caused by the ever-increasing work-life conflicts - lower productivity, increased turnover intentions and turnover rates, decreased job satisfaction and organizational commitment, as well as increased levels of job related stress, burnout and absenteeism. Lastly, the paper will address the need for harmonization between public and private sector in this respect.

2. TYPES OF FAMILY-FRIENDLY POLICIES

Although there is, in most of the cases, a consensus on what the most beneficial family-friendly measures and policies are, different sources offer different approaches (UNICEF, 2019).

As numerous studies showed, the most popular benefit available in many organizations is work flexibility - changing hours and/or working from home (or remotely) (Ivančević, Matošević & Ivanović, 2020). The number of employers that enable this opportunity to their employees on occasions or as a permanent working time and place arrangement constantly rises. Not only that work flexibility is one of the most favorite benefits, but it also has the highest impact on organizational attraction and retention (Chung, 2018). It is not surprising that this benefit is especially appreciated within a population of working parents (Chung & Van der Hors, 2018). It enables working from home when a child is sick, or managing to get a child from child care on time. In addition, it is shown to be of crucial importance for working mothers who want to maintain their position at the company after childbirth (Chung & Van der Hors, 2018). All in all, work flexibility makes parents' lives less complicated.

Among other desirable benefits are those such as: on-site child care, paid leaves for different family members, child care subsidies as well as family health insurance (Medina-Garrido *et al.*, 2017). Research demonstrated that older employees often find back-up elder care relevant the most, while younger employees place higher importance on child care options provided on-site. This leads to the conclusion that employers should implement family-friendly benefits and policies based on the real needs of their employees (Bilal *et al.*, 2010).

However, it is difficult to find a list consisting of all the possible family-friendly benefits or policies which are at companies' disposal. In addition, numerous authors group these policies into categories, such as dependent care, flexible work, legal assistance, employee assistance, and others (Cayer, 2003), or childcare subsidies, paid leaves for the care of family members, alternative work arrangements and telework (Kim & Wiggins, 2011). On the other hand, some institutions, like the Society for Human Resource Management, make a distinction between job/work flexibility policies and family-friendly policies. In this respect, Bae and Goodman (2014) provide a comprehensive register of family-friendly benefits as well as work-flexibility options that are common at the workplace, adopting it from the Society for Human Resource Management (2013, p. 34-38). The order of the policies is based on their popularity/presence in the companies (Bae & Goodman, 2014). The list is provided in the table below (Table 1). Although comprehensive, this list is still incomplete and it mentions only a number of the possible benefits. For example, parental leave and the five-day working week are not mentioned, as it is supposed that they should be obligatory and provided by law, but an additional paid or unpaid parental leave should have been included in the list. Regardless, it is important to mention, that in this study (herein), flexibility policies are treated as part of family-friendly policies.

Table 1. *Family-Friendly and Flexibility Policies*

Family-friendly policies	Work flexibility policies
Dependent care flexible spending account	Casual dress day (one day per week)
On-site lactation/mother's room	Telecommuting
Bring child to work in emergency	Flextime
Domestic partner benefits for same-sex partners	Flextime during core business hours
Domestic partner benefits for opposite-sex partners	Telecommuting on an ad hoc basis
529 plan (college savings plans)	Break arrangements
Child care referral service	Mealtime flex
Adoption assistance	Telecommuting on a part-time basis
	Compressed workweek
	Casual dress (every day)
	Flextime outside core business hours

Elder care referral service	Casual dress (seasonal)
Lactation support services	Telecommuting on a full-time basis
Access to backup child care services	Shift flexibility
Subsidized child care program	Seasonal scheduling
Nonsubsidized child care center	Job sharing
Subsidized child care center	Alternating location arrangements
Foster care assistance	Results-only work environment
Access to backup elder care services	
Babies at work	
Geriatric counseling	
On-site elder care fairs	
On-site parenting seminars	
Elder care assisted living assessments	
Elder care in-home assessments	
Consortium child care center	
On-ramping programs for family members dealing with elder care issues	
On-ramping programs for parents reentering the workplace	
On-site vaccinations for infants/children	

Source: Bae and Goodman (2014) who adapted it from Society for Human Resource Management (2013, p. 34-38)

In the attempt to improve the use and the effectiveness of family-friendly policies, UNICEF proposed four major innovative trends that would, according to them, contribute most efficiently to creating optimal work - life balance: from maternal to parental leave - it is crucial that both caregivers are present to support a child's development in the earliest stage; from infrastructure to people - safer work conditions and special spaces, such as daycares or breastfeeding rooms, are not essential as enabling employees to spend enough time with their families; from individual to co-responsibility - the wrong perspective is just seeing companies or governments responsible for family-friendly workplace - their cooperation, altogether with society's support is needed; from 'reducing parental stress' to 'enhancing family wellbeing' - these benefits diminish parents' stress by switching the focus to the enhancement of families' wellbeing, which, consequently, increases productivity and retention (UNICEF, 2019).

While UNICEF is child-oriented organization which proposes measures that would impact not only employees but society in general, applied research on this topic brings slightly different approach for business.

3. SUPERVISORS' SUPPORT AND CULTURE THAT ENCOURAGE FAMILY-FRIENDLY POLICIES

Even though a certain number of family-friendly policies have already been introduced by organizations, they are usually not used to the fullest (UNICEF, 2019). In the concrete, the availability of family-friendly policies per se will not enhance work-life balance if it is not assisted by two major factors – supervisors' support and consonant organizational culture norms. Hopkins (2005) states that supervisors play the key role in the implementation of family-friendly policies and that they should encourage employees to use specific policies. Their support is also proven to be connected with lower level of work-life conflicts (Munir *et al.*, 2012). Equally, family-friendly corporate culture is pivotal in assuring employees that work environment is safe, less stressful and committed to workers' general wellbeing (Afonja, 2019), and its values should be communicated continuously, loudly and clearly to create the atmosphere of trust and support. To that purpose, human resource sectors should also announce the policies for establishing work-life balance more frequently and through different modes of internal communication, and embolden employees to utilize them without fear of being characterized as underperformers (UNICEF, 2019). Only in that way the workers will experience the true benefits of family-friendly policies and the companies will ensure sustainable and committed workforce (Afonja, 2019). Investigating this, Vyas, Lee and Chou (2017) prove that employees who recognize the effectiveness of family-friendly policies and feel that work-life balance is perceived positively and valued in their company's culture, are more ready to use family-friendly measures than those who have negative perception of these policies' effectiveness and work-life balance treatment in their companies.

Unfortunately, majority of organizations fail to understand this. In reality, a high percentage of employees fear that the actual use of the proposed policies, such as flexibility and spending time on family responsibilities will reduce their advancement possibilities (Bond *et al.*, 2002) or lead to other negative consequences (UNICEF, 2019). Organizations frequently make mistakes by placing a greater accent on behaviours that hinder work-life balance, for example staying late at work and working while ill (Wadsworth & Owens, 2007) or by not giving the same conditions to achieve the best possible results to those employees who work from home as to those who work from the workplace (by excluding them from the relevant activities, such as meetings and other). In this way, the companies propose the benefits first but then 'punish' their employees for using them, creating a climate of distrust and anxiety by sending these ambivalent messages (Bilal *et al.*, 2010). To solve this problem, the experts suggest that the governments should take a regulatory approach to the implementation of family-friendly policies when the voluntary implementation fails. Regardless, the question of why a great many companies are reluctant to

create more supportive work-life cultures (Chou & Cheung, 2013) and even fail to notice the existence of the mentioned incongruity still remains.

On the other hand, when implemented right, these policies reflect work culture of support, which consequently impacts a variety of variables, such as: job satisfaction, organizational commitment, higher productivity, lower turnover and absenteeism rates as well as decreased work-life stress and lower risk of employees' burnout syndrome.

4. THE EFFECTS OF FAMILY-FRIENDLY POLICIES ON PRODUCTIVITY, TURNOVER AND TURNOVER INTENTION

Much research tried to target specific organizations' benefits stemming from the introduction of family - friendly benefits and policies, encompassing increased productivity and lower turnover rates (Bae & Goodman, 2014), as well as reduced turnover intentions. As a result, different kinds of studies confirmed these very relations. Some of the studies were extremely comprehensive, including the data from hundreds of national and international companies, while other studies exposed subjective pieces of evidence collected from the questionnaires and interviews conducted internally within specific companies with the help of their own HR departments (Capowski, 1996; Lawlor, 1996; Bae & Goodman, 2014). Before presenting the results of the related studies, the concepts of productivity, turnover and turnover intention are to be defined.

Singh & Mohanty (2012, p.74) defined employee productivity as 'the log of net sales over total employees - an economic measure of output per unit of input'. Productivity as a performance measure encompasses both effectiveness and efficiency (Bhatti & Qureshi, 2007). Turnover or turnover rate may be defined as 'the number of employees who leave voluntarily during the period, divided by the average number of employees during the same period' (Lee & Hong, 2011, p.875]. Turnover intention is usually described as a worker's personal intent to depart from the organization in the future and, according to a number of authors, it usually predicts the actual turnover behavior (Ivanović & Ivančević 2019).

By most of the research, the positive relation between family-friendly benefits and higher productivity as well as lower turnover has been confirmed. For example, a study of a Fortune 500 organization including 120 workers showed that ninety-seven percent of both supervisors and employees stated that family-friendly benefits, like teleworking, improve employees' productivity/performance (Riley & McCloskey, 1997). Perry-Smith and Blum confirmed a positive and significant relation between a great number of family-friendly programs and the enhanced work-life balance and the companies' productivity (Perry-Smith & Blum, 2000). Shepard *et al.* reported an increase in

organizational productivity caused by flexible work scheduling (Shepard *et al.*, 1996). A study conducted in South Korea that included 158 public organizations and examined extremely wide spectrum of family-friendly benefits (e.g. on-site childcare and other childcare benefits, maternity and paternal leaves, menstrual leave, miscarriage leave, infertility leave, prenatal health check-up leave, breast-feeding breaks, constraint of overtime work, work during holidays and night duties, and such) has also proved that there is a statistically significantly positive relation between these policies and the organizational productivity (Bae & Goodman, 2014). Investigating different groups of family friendly policies, a number of other studies also confirmed their positive impact on workers' productivity and performance (Clifton & Shepard, 2004). An interesting overview and the summary of several studies' results regarding this particular connection is presented by the authors Benito-Osorio, Muñoz-Aguado and Villar (2014), and the original table form their paper 'The Impact of Family and Work-Life Balance Policies on the Performance of Spanish Listed Companies' showing the results of the analyzed studies is presented herein (Table 2).

Table 2. *Literature review on work-life balance policies*

Authors	Sample Year	Country	Results
Konrad & Managel (2000)	2000	United States	Results show that there is a greater positive impact on the firm productivity in organizations which have a higher percentage of professionals and implement work/life balance policies
Perry-Smith & Blum (2000)	1993-1994	United States	Findings support the hypotheses stating that firms with more work-life balance policies achieve better performance than those with less family-friendly policies
Meyer <i>et al.</i> (2001)	2001	United States	Concludes that work-life practices have a positive effect on firm performance; however, some particular policies were found to have a negative effect, such as job sharing
Dex & Smith (2002)	1998	United Kingdom	Findings indicate that 9 out of 10 companies using work-life balance policies were profitable, but authors stated that they could not assure that

			work-life policies were causing those improvements in performance
Grey (2002)	2002	United Kingdom	Results show that 97% firms with work-life balance policies had a superior financial performance than the average, while only 55% of firms with no policy at all surpassed that mark
Mañas & Garrido (2007)	2006	Spain	63% of managers responsible for Human resources stated that work-life balance policies positively affect productivity
Albert <i>et al.</i> (2009)	2009	Spain	In a survey for human resource managers, they concluded that main benefits from work-life balance policies is to improve brand image and workplace climate, as well as transmitting modernity
Bloom <i>et al.</i> (2011)	2010	Germany /France/ United Kingdom /United States	Authors suggest that there is no positive relationship between work-life balance and firm performance; however, they also noted that work-life practices do not entail a negative effect on performance
Yamamoto & Matura (2012)	2010	Japan	There is a positive correlation between work-life balance policies and productivity; family-friendly policies were not found to increase firm productivity by itself

Source: Benito-Osorio, Muñoz-Aguado & Villar (2014)

On the other hand, numerous studies, focused on turnover since work-family conflicts are frequently reported to be the leading reason for employees' turnover intentions (Yu, 2019). Researchers found that employees who have family-friendly policies at their disposal show lower turnover intention and higher organizational commitment (Shepard *et al.*, 1996; Halpern, 2005). Following these findings, some researchers examined the actual turnover rates. Durst stated that 52% of agencies on the national level agreed that family-friendly programs reduce turnover rates (Durst, 1999). Multiple other studies

showed that a variety of family-friendly benefits like telework, flexitime, alternative schedules and child care subsidies decrease both turnover intention and turnover rates in public sector (Lee & Hong, 2011; Kim & Wiggins, 2011). On-site child care as a benefit has also been proven to be negatively correlated with voluntary turnover (Selden & Moynihan, 2000).

However, it is important to mention that there are studies that do not confirm these links. Bae and Goodman's (2014) South Korea study showed that the availability of family-friendly benefits did not lead to decreased turnover rates significantly, while Preece and Filbeck (1999) did not confirm the correlation of these policies with organizational productivity. Nevertheless, these findings do not annul other studies' important discoveries.

5. THE EFFECTS OF FAMILY-FRIENDLY POLICIES ON JOB SATISFACTION AND ORGANIZATIONAL COMMITMENT

Job satisfaction is described as 'the ultimate feeling of people after performing a task' and it is related to the degree to which work encounters peoples' basic needs and is in congruence with their values and expectations (Ivanović & Ivančević, 2019, p.56). Organizational or employee commitment is defined as a psychological state which marks the employees' relations with the company and has implications to their decision about continuing membership in the company (Bhatti & Qureshi, 2007).

Numerous studies have shown that workers using family-friendly policies report increased levels of both overall and job satisfaction in comparison to those who do not use such policies (Bond *et al.* 2002; Scandura & Lankau, 1997). Other studies confirm this relationship with organizational commitment (Scandura & Lankau, 1997; Halpern, 2005; Allen, 2001). Kwang Bin Bae and Gigeun Yang (2017) conducted a study in Korea in the attempt to examine the relationship between a variety of family-friendly benefits and employees' satisfaction at job, but also to examine the influence of these benefits on employees' organizational commitment. The study revealed that family-friendly policies are positively related with both the phenomena, and that the increase in number of these policies would boost both employees' satisfaction and their commitment to their companies. Furthermore, examining some of the most frequently utilized benefits - maternity leave, childcare leaves and other childcare subsidies - showed that receiving both leaves policies have a significant and positive effect on work satisfaction, while this relationship is insignificant when it comes to child care subsidies. In addition, all the three mentioned policies were shown to positively affect organizational commitment (Kwang & Yang, 2017). The last finding is in line with other similar studies claiming that family-friendly benefits contribute to the increased organizational commitment (Grover & Crooker,

1995). Afonja (2019) conducted a research in Nigeria in 2019, and proved that introduced family-friendly workplace policies, such as parental leave, working from home, family insurance, flexible work time, workplace child support and care, and job sharing are predictors of sustainable/committed workforce both in public and private organizations.

6. THE EFFECTS OF FAMILY-FRIENDLY POLICIES ON JOB-RELATED STRESS, BURNOUT AND ABSENTEEISM

In the attempt to define the term 'stress', psychological literature refers to the concepts such as 'external stimuli, perceptions of situational demands, psychological states, and physiological reactions' whereas the role theory focuses the attention to role ambiguity, role conflict and role overload (Jackson & Maslach, 1982, p.63). When talking about job-related stress, one may conclude that it is a reaction of an organism provoked by external or internal stimuli connected to work, the workplace, role conflicts or work-life conflicts. If these stress reactions are continuous and an individual does not have time to recover and regain balance, burnout may occur (Ivanović, Ivančević & Maričić, 2020). Indeed, burnout syndrome is defined as a consequence of prolonged stress in the workplace and is manifested as a state of utter physical, psychological and emotional exhaustion, usually accompanied by cynicism, a hostile attitude towards one's work and low self-esteem (Maslach, 2015). Its main components are emotional exhaustion, depersonalization and low personal accomplishment (Schaufeli *et al.*, 2009) and it affects the employees in all walks of life (Trajković *et al.*, 2019; Ivančević *et al.*, 2020). Finally, absenteeism is usually defined as behaviour connected 'to not attending work for all or part of a given time period' (Avey *et al.*, 2006, p.43) and studies confirmed that if employers failed to meet their employees' expectations, their absenteeism rose (Muchinsky, 1977).

Since there is an increasing tendency to identify burnout and stress as a psychological difficulty that results from a strain in the work-family interaction (Maslach & Leiter, 2006), and these health deteriorating factors can consequently raise absenteeism, a lot of research has been done on the topic in the attempt to confirm that family-friendly policies can reduce work-life conflicts thus reducing the connected stress and burnout, as well as the related absenteeism.

Through their empirical researches, Clifton and Shepard found a negative relation between family-friendly policies and absenteeism (Clifton & Shepard, 2004), while Kossek and Ozeki reported it for stress (Kossek & Ozeki, 1999), and Almer and Kaplan (Almer & Kaplan, 2002) for burnout. Halpern (2005) investigated time-flexible work policies in particular, and found that the larger

the number of these policies available to employees, the fewer symptoms of stress are reported along with the more reduced costs caused by absenteeism. Hill found that perceived flexibility in the workplace predicted less stress and burnout (Jeffrey *et al.*, 2008). Mansour and Tremblay (2016) found that family support provided by the organization reduces job-stress via alleviating work-family conflict. Numerous researches actually focused on the relation between work and family roles conflicts and stress and burnout, and discovered that they are positively related (Griffin & Sun, 2018) or found that work and family roles conflicts mediate the relation between work demands and burnout (Lingard & Francis, 2005).

In conclusion, we can say that family-friendly policies contribute to stress and burnout reduction caused by work-life conflicts and that they also decrease the corresponding absenteeism rates, saving the companies' costs on one hand and employees health on the other by allowing them to establish the desired work-life balance.

7. THE NEED FOR HARMONIZATION BETWEEN PUBLIC AND PRIVATE SECTOR

The aforementioned research conducted in Nigeria brought up another significant issue when it comes to family-friendly policies and benefits. Namely, it revealed a significant disparity in family-friendly policies between public and private sector companies in Nigeria. Their target industry was service (Afonja, 2019). The public sector appeared to be better than private sector in the provision of the crucial family-friendly benefits, like maternity leave. This finding is in line with that of Adewale who reported this difference as well (Adewale, 2004). The data show a similar situation in the United States, where public sector is much better than private one in the acceptance of such policies. For instance, the U.S. Bureau of Labor Statistics (BLS) revealed that in 2015, a high number of 98% of full-time workers in both state and local government were able to use paid sick leave in comparison to 61% of the employees in private sector companies (U.S. Bureau of Labor Statistics, 2015). Other family-friendly benefits, such as on-site child care, flexible scheduling, alternative work schedules and telecommuting opportunities have also been gaining attention of public sector's management worldwide (Cadigan, 2006; Lee & Hong, 2011; Wadsworth & Owens, 2007). All of these raise the need for family friendly policies' harmonization in public and private sectors (Afonja, 2019), calling for private sector to adopt public sectors' best practices. The entire society will consequently benefit from this harmonization, and the necessary laws that would support it should be introduced, as recommended by the researchers (Afonja, 2019).

CONCLUSION

In contemporary world, where the gap between work and life is growing continuously causing different roles individuals have to be more conflicting, the opposite need for bridging this gap and maintaining work-life balance is increasing simultaneously. To satisfy this need, companies worldwide, in both public and private sectors, introduce various family-friendly policies addressing different occurring problems. Research has shown that work-life conflicts can cause difficulties for organizations, such as lower productivity, increased turnover intentions and turnover rates, decreased job satisfaction and organizational commitment, as well as increased levels of job related stress, burnout and absenteeism. However, research has also proven that appropriate family-friendly policies can positively influence all the mentioned work aspects and resolve the related potential or real problems. In this way, companies can succeed in having healthy and sustainable workforce while taking care of their employees and enabling them to gain the necessary balance.

The mere provision of these policies is not sufficient. Employees will learn to utilize them and effectively benefit from them only if the policies are properly implemented. For this to happen, the active engagement of supervisors, managers and HR departments is necessary as they should constantly communicate these policies and encourage the employees to use them. The culture of support and care should be nurtured and the workers assured that both themselves and their advancement will not be affected negatively with the actual use of the provided policies.

Last but not least, to benefit the most from family-friendly policies, companies need to adjust them to the particular needs of their employees, by doing internal surveys and data analyses. Only by determining the exact demands of their very workforce, will they know what benefit packages should they provide to their employees and even personalize them according to their employees' individual needs. This will save the unnecessary costs, increase the retention rates and more significantly affect employees' wellbeing.

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Digital transformation of work – will Covid-19 pandemic influence intelligent automation of work

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Abstract: Global health crises, influenced by current covid-19 viruses, has changed our lives and the way we used to work. Digital transformation of workstyle is faster than ever and the major drivers of this digital transformation are IoT, AI, 5G, cloud services, etc. In various fields, like business, education, healthcare, welfare etc new forms of services are becoming more popular. In this paper we are going to investigate the digital transformation of workstyle initiated by the COVID-19 pandemic in the higher education.

Keywords: digital transformation, IoT, artificial intelligence, technology, innovation

JEL: O32, O39, O20, I19

1. INTRODUCTION

The global scale of infections spread via coronavirus (COVID-19) have acted as a driving force towards digital transformation of working styles in various fields, like business, education, healthcare, welfare etc. Term digital transformation refers to the use of new digital technologies in order to gain major business improvements (Liere-Netheler *et al.*, 2018). Today, new digital technologies that are main drivers of digital transformation are Internet of things (IoT), artificial intelligence (AI), 5G networks, blockchain technologies, cloud services, etc. (Kodama, 2019).

In order to urgently respond to COVID-19 pandemic businesses, healthcare providers, etc. have looked to applications of Artificial Intelligence (AI) in order to compensate for the unavailability of human workers. According to Coombs, Hislop, Taneva and Bernard (2020), using AI for automation of work is an example of a new form of automation known as intelligent automation. Applications based on AI are fundamental parts of IoT solutions, where they are now used for analyzing data collected from various sources and stored on cloud.

In this paper we are investigating the digital transformation of workstyle initiated by COVID-19 pandemic in healthcare and education and how new

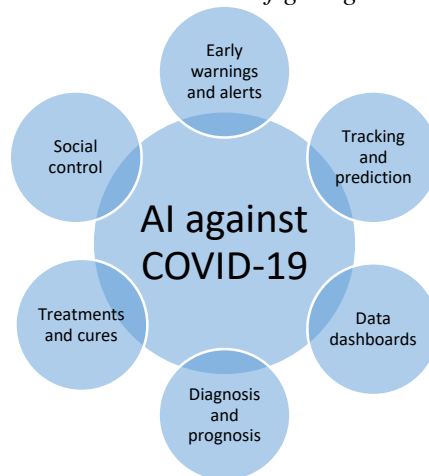
technologies like AI tools, IoT and cloud services can lead to intelligent automation of work.

The paper is organized as follows: the first section will provide a framework of the new technologies like IoT and AI, and their role in digital transformation of work during COVID-19 pandemics. The next section will outline the possibilities of the intelligent automation of work in higher education. This is followed by the methodology and results. The final sections are discussion and conclusion.

2. ROLE OF NEW TECHNOLOGIES IN DIGITAL TRANSFORMATION OF WORK DURING COVID-19 PANDEMICS

AI involves various technologies like machine learning, knowledge reasoning, natural language processing, robotics and computer vision that can match human capabilities, particularly in a domain of learning and problem solving (Gerasimovic *et al.*, 2011). AI are well suited to extract useful information from complex, nonlinear and often noisy data. Unlike statistical models artificial neural networks make no assumptions about the statistical distribution or properties of the data, and therefore tend to be more useful in practical situations (Miljkovic *et al.*, 2011.)

Figure 1. *AI contributed to the fight against COVID-19*



Since the epidemic in China has begun, artificial AI were used in various situation. According to Naudé (2020), there are six areas where AI can contribute to the fight against COVID-19: early warnings and alerts, tracking and prediction, data dashboards, diagnosis and prognosis, treatments and cures,

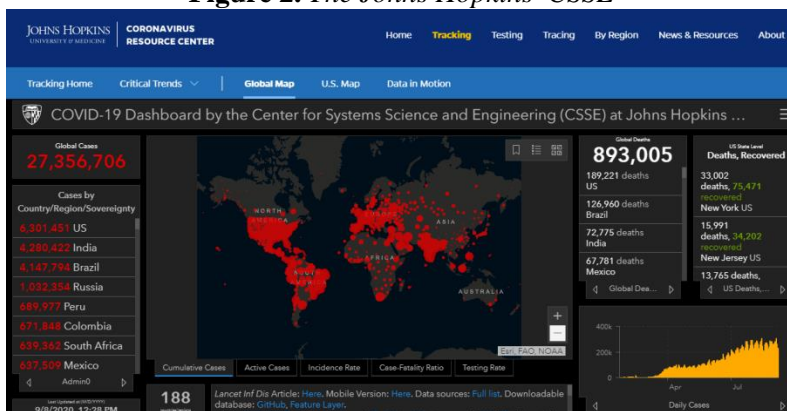
and social control (Fig.1).

Recent researches (Naudé, 2020; Kreuzhuber, 2020) indicate that AI tools are efficient in early warning. AI-based model, *HealthMap*, at Boston Children's Hospital (USA), issue a warning to its clients on 30 December 2019. The other example that demonstrate that AI tool can be more efficient and even out-predict humans in spotting infectious disease outbreaks is the case of the Canadian-based AI model, *BlueDot* (Naudé, 2020). According to Kreuzhuber (2020) AI tool - *BlueDot* predicted the outbreak of the infection at the end of 2019 and issue a warning to its clients on 31st of December 2019, before the World Health Organization did so on 9th of January 2020.

AI is used to track and to predict how the COVID-19 disease will spread over space time. According to Hao (2020) at Carnegie Mellon University, neural networks algorithm that was used for predicting seasonal flu, are now being retrained to predict COVID-19 spread. Using AI for tracking and predicting the spread of COVID-19, provided valuable data and information to public health authorities in order to plan, prepare and manage pandemic, as well as for tracking epidemiological curve (Naudé, 2020).

According to Bullock *et al.* (2020), Vaishya, *et al.* (2020), AI is used for predicting transmission, for detection and diagnosis of the infection, monitoring the treatment, contact tracing of the individuals, for identification of the high-risk patients, for controlling this infection in real-time and predicting mortality risk. Tracking and predicting spread of COVID-19 in terms of space and time is much easier using dashboards and visualization tools. Since AI has the potential to improve tracking and predicting of COVID-19 it was used in conjunction with interactive maps. On March 6th 2020 *MIT Technology Review* published rank of interactive maps and visuals revealing where the virus has spread, as well as numbers on the latest in infection rates and deaths. There were several criteria adopted in order to rank usefulness and practicality. Among them, they are easy to navigate, to provide insights from the data while also taking into account people's concerns and fears; to represent locations of infection; provide known details for each case, real-time updates. Top ranked dashboards were UpCode, NextStrain, the Johns Hopkins' CSSE, Thebaselab, the BBC, the New York Times, and HealthMap. Figure 2 represents the Johns Hopkins' CSSE, which provide insights in cumulative and active cases, incident and testing rate, as well as case-fatality ratio all over the world.

Figure 2. *The Johns Hopkins' CSSE*



Source Perception: <https://coronavirus.jhu.edu/map.html> (Retrieved September 5th 2020.)

In the past decade AI were extensively used in image recognition. Nowadays the same machine learning algorithms are used in making diagnoses based on the chest radiography images. According to the research conducted by Bullock *et al.* (2020) AI is faster and chipper to use in diagnostics process with standard tests for COVID-19. Furthermore Bullock *et al.* (2020) makes the point that AI is as accurate as humans and could save radiologists' time. Several studies underway in this regard. Wang, L. and Wong, A. (2020) developed AI tool Covid-Net which uses artificial neural networks in order to diagnose COVID-19 from chest radiography images. For training artificial neural network algorithm they used open data from around 13,000 patients with various lung conditions, including COVID-19.

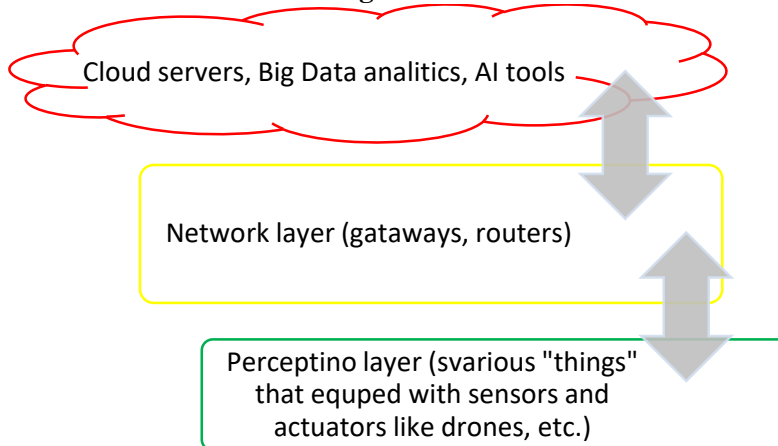
The Dutch University of Delft developed AI tool: CAD4COVID, for diagnosing COVID-19 from X-rays. It was developed on the basis of AI tool previously developed for diagnosis of tuberculosis.

Yan *et al.* (2020) used machine learning algorithm to develop AI tool in order to predict the mortality risk of a person that has been infected. Jiang *et al.* (2020) build an AI tool that can predict which person with COVID-19 may go on to develop acute respiratory distress syndrome.

Due to the lack of human workers, chatbots are being used for customer service work (Howard and Borenstein, 2020). In hospitals, semi-automated robots are being used to deliver medication and food as well as for cleaning and sterilization (OECD, 2020). In his paper Chun (2020) described that AI algorithms and infrared cameras were used in order to “scan the crowd on railway stations and airports and pinpoint the individual with high temperature and weather he or she is wearing a mask”.

In order to use AI technologies, lots of data have to be collected. The innovative technology providing extensive data collection is Internet of Things (IoT). IoT refers to the network (public or private) of interconnected devices or embedded systems equipped with sensors and actuators (“things”). These “things” in IoT can actively exchange data and information over the Internet without human intervention. All collected data are stored at cloud for further analysis. In order to process and analyze such a big collection of data machine learning algorithms are used. The results of the data analysis are then sent back to actuators of “things” so that they can react properly according to the situation (Fig. 3).

Figure 3. IoT architecture



During COVID-19 pandemics IoT solutions were used in various situations for intelligence automation of work (Fig. 3). Drones were used to collect health data from various locations of the infected patients, to ensure compliance with safety regulation like mask-wearing and that all infected are quarantine (Javaid *et al.*, 2020). Also IoT devices were used for the biometric measurements like blood pressure, heartbeat and glucose level (Singh *et al.*, 2020), as well as to restrict the person to person contact (Chaudhari *et al.*, 2020). All collected data, by IoT sensors are uploaded to the cloud so doctors and authorities can use it for further action.

According to Wang *et al.* (2020) the majority of the problems arising in the present situation are because of the non-effective reachability to the patients. IoT allows data exchange between the person in need and the in higher education since it has ability to reduce workloads, personalize experiences and analyze large sets of data. AI is used in IBM Watson Tutor system in order to improve students’ learning outcomes in online courses.

Furthermore, recant researches indicate that AI is used in various softwares to personalize education, and enable automation of administrative teaching tasks

(Garrido, 2012) as well as in virtual tutoring (Rivers, & Koedinger, 2017; Ganzfried & Yusuf, 2018). Also, AI is used to predict student's mood during online test (Moridis & Economides, 2009), and to investigate students' learning styles (Hinojo-Lucena *et al.* 2019).

The most frequent application of AI in education are this intelligent tutors and teaching systems (Ganzfried & Yusuf, 2018). In their researches Sánchez and Lama (2007) pointed out that in intelligent tutors AI has a role to track progress in students' learning and guide it, based on their content knowledge and personal characteristics, while the role of distributed intelligent teaching systems is to support collaboration and interactions among students.

Rivers and Koedinger (2017) indicate that AI can lead to intelligent automation of work in higher education since its implementation can improve the teaching and learning process and are able to generate "virtual teacher" who is fully trained and has human characteristics, and is able to interact at any time and place.

As indicated in Miljkovic *et al.* (2011), AI tools is also very useful in predicting professional movements of graduates and the results of such analysis can be used in defining enrollment policy. Furthermore, AI tools can help higher education institutions to analyze retention rates and program performance.

2.1. Digital transformation of working style in education during pandemic of COVID-19

According to UNESCO report (2020) as of March 13, nearly 60 countries, all over the world have closed schools and universities in order to follow social distancing measures. This rapid and sudden change force educational institutions across the globe to turn to available technical resources and start with online teaching (Bao, 2020). Although this was unexpected and sudden situation for education institutions it was not the first time online teaching appeared as feasible option for conventional education. It also happened in 2014 when SARS also negatively impacted education activities (Cauchemez *et al.*, 2014).

Although online courses were provided, several problems occurred. Faculty members face with additional requests since they had to adopt teaching materials for on-line teaching and had to teach in front of a computer screen.

In this unexpected situations, many teachers and faculty members found themselves in a situation where they did not have enough on-line teaching experience, nor enough time for adopting and preparing additional materials. Furthermore, they were facing the challenges of lacking technical support (Bao, 2020).

At the same time their students had to stay at home and take the courses through the Internet. Adnan and Anwar, (2020) in their research pointed out that online learning can be effective in digitally advanced countries, but cannot have the same effect in underdeveloped countries, where a great number of students don't have access to the internet due to technical as well as monetary issues. The other research that investigates students' perspective on on-line teaching in China during COVID-19 pandemics indicates that challenges for students did not come from technical operational obstacles. Instead, they had difficulties due to the lack of self-discipline or good learning environment when they are staying at home (Bao, 2020).

2.2. Research problem

The COVID-19 pandemic has a huge impact on global education in a general as well as on our education system in particular. Our education system, at all levels was unprepared for the lockdown announced on March 2020.

Therefore, our research aims to determine:

1. The effects of working style transformation caused by COVID-19 pandemics i.e. what is the effectiveness of on-line learning form higher education students' perspective and
2. To highlight the obstacles and challenges of on-line learning faced by higher education students in Serbia.

2.3. Research methodology

Our research was conducted during spring semester 2019/2020 academic year on two private universities in Serbia. Data were collected by conducting online survey. Total sample included 107 undergraduate students. Students were from different majors: Management (57%), Economy (6%) and IT (37%). The participants were informed that their participation is entirely voluntary in the study and their responses are completely confidential.

The survey consisted of 11 questions and they were divided in two sections. The first section consisted of four items that represented the student personal information data. The second section of the survey consisted of seven items representing the attitudes regarding on-line learning.

A five-point Likert Scale, with Strongly Agree (5), Agree (4), Don't know (3), Disagree (2), and strongly disagree (1), has been used to measure the ten attitude questions (Table 1).

The survey was developed according to the relevant study (Adnan, M., & Anwar, K. (2020) in order to ensure content validity. The questions used to determine students attitudes on-line learning, are presented in Table 1.

Table 1. Students Attitudes Regarding Online Learning

Question	Strongly Disagree (1)	Disagree (2)	Somewhat agree (3)	Agree (4)	Strongly Agree (5)
Q1 I have good Internet access	13%	25%	17%	23%	22%
Q2 I feel qualified to use a computer/laptop	2%	4%	4%	67%	15%
Q3 I am comfortable communicating electronically	1%	8%	4%	53%	34%
Q4 No difference between online and conventional learning	22%	46%	21%	8%	3%
Q5 Online learning is more motivating than conventional learning	31%	58%	7%	3%	1%
Q6 Complete faculty courses can be completed effectively through internet	19%	42%	10%	19%	10%
Q7 It is easy to complete group projects digitally	10%	12%	5%	46%	27%
Q8 Face-to-face contact with the instructor is necessary for learning	5%	8%	11%	52%	24%

2.4. Results

The collected data were analyzed using the Statistical Package for Social Science (SPSS). First, normal distribution was approved by Kolmogorov-Smirnov test. Then, reliability test, for the seven independent variables that represent the attitudes, has been checked by calculating Cronbach's alpha ($\alpha=0,875$).

The first part of survey dealing with students' personal information revealed that in total sample 62% were female students as compared to the 38% of male students. 81% of the students age ranges between 19 and 24, 13% are between 25 and 29 years old and 6% are older than 29. 62% of students were form Management major, 21% form Economy major and 17% form IT major. All the students are studying at the undergraduate level.

The rest of this section presents the findings regarding students attitudes towards on-line learning. Answers "agree" and "strongly agree" are considered as answers with positive attitude, "somewhat agree" as neutral and "strongly disagree" and "disagree" as negative attitude.

The results have shown that 45% of students have good internet access while 55% don't.

Responding to the question whether students feel qualified to use a computer/laptop for on-line learning, 82% of students feel that they are well qualified to use computer/laptop for on-line learning, 10% of students reported that they are comfortable with it, while 8% feel that they are facing problems in digital communication.

Similar percentage of students 87% find communication through internet more comfortable than face-to face, 4% see no difference, while 9% prefer face-to-face communication rather than digital communication.

In response to the question whether on-line and conventional learning is the same, 68% reported that on-line learning is way different from conventional learning, while 21% feel that there is little difference between online and conventional learning. Only 11% of students feel that online learning is more motivating than conventional learning.

Students have similar attitude regarding questions whether on-line learning is more motivating than conventional learning. 88% of them find on-line learning less motivating than conventional learning, 7% see no difference, while only 4% think opposite.

In examining completion of entire faculty courses through the internet 61% experience difficulty or find it is not possible to effectively complete entire faculty courses online, 10% see no difference, while 29% reported that it is possible to complete an entire course through online learning. But 73% respondents find that completing group projects digitally are easier, 5% see no difference, while 22% don't think it is easier completing group projects digitally.

Responding to the question about face-to-face interaction, 76% of students find it necessary for learning and on-line learning, 9% find that it is of not so importance while 13% think face-to-face contact with the instructor is not necessary for learning.

In order to examine whether there is any significant difference in the students' attitudes towards on-line learning with regard to their major, one-way ANOVA was used with Turkey's post hoc test. The results are shown in Table 2.

Table 2. One-way ANOVA and post hoc comparisons for major

Question	Education major						Post hoc comparisons			
	IT (1)		Management (2)		Economy (3)		p	1 vs. 2	1 vs. 3	2 vs. 3
	M	SD	M	SD	M	SD		p	p	p
Q1	3.43	1.124	3.41	1.301	3.86	1.315	0.271	0.314	0.064	0.321
Q2	2.13	1.034	3.50	1.225	3.71	1.103	0.088	0.412	0.124	0.337
Q3	3.73	1.532	4.01	0.955	3.95	0.826	0.133	0.344	0.224	0.241
Q4	3.16	1.029	3.73	1.125	3.71	1.614	0.221	0.234	0.153	0.331
Q5	3.37	1.217	3.24	1.325	3.56	1.604	0.344	0.426	0.224	0.264
Q6	2.79	0.831	2.77	0.448	3.71	0.426	0.235	0.115	0.072	0.314
Q7	3.44	0.942	3.25	0.822	3.12	1.012	0.082	0.277	0.142	0.197

The result presented in Table 3 indicated that there is no significant difference in the students' attitudes towards on-line learning with regard to their major.

In order to examine whether there is any significant difference in the students' attitudes towards online learning regarding their age, one-way ANOVA was used with Turkey's post hoc test. The results are presented in Table 3.

Table 3. One-way ANOVA and post hoc comparisons for age groups

Question	Age groups						Post hoc comparisons			
	19-24 (1)		25-29 (2)		Above 29 (3)		p	1 vs. 2	1 vs. 3	2 vs. 3
	M	SD	M	SD	M	SD		p	p	p
Q1	3.23	1.049	3.21	1.727	3.38	1.061	0.341	0.652	0.165	0.421
Q2	3.71	0.532	4.35	1.389	4.14	0.756	0.134	0.623	0.182	0.354
Q3	2.43	0.816	3.48	1.282	3.15	1.054	0.191	0.082	0.311	0.367
Q4	3.43	1.308	3.98	1.246	3.41	1.101	0.431	0.312	0.131	0.251
Q5	2.78	1.202	3.92	1.101	4.01	1.309	0.125	0.523	0.423	0.375
Q6	3.31	1.456	3.21	1.302	3.32	1.269	0.454	0.413	0.156	0.254
Q7	2.65	0.371	3.71	0.463	3.08	0.991	0.164	0.645	0.129	0.304

The result presented in Table 3 revealed that there is no significant difference in the students' attitudes towards the on-line learning regarding their age.

2.5. Discussion

COVID-19 lockdown force students and their parents to go outside the cities. Contemporary way of living has speeded up our lives and generated more stress than before. In such circumstances people are seeking for more peaceful way of living and rural environment is offered as a solution (Radanov, Brzakovic, 2017). The other reason of this trend is that people are quite aware of how the quality of air, water, land and pollution influence the quality of life (Radanov, 2016). In COVID-19 pandemic, migrations from cities to rural places were evident in Serbia during lockdown. On the other hand, rural places in Serbia don't have quality internet access and that explains why only 45% of students responded they were having good internet access while 55% didn't.

In 2018 Serbian Government adopted the Strategy for the development of new generation networks until 2023 and showed its readiness for a complete digital transformation of the economy and business in the Republic of Serbia. The strategy promotes the use of cloud computing and the Internet of Things, as well as the development of fifth-generation (5G) of mobile networks as the major drivers of this digital transformation. The new infrastructure is what is needed to make online learning accessible to all.

As a result majority of respondents are reserved about on-line learning and among major reasons are not only insufficiently good internet connection but rather ineffective technology used for on-line learning. Current on-line learning system needs improvement towards intelligent tutors system that can track students' learning progress and guide it, based on their content knowledge and personal characteristics.

The sudden shift from conventional to on-line learning has resulted in a completely different learning experience for students. The lack of adequate interaction with teaching members influenced respondent attitude regarding motivation. Respondents find on-line learning less motivating than conventional way of teaching since they were not actively involved in learning process. Rather they were in passive receiving position.

Furthermore, it seems that students need more feedforward from professors in order to understand complex topic and as well as to improve their learning process. That explains why the results show that 76% of students need direct contact with teaching members necessary for learning.

The results show that majority of students can manage their study time effectively on-line but find it difficult to complete entire faculty courses on-line, because of the lack of face-to-face interaction and discussion. On the other hand respondents find it is easier completing group projects digitally since they are familiar with digital communication .Current students belong to so called

“Millennial generation”, and were born in a time when the use of computers was already disseminated among common users, and when most of the digital technologies available today were already part of everyday life (Stanojevic & Rakic, 2018). That is why the majority of students (87%) find themselves comfortable in digital communication and 82% of students feel that they are well qualified to use a computer/laptop for online learning.

CONCLUSION

This research suggests that emerging technologies like IoT, AI, high-speed networks, cloud services, etc. can influence intelligent automation in various fields of work and can support the response against COVID-19. In this paper, we have highlighted several applications where these technologies were used during COVID-19 pandemics. As it was indicated AI tools and IoT solutions can be used together for intelligent automation of work in various situations, like early warnings and alerts, tracking and prediction, data dashboards, diagnosis and prognosis, treatments and cures, and social control. Furthermore, AI is used for predicting transmission, for detection and diagnosis of the infection, monitoring the treatment, contact tracing of the individuals, for identification of the high-risk patients, for controlling this infection in real-time, and predicting mortality risk.

In the past decade, AI was extensively used in image recognition. Nowadays the same machine learning algorithms are used in making diagnoses based on chest radiography images.

To use AI technologies, lots of data have to be collected. The innovative technology providing extensive data collection is the Internet of Things (IoT). IoT application is used for health data capture from various remote locations, virtual engagement, and monitoring while AI tools were used for big data analytics of data collected to generate early warnings and alerts, as well as for tracking and prediction. During COVID-19 pandemics IoT solutions were used in various situations for intelligence automation of work. As a part of IoT, solutions drones were used to collect health data from various locations of the infected patients, to ensure mask-wearing and that all infected are quarantine as well as to restrict the person to person contact. Also, IoT devices were used for biometric measurements like blood pressure, heartbeat, and glucose level.

The COVID-19 pandemic initiated a sudden and dramatic digital transformation in society that influenced the field of education as well. The pandemic forced us to take a digital leap, which required significant adjustments not only from students and their professors but also from their families and faculty administration. In this new situation, professors and faculty staff had to take the lead in the sudden digital transformation of higher education, without being well prepared for it. Also, this digital transformation meant that students had to possess a variety of skills, competencies, and resources.

As previous research indicated, various software tools were used to increase student engagement in learning and produce effective learning. In recent years many higher education institutions used AI as a part of intelligent tutor systems. Online learning was used as an additional way of learning not as a dominant one. That is why several problems occurred in this new situation. Faculty members face additional requests since they had to adapt teaching materials for on-line teaching and had to teach in front of a computer screen. Moreover, teachers and faculty members found themselves in a situation where they did not have enough on-line teaching experience, nor enough time for adopting and preparing additional materials, and they were facing the challenges of lacking technical support (Bao, 2020).

As Basilaia & Kvavadze (2020) emphasize in their work, online learning can be effective in digitally advanced countries.

Our research is in line with their finding since students' attitudes, presented in this paper showed that on-line learning cannot produce desired results in underdeveloped countries like Serbia. One of the reasons is that not all students are in an equal position to engage in their digitalized education. There are issues with technology access and use, as well as with skills and competencies. Some students have benefitted from the situation while others have suffered. Furthermore, respondents find online learning less motivating than the conventional way of teaching since they were not actively involved in the learning process. Furthermore, the result shows that students need more feedforward from professors to understand a complex topic.

According to the World Health Organization instruction, we need to adjust our daily and working activities with COVID-19 because no one can predict its duration. In times to come, higher education systems have to design appropriate on-line learning systems that will incorporate intelligent components based on AI since AI solutions can bring more human-like connections and raise the digital literacy of their faculty members to enable better learning outcomes.

Moreover, great attention should be paid to student retention, not only recruitment. Since the world has significantly changed in the past couple of months, faculties and universities have to be more active in preparing for digital transformation since new kinds of digitalized students will be entering higher education institutions in years to come. Furthermore, faculty management should consider how to empower professors to act as leaders of the digital transformation of education.

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Innovation in the working environment as a way to overcome the crisis and create new consumer habits

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Abstract: The pandemic caused by COVID-19 virus forced organizations around the world to rapidly adopt innovations in work environment, in response to crisis and accompanying challenges. In order to ensure the health safety of employees, organizations switched to new way of working - working from home. This paper will present research conducted on impact of pandemic on working environment in the world and in our country. At the end of April 2020, an empirical, quantitative research was conducted in Serbia, using a test method, in order to find out how much work from home is present in Serbia since the beginning of pandemic, then how much such work is represented in relation to private and public sector, as well as whether such virtual way of working has impact on consumer habits, increase of online ordering, degree of concern among respondents about certain possible economic consequences of pandemic. The sample is representative for online population in Serbia and it is made of 510 respondents. Working from home, as a new way of working for some employees after declaration of a pandemic, affects creation of new habits of employees also as consumers.

Keywords: innovation, remote working, working from home, pandemic, employees, consumers
JEL: J01, M00, M31, O15, O31, O33

1. INTRODUCTION

The pandemic has forced organizations to adopt new ways of working. COVID-19 has caused great challenges so far. The key challenge of resolving the crisis as an optimal solution is not "returning to the old", but completely redefining the logic/paradigm of society functioning, i.e. the logic/paradigm of business by identifying new sources of value and competitive advantage. However, individuals and organizations have difficulties in developing and implementing the necessary responses to the crisis, which are not natural for either people or organizations. The natural response to the crisis is the aspiration to return to the *status quo*. With the appearance of crisis, the known, and therefore less risky, gets lost, and a new one, which is assessed as more risky, comes along. A

particular problem is that the value of what the organization has been investing in for years (knowledge, resources, structures, brands, consumers) disappears (Vlašić *et al.*, 2020, p. 32-33). Regarding organizing the workers, the organizations around the world have acted quickly so to protect employees and switched to the new way of working - working from home, which could not be even predicted.

One aspect of the paper deals with employees during pandemic with a special focus on working from home - how much it is present and what changes it brings. As per another aspect of the paper, employees are simultaneously seen as consumers, in order to find out how big is impact of virtual mode of working on creation of consumers` new habits and increase of online ordering. Also, the degree of consumers` concern regarding certain potential economic consequences of pandemic is being examined. These lines presented at the same time subject and goals of research. Contribution of the paper is reflected in the comparative analysis of employees in Serbia during pandemic and of employees in the role of consumers, due to the assumption that the new way of working determines the new face of consumers in terms of creating new consumer habits. Based on the results of empirical research, the presence of working from home in relation to the private and public sector in Serbia is analyzed, which is not included in previous researches on this topic.

2. INNOVATIONS IN WORKING ENVIRONMENT IN THE AGE OF PANDEMIC

Learning from forced experiment and investing in risk reduction technologies can help organizations become smarter and more flexible. Thus, for example, before the new crisis, companies considered investing time and resources in experiment of working from home too big cost, but crisis of COVID-19 left many without other options. There is massive investing in IT equipment and systems so employees can work from home. It is believed that flexible arrangements of working from home will become permanent policy of many organizations even after the crisis (Luo & Galasso, 2020). Workers who prefer working from home can achieve increased productivity, shorter commuting time and lower rate of job quitting, because they are generally happier (Luo & Galasso, 2020). Similar considerations apply to business travel that has been replaced by videoconferencing.

Greater use of robotics, artificial intelligence and automation brings testing of accountability systems in many countries, which affects employment and wages. Widespread use of temperature scanning, monitoring of physical movement and human health will trigger discussions about privacy and data protection. In the midst of these massive changes, combination of short-term and long-term responses to innovation can provide a glimmer of hope for businesses. Although, in short-term they represent unavoidable challenges for individuals and

organizations, innovative and creative risk mitigation technologies can potentially lead to better user experience and employee satisfaction, both now and in the future. (Luo & Galasso, 2020)

2.1. Impact of pandemic on working environment in the world

As measures to combat the spread of the virus have and can have far-reaching consequences for human health (due to limited physical activity, stress, anxiety, depression), for employers and policy makers is important that attention is directed to the benefit of employees, which is central for recovery plans. Long-term prosperity depends on the life-saving, maintenance of livelihood and support to the quality of life. Activities that affect the improvement of well-being, such as support to mental health and satisfaction with work, are often surprisingly simple and cost-effective. (Allas *et al.*, 2020 - McKinsey) Mental health problems are present in a large number of people, and the employees are those who need to play a key role for their employers` adjusting. According to a McKinsey survey (1st June 2020, p. 91), as many as 59% of respondents admitted to have difficulties such as anxiety or depression, or both, caused by loneliness in new living and working conditions. In order to preserve the mental health of employees, and of all people in general, there will be a need to provide psychological therapies via the Internet, telephone, as well as conducting meditation. It is pointed out that every Euro that is invested in preserving and improving health and productivity can return four Euros (Allas *et al.*, 2020, p. 8 - McKinsey).

It is believed that sharp decline in economic activity may cause permanent slowdown in growth of countries, resulting in drop of revenue and job losses, which most affects the most vulnerable ones in society. Governments around the world have already set aside more than \$ 13 trillion to stabilize declining economies and restart growth, and it is estimated that the deficit could reach \$ 30 trillion by 2023. These measures have succeeded in many ways, but as the crisis continues, new questions arise - is the money directed in the best possible way, and whether more money should be set aside for the same purpose. (McKinsey & Company, 25th June 2020)

According to Gordon *et al.* (2020) and McKinsey survey, between 20% and 60% of consumers in most countries say that they are afraid of losing job, and about half of them have savings enough for four months or less. In general, makers of household financial decisions in the world estimate their personal financial situation as poor. Such opinion was most pronounced in South Africa and Italy, i.e. it is opinion of 39% and 21% of respondents, respectively. In China and the USA, respondents rate their personal finances, on a net basis, as slightly positive. It is noticeable that respondents in all countries evaluate the current state of the economy more negatively than their own current financial situation. This difference is the most obvious in Great Britain, where the net economic

feeling is 50 percentage points more negative than the net feeling about people's financial situations. The Great Britain is followed by the USA, Italy and Brazil, where the differences are 46, 44 and 42 percentage points. In China, assessments of personal financial situation are mostly in line with views on the economy.

According to research by McKinsey & Company and Allas *et al.* (June 2020), in Europe, average satisfaction with quality of life has been growing, but, with the outbreak of pandemic, it fell to the lowest level since 1980. The countries with relatively high scores of satisfaction with quality of life before pandemic, such as Ireland and Luxembourg, experienced a decline during the crisis harder than countries with a lower level of satisfaction, such as Croatia and Hungary. It appears that countries with greater level of well-being have shown greater resilience in some dimensions, such as the ability of people to work from home.

It was believed that personal presence in the workplace is crucial for workers' productivity. As the pandemic forced organizations to quickly "switch" the entire business to teleworking, and to start or accelerate the process of digital transformation, it has been confirmed that workers are even more productive when they work from home.

At the beginning of April, this year, 62% of employees in the USA worked from home during crisis, which is much higher percentage compared to about 25% from a few years ago, which was contributed by rapid and effective adoption of technology for videoconferencing and other forms of digital collaboration (Boland *et al.*, 2020 - McKinsey). As many as 73% of consumers in the USA stated that they got used to working from home and that they were not comfortable with returning to "regular" activities outside the home (McKinsey, 26th June 2020). According to Boland *et al.* and McKinsey research (2020), 80% of respondents said that they enjoyed working from home, out of which 41% of employees thought that they were more productive than they had been before, while 28% of employees said they were equally productive. Many employees, relieved from long commuting, found more productive ways to spend the saved time – they enjoy greater flexibility in balancing between personal and professional life and they declared to prefer working from home, rather than from office. According to a study conducted by Institute Forsa and IGES on a sample of 7,000 employees (The News ABC, 2020), employees feel less stressed, more motivated and productive since they switched to working from home during pandemic. Prior to outbreak of this crisis, 21% of surveyed employees claimed they were under stress at work, while 15% of employees said so during the crisis. In terms of productivity, 56% of employees feel more productive while working from home. Those who argue that working from home is better, state saving time needed for commuting as one of the reasons for such position. About 77% of respondents would like to work from home in the future.

According to 75% of employees, drawback of working from home is the lack of personal contacts with colleagues.

Some organizations completely reoriented their business to working from home. For example, employees in companies Google, Facebook, Twitter, Siemens, are approved to work from home for indefinite period of time, if that suits them better. All Google employees, both full-time and part-time employees, about 200,000 of them, will work from home at least until July 2021. Main motive for that is to help workers who must take care about children, because functioning of kindergartens and schools around the world is uncertain (Copeland & Grant, 2020). And when it comes to educational institutions, especially primary and secondary schools, they have adapted their work system to working from home, through e-learning. However, many modern higher education institutions in the world have this way of distance learning developed, and they readily met changes caused by pandemic. E-learning development has always been a pursuit for understanding of the way in which students learn and how to provide them with attractive materials. E-learning courses are supposed to be easy to navigate and ready for implementation via exercises, case studies, knowledge checks, scenarios, simulations and interactive games. (Mamula & Ćoso, 2015)

According to Senz (2020), at least 16% of employees will work from home long after the withdrawal of the COVID-19 virus. The survey, which was conducted on a sample of 1,800 employees, came also to the following conclusions: telework is much more common in industries with better educated and better paid workers; respondents in better educated and highly paid industries noticed smaller loss of productivity since transition to teleworking; more than one-third of organizations in which employees moved to teleworking believes that this will remain the practice in their company even after the crisis caused by the COVID-19 virus.

A study on the impact of the pandemic on companies was conducted by International Labor Organization (2020), and it included 1,066 companies from Indonesia, Peru, Myanmar, Colombia, Ghana, Tunisia, Bolivia and Pakistan. As many as 70% of businesses temporarily suspended operations when the pandemic began; 75% of businesses experienced revenue reductions; 79% of companies expect revenue reductions throughout 2020; 69% of companies reduced labor capacity (43% asked employees to take paid leave, 42% reduced working hours, 42% of companies reduced the number of temporary employees, 19% asked employees to take unpaid leave, 18% companies reduced the salary of employees, 11% of companies dismissed employees). As many as 49% of enterprises reduced the production of products or services; 29% of them have introduced online marketing, sales, delivery; 20% of companies responded to the new demand (for masks, disinfectants, etc.); 12% of enterprises increased production in response to higher demand; and 10% of companies did not take

any action. 30% of micro, small and medium enterprises diversified their sales channels. About 50% of micro enterprises and 31% of SMEs diversified products and sales channels. Online training on business management is attended by employees from 39% of large organizations, and from 15% of micro, small and medium enterprises.

2.2. Impact of pandemic on the working environment in Serbia

According to the results of a survey conducted by SeConS in mid-April 2020, 8% of employees in Serbia, or about 200,000 people, lost their jobs during pandemic and state of emergency. The largest percentage of respondents lost their jobs due to organization`s suspension (46.2%), followed by those whose contract expired and a new one was not offered (20.5%), then by those who resigned because they had to take care about children or the elderly (12.1%), resigned or dismissed because they could not organize transportation (10.6%) and 5.3% each of those who were dismissed for some other reasons. Persons employed in vulnerable forms of employment, such as those with temporary contracts or the informally employed and self-employed, have been hit hardest by job loss. People employed in catering, trade, construction, art, entertainment and recreation, communications and other service activities (such as personal services) were most hit. The loss of jobs affected more young than older employees, as well as rural residents compared to urban areas. Employees in the private sector were considerably more exposed to job loss, while monthly salaries were significantly more often reduced to employees in the private than in the public sector.

According to the results of research conducted by Poslovi Infostud at the end of May 2020, 20% of employees in Serbia pointed out that their organization dismissed some workers during the state of emergency. It is a positive fact that almost 70% of companies did not reduce their employees` salaries. As many as 54% of respondents said that after the end of the pandemic they would like to work at least in a combined way - part from home and part from the office, while 30% of respondents opted to work from the office. Respondents who had the possibility to work from home largely stated that they did not feel a difference in their productivity (43% of them) and 25% stated that they were more productive than during office work. The biggest challenge for the respondents is the fear of economic crisis` deepening and struggle for existence. Regarding economy, the number of companies that feel a significant negative impact decreased from 56% (according to findings from the first week of April) to 27% as measured at the end of May. On the other hand, only 8% of companies stated a positive impact on their business. The biggest challenge faced by even 40% of companies is more difficult planning of activities due to many unknowns, and in the second place with 28% is financial sustainability. Half of the companies expect the financial plan for this year to be fulfilled below the expected, and only 5% see the possibility of being above expectations. 20% of companies believe that the

risk of crisis will affect their business sustainability in the long run, 45% believe that sustainability will be short-term. As for positive aspects of doing business after the end of state of emergency, 40% of organizations pointed out that working from home can be feasible and useful for a good part of company, and 23% stated that they became more serious in digitalizing their processes. More than half of businesses cut their costs, among which those related to marketing were the first to suffer. Even 60% of companies enabled working from home for at least part of employees, and the same percentage does not see a drop in productivity. In companies where employees returned to workplace, even 70% apply protection measures against virus prescribed by the Government of Serbia, while 15% pointed out that they do not have a special regulation on it. Just over 30% of companies plan to enable their employees to work from home even after the danger of the epidemic is over, while almost 40% point out that they will return to normal business processes and work from office.

Serbian Association of Employers (2020) conducted a research on impact of the pandemic caused by the COVID-19 virus on activities of companies in Serbia. It was conducted during April 2020 and 400 businessmen participated - where the largest number of surveyed companies is from the category of micro, small and medium-sized companies that have been operating in the market for more than 20 years. It is in micro and small companies that employ up to 10 employees where the lowest resistance to new market situation caused by the virus has been registered. Almost a quarter of these companies could not perform business activity at all, especially in the sectors of hospitality, hotels, transport, real estate, textile industry. More than 80% of surveyed businessmen stated that they managed to function during crisis, either doing business from their premises or working remotely. Large economic systems have proven to be the most successful because more than 60% of companies operated without almost any disruptions, and on the other hand the biggest losers come from the tourism and hospitality sector where 72% of companies were closed during the state of emergency. One of the key sectors, especially in the changed, extraordinary circumstances, the food industry sector, managed to operate in full and in its premises during the crisis. The textile industry was also considerably troubled due to interruption in supply chain and fall in demand. As many as 90% of companies were forced to change their business model in order to protect themselves from the negative consequences caused by the COVID-19 virus. More than half of the respondents emphasize that the crisis had a very negative impact on their finances and business, and even 65% of companies employing up to 10 employees estimated that the crisis caused by the virus negatively affected financing of their business activities, and 30% to 40% are facing threats to liquidity. According to the results of this research, a month after the introduction of the state of emergency in Serbia, 91% of organizations did not dismiss any employees, and 8% of companies plan to do so in the coming period. The smallest and the largest companies dismissed employees less likely

than companies with 11 to 250 employees. Businessmen, even 70% of them, point out reduced demand and a drop in turnover, in the first place as main challenges they face due to pandemic caused by the COVID-19 virus, and there are also challenges related to suppliers and delivery of goods, problem to provide a sufficient number of employees, considering changes in working conditions, absence due to illness and the like.

2.3. Innovations in leadership and management style

In order to release the potential of individual creativity and manner of thinking, companies increasingly invest in intellectual property, rely on intense knowledge of their employees, and use their proposals and proactive leading to innovation (Mamula *et al.*, 2019). As the organization adapts to a remote, digital workspace, managers are forced to change their approach to managing digital transformation. Several key characteristics of a leader were identified to help companies take full advantage of opportunity to digitally transform.

Empathy is necessary in order to gather the workforce and respond to the needs of customers and consumers. According to an analysis by Snyder and Conroy (2020), a high level of empathy is a main factor of successful leaders in digital companies, and the mismatch between leaders and employees is largely associated with lower levels of digital acceleration. And it is believed that mutual understanding and expression of concern will be even more important in the future. In addition to empathy, according to the same study, connecting employees with the purpose of the organization can encourage the way employees think and their efforts to support digital transformation, contributing to the long-term ability of the organization to fulfill its mission.

In order for leaders to inspire, motivate and engage their teams so that they can operate in a world of change such as COVID-19, they should develop their own leadership practices. The development of a coaching approach in leadership and employee development provides a more active approach to change management. The coaching approach of leaders has shown results if the leader wants more engaged teams with high performance who will become future leaders who inspire change and proactively enter and implement transformations in a developed culture of learning, innovation and responsibility (Mamula & Kužet, 2015). In order for leaders to understand how to implement the change and to adapt to patterns of work and behavior of the new "digital generation" also in the VUCA world (volatility, uncertainty, complexity, ambiguity), modern programs of communication and training which apply the power of technology (on-line coaching and on-line training) are important. Managers' role is to boost dialogue via regular meetings, feedback culture, mentoring and coaching, and managers should organize trainings and establish a reward system through various financial and non-financial incentives. (Mamula *et al.*, 2019)

Visibility of processes, transactions, and relations, enabled by the Internet and social networks, calls for even greater responsibility so as to make communication, business solutions, and cooperation as quality as possible. Survival of each organization, and even nations, depends on the possibility to keep in permanent contact with progress and changes in all spheres (Mamula & Kužet, 2015; Mamula *et al.*, 2019).

During the COVID-19 pandemic, the ways of recruiting talents and retaining employees, as well as organizing employees during teleworking, are also changing. New business models introduce digital transformation also in the HR sector. The role of HR analytics which enables employee satisfaction to be measured and decisions on how to personalize benefits for each employee to be made, is becoming bigger and bigger. Some of these benefits are more flexible working hours, good organization of work, and the time for mentoring and coaching. Recruiting employees and young talents of Generation Y as a digital generation is no longer a one-way process, because as much as the company and recruiters check the potential candidate, so does the candidate check and evaluate the company (Mamula & Nećak, 2019).

3. SPEED OF ADOPTION OF INNOVATIONS

On one hand, innovations are a way of solving problems during crisis, but innovations alone are not a sufficient condition for overcoming crisis, because, on the other hand, it is necessary for them to be accepted and then also adopted by the users. In this paper, the users of innovations are observed from the aspect of employees and innovations in the working environment of the organization, but also in their role of consumers of various types of consumer goods and the modern way of ordering. When it comes to working from home, it certainly assumes the use of the Internet and various programs. According to Perčić and Perić, consumers in Serbia generally surf the Internet to a great extent, and the younger population finds social networks (Facebook and Instagram) to be attractive in terms of visiting them and following pages on them.

The Internet and social media are one of the vital key forces having a significant impact on the innovation in the society as whole and on many industries. The role of digitally affluent generation Y is enormously important as they represent the future of both consumer as well as employee (Paunović *et al.*, 2020). Since generation Y is open to new technologies there is a plenty of space for the implementation of various types of innovative and interactive materials using digital channels that give them greater freedom to express themselves and exchange ideas (Mamula Nikolić *et al.*, 2020).

According to Rogers (2003), there are five categories of consumers with regard to the speed of adoption of innovations (new products), being the following: innovators (2.5%), early adopters (13.5%), early majority (34%), late majority

(34%) and laggards (16%). Based on this division, it can be seen that in the category of innovators there are only 2.5% of consumers, and given the high degree of acceptance and adoption of innovations during the pandemic, it can be assumed that this percentage is much higher, because the speed of innovation is a factor of survival and development of organization, and in the case of a pandemic a way of overcoming the crisis, at the micro and macro level.

According to Perčić *et al.* (2019), the highest percentage of consumers in Serbia (32.2%) dislikes changing their habits and products that they are prone to, i.e. they belong to a group of consumers who are called laggards. Although the percentage of laggards in Serbia is twice as high as the theoretical data, according to Rogers, the percentage of innovators is quite high (12.0%). „A large percentage of laggards in Serbia is not a good indicator of successful growth and development, as knowledge and technology diffusion is one of the preconditions for growth and development on micro and macro levels, while a relatively high percentage of innovators, represents the potential for more efficient business and quick implementation of innovations and innovative processes in marketing and in general“, (Perčić *et al.*, 2019, p. 69).

In Serbia, according to segmentation of generation Y, there are 81% of Digital natives and Smart immigrants that are trendsetters whose habits are oriented toward the e-commerce which implicates that they need to know more about the product before they are ready to buy it as an educated consumers (Mamula Nikolić *et al.*, 2020).

Acceptance of innovations by users and consumers in regular circumstances is a much slower process than the one which occurs during a pandemic, and thus, the percentage of consumers in the category of innovators in new living and working conditions is higher than theoretical and empirical values before the pandemic.

4. METHODOLOGY OF EMPIRICAL RESEARCH

A survey was conducted in the Republic of Serbia in order to find out how much working from home has been present since the beginning of the COVID-19 virus pandemic, how much such work is represented in relation to the private and public sector, and whether such virtual way of work has an impact on consumer habits, increase in online ordering, the degree of concern among respondents about certain possible economic consequences of the pandemic, but also the impact of the pandemic on household income, consumption and savings. It is an empirical, quantitative research using the test method, which was conducted in the period from April 23 to 29, 2020.

The sample, made of 510 respondents, is representative for online population in Serbia and it turned out that women are more open to complete online survey, so

therefore there is no equal division by gender, which could show significant statistical differences related to gender. For the purposes of research, an online questionnaire was used, created for this research.

SPSS software was used for data processing and interpretation of the obtained results, and quantitative statistical methods were used for analysis: descriptive statistics - frequency distribution and comparative statistics (χ^2 test, t-test). Some of the questions in the questionnaire referred to the five-point Likert answer scale.

Based on conducted research on the topic of innovations in work environment during pandemic, which are indicated in the references, the following research hypotheses have been formulated:

Hypothesis H₁: It is assumed that there is a significantly higher number of employees in Serbia working from home after pandemic declaration compared to period before pandemic.

Hypothesis H₂: Working from home, as a new way of working of some employees after declaration of pandemic, affects creation of new habits of employees observed also as consumers.

Hypothesis H₃: It is assumed that percentage of those who order online is bigger for employees working from home compared to those who do not work from home, since working from home implies access to the Internet and knowledge of work in various programs and applications.

Hypothesis H₄: Since working from home is also one of the alternatives to save the job if there are conditions for such way of working, it is assumed that greater concern for job is present among employees who do not have the opportunity to work from home.

The structure of the sample consists of:

- 29% of male respondents and 71% of female respondents;
- 8% of respondents aged 18 to 25, 42% of respondents aged 25 to 40, 31% of respondents aged 40 to 50, 17% of respondents aged 50 to 65 and 2% of respondents over 65;
- 60% of respondents are from Belgrade, and 40% are from other cities in Serbia;
- 15% of respondents have VII/2 and VIII degrees, 49% have university degree, 12% higher degree, 22% finished secondary education, and 2% primary education;
- 67% of respondents are employed in private sector and 33% in public sector;

- 68% of respondents are employed, 17% are employed but at the time of completing the questionnaire they were not working due to the COVID-19 virus, and 15% of respondents are unemployed;
- of those employed, 58% work from home and 42% do not work from home;
- among respondents working from home, 31% of respondents worked from home before the pandemic, 46% did not, and 23% of respondents occasionally worked from home (for 54% of respondents, working from home is a familiar way of working).

5. RESULTS OF EMPIRICAL RESEARCH AND DISCUSSION

A large percentage of respondents (82%) easily adapted to working from home, and 18% of respondents had difficulty adjusting to the new way of working. Almost 30% of the respondents started using some of the programs for working from home. Such a percentage of respondents in Serbia (30%) increased the share of online ordering of products after the outbreak of the pandemic.

The analysis found that:

- there is no statistically significant difference in male and female responses related to working from home before pandemic caused by the COVID-19 virus (t-test; $p = 0.638 > 0.05$); nor after the outbreak of a pandemic (t-test; $p = 0.083 > 0.05$);
- there is no statistically significant difference in answers of respondents from Belgrade and from other cities in Serbia related to working from home before pandemic (t-test; $p = 0.525 > 0.05$); but *there is a statistically significant difference in answers of respondents from Belgrade and from other cities related to working from home after declaration of pandemic* (t-test; $p = 0.00 < 0.05$), i.e. the *percentage of respondents from Belgrade who work from home after the beginning of pandemic (66%) is twice as big as percentage of Belgraders who do not work from home (34%)*, and, on the other hand, 45% of respondents from other cities in Serbia work from home after the pandemic is declared;
- there is no statistically significant difference in answers of respondents of different age categories related to working from home before pandemic (Pearson Chi-Square test; $p = 0.702 > 0.05$); nor after the outbreak of a pandemic (Pearson Chi-Square test; $p = 0.858 > 0.05$);
- *there is a statistically significant difference in answers of respondents of different levels of education related to working from home before pandemic* (Pearson Chi-Square test; $p = 0.015 < 0.05$); *and after a pandemic was declared* (Pearson Chi-Square test; $p = 0.00 < 0.05$); *the higher the level of education, the higher the percentage of respondents*

who worked from home before pandemic, and after the outbreak of pandemic.

Table 1. *Distribution of respondents by sector in which they are employed and in relation to working from home*

Sector	Do you work from home?		Did you work from home before COVID-19?		
	No	Yes	No	Yes	Occasionally
Private sector	42%	58%	44%	30%	26%
Public sector	39%	61%	56%	35%	9%
Owners of organizations	40%	60%	25%	30%	45%

Source: Authors

There is a statistically significant difference in answers of the respondents related to the sector in which they work and working from home (Pearson Chi-Square test, $p = 0.002 < 0.05$). Whether working in the private or public sector, at the time of the survey, a higher percentage of employees worked from home compared to office work, in an approximate percentage: 58% of employees in the private sector, 61% of employees in the public sector. Owners of organizations were also among respondents and working from home is more prevalent; 60% of the owners worked from home and 40% from their workplace (Table 1).

Also, there is a statistically significant difference in answers of the respondents in relation to the sector in which they work and work from home before pandemic (Pearson Chi-Square test, $p = 0.001 < 0.05$). According to Table 1, before the outbreak of pandemic, the largest percentage of employees did not work from home, both from private (44% did not work from home, 30% worked from home before pandemic, and 26% occasionally worked from home before pandemic), and from public sector (56% did not work from home, 35% worked from home, and 9% occasionally worked from home before the outbreak of pandemic). Before outbreak of the COVID-19 virus, the largest percentage of business owners occasionally worked from home (45%), a slightly smaller percentage worked from home (30%), and only 25% did not work from home. The percentage of employees working from home after outbreak of the pandemic has generally doubled compared to the percentage before the beginning of pandemic, when employees by sectors are observed, but also the owners of organizations.

Table 2. *Distribution of respondents related to working from home after the outbreak of pandemic and their habits*

		Do you think that some acquired habits will remain after pandemic?		Did you increase share of e-commerce / online ordering in your spending since pandemic was declared?	
		No	Yes	No	Yes
If you stated that you are employed, do you work from home?	No	32%	68%	79%	21%
	Yes	18%	82%	62%	38%

Source: Authors

According to Table 2, a large percentage of the employees who work from home (82% of them) believe that the acquired habits will be retained after a pandemic. Those who work from home (meaning those who worked from home before pandemic, but also those who started working from home with the outbreak of pandemic increased the share of online ordering of products after the declaration of pandemic) in a higher percentage (almost twice as high compared to those who do not work from home, 38% of them). And even 79% of those who do not work from home believe that they have not increased the share of e-commerce.

Table 3. *Distribution of respondents related to working from home before pandemic and their habits*

		Do you think that some acquired habits will remain after pandemic?		Did you increase share of e-commerce / online ordering in your spending since pandemic was declared?	
		No	Yes	No	Yes
Did you work from home even before appearance of the COVID-19 virus?	No	19%	81%	61%	39%
	Yes	16%	84%	63%	37%
	Occasionally	21%	79%	66%	34%

Source: Authors

Regardless of whether they worked from home before pandemic or not, a higher percentage of respondents (about 80%) believe that some acquired habits will remain after pandemic, as well as that they have increased online ordering of products since pandemic was declared, which is pointed out on average by about 37% of respondents (Table 3). It is also noticed that it is the largest percentage of employees (39%) who did not work from home before pandemic and who accepted the new working conditions, and thus as consumers increased online ordering in a higher percentage compared to those who worked before pandemic from home (permanently or occasionally).

There is no statistically significant difference in answers of the respondents related to *working from home* and the *following variables*:

- concerns which were examined: possibility to travel (Pearson Chi-Square test, $p = 0.05$), negative impact of pandemic on salary amount (Pearson Chi-Square test, $p = 0.128 > 0.05$), availability of groceries/medicine (Pearson Chi-Square test, $p = 0.221 > 0.05$);
- impact of pandemic on consumption (Pearson Chi-Square test, $p = 0.101 > 0.05$) according to the respondents;
- certain habits since declaration of the pandemic: delivery of perishable food from small and individual producers (Pearson Chi-Square test, $p = 0.188 > 0.05$).

There is a statistically significant difference in answers of the respondents relates to *working from home* and the *following variables*:

- concern regarding: the negative impact of COVID-19 on financial stability (Pearson Chi-Square test, $p = 0.025 < 0.05$), reduced opportunities for work (Pearson Chi-Square test, $p = 0.001 < 0.05$), less job security (Pearson Chi-Square test, $p = 0.008 < 0.05$), spending money compared to previous habits (Pearson Chi-Square test, $p = 0.009 < 0.05$), reducing costs to preserve personal finances (Pearson Chi - Square test, $p = 0.013 < 0.05$);
- the impact of the pandemic on household income (Pearson Chi-Square test, $p = 0.00 < 0.05$) and on savings (Pearson Chi-Square test, $p = 0.002 < 0.05$) according to the respondents;
- certain habits since declaration of the pandemic: payment of household bills over the Internet (Pearson Chi-Square test, $p = 0.00 < 0.05$), ordering food delivery (Pearson Chi-Square test, $p = 0.00 < 0.05$), ordering fast food delivery (Pearson Chi-Square test, $p = 0.021 < 0.05$). A large percentage of respondents (88%) paid for digital services even before pandemic began, and only 12% of respondents started paying for digital services after pandemic was declared.

There is an increased level of concern among respondents who do not work from home (regarding negative impact of the virus on financial stability, then reduced

opportunities for work, poorer job security, spending money compared to previous habits and reducing costs to preserve personal finances), whose household incomes and savings are also noticeably more influenced by pandemic, in a negative sense. Those who work from home, paid their bills online in a higher percentage even before pandemic, but they also in a larger number started using this type of service after the outbreak of pandemic. The same is the case with ordering and delivering food and fast food.

When only those respondents who work from home are observed, there is no noticed statistically significant difference in answers of respondents related to *working from home before pandemic* and the *following variables*:

- concerns which are examined: possibility to travel (Pearson Chi-Square test, $p = 0.661 > 0.05$), negative impact of pandemic on salary amount (Pearson Chi-Square test, $p = 0.159 > 0.05$), availability of groceries/medicine (Pearson Chi-Square test, $p = 0.446 > 0.05$), negative impact of COVID-19 on financial stability (Pearson Chi-Square test, $p = 0.144 > 0.05$), reduced opportunities for work (Pearson Chi-Square test, $p = 0.499 > 0.05$), less job security (Pearson Chi-Square test, $p = 0.484 > 0.05$), spending money compared to previous habits (Pearson Chi-Square test, $p = 0.765 > 0.05$), cost reduction to preserve personal finances (Pearson Chi-Square test, $p = 0.462 > 0.05$);
- impact of pandemic on household income (Pearson Chi-Square test, $p = 0.721 > 0.05$), consumption (Pearson Chi-Square test, $p = 0.613 > 0.05$) and savings (Pearson Chi-Square test, $p = 0.947 > 0.05$) according to the respondents ;
- certain habits since declaration of the pandemic: payment of household bills over the Internet (Pearson Chi-Square test, $p = 0.490 > 0.05$), ordering food delivery (Pearson Chi-Square test, $p = 0.926 > 0.05$), delivery of perishable food from small and individual producers (Pearson Chi-Square test, $p = 0.936 > 0.05$), ordering fast food delivery (Pearson Chi-Square test, $p = 0.758 > 0.05$).

Table 4. *Distribution of respondents in related to working from home and fear of the possibility to lose a job*

		Are you afraid that you will lose your job in the coming period due to the COVID-19 pandemic?	
		No	Yes
If you stated that you are employed, do you work from home?	No	67%	33%
	Yes	75%	25%

Source: Authors

When observing the distribution of respondents according to whether they work from home and whether they are afraid that they will lose their jobs in the next period, there is no statistically significant difference in answers of respondents (Pearson Chi-Square test, $p = 0.078 > 0.05$), which means that the approximate level of fear is felt by all employees, regardless of whether they work from home or not (Table 4). About 24% of the total number of respondents feels fear due to the possibility of losing their job in the coming period.

Hypothesis H_1 was confirmed - the number of employees in Serbia who work from home after the declaration of a pandemic is twice as high as in the period before the pandemic. Increase in number of employees working from home is present in the private sector (30% of employees worked from home before pandemic, and 58% after outbreak of pandemic) and in the public sector (35% : 61%), as well as among owners of organizations (30% : 60%).

When comparing the results of empirical research from April this year, when the authors of this paper conducted research in Serbia and when the research was conducted in the USA, it can be seen that the percentages of employees who worked from home before pandemic (about 30% of employees) and after the beginning of pandemic (about 60% of employees) are very similar.

Hypothesis H_2 was confirmed, i.e. it has been proven that working from home, as a new way of working for some employees after declaration of a pandemic, affects creation of new habits of employees also as consumers. Even 39% of employees who did not work from home before pandemic, and who accepted the new conditions of work, increased, as consumers, the online ordering, and even in a higher percentage than those who worked from home regularly or occasionally even before pandemic.

Hypothesis H_3 was also confirmed, i.e. it was proven that employees who work from home order via the Internet in a higher percentage than those who do not work from home. Those who work from home increased the share of e-commerce products after declaration of pandemic in a higher percentage (almost twice as high compared to those who do not work in this way, 38% of them). And on the other hand, even 79% of those who do not work from home believe that they did not increase the share of online ordering.

Employees who do not work from home state an increased level of concern regarding the negative impact of the virus on financial stability, then reduced opportunities for work, poorer job security, then spending money compared to previous habits and reducing costs to preserve personal finances. With these employees it is noticeable a decrease in household income, as well as a decrease in savings. And where income declining is present, consumers are less willing to make riskier purchases, such as online purchase. Employees who work from

home paid bills online and ordered the delivery of food and fast food in a higher percentage even before the pandemic, but they also in greater numbers began to use the mentioned types of services after the outbreak of the pandemic.

Hypothesis H₄ is not accepted. The assumption was that greater concern for workplace is present among employees who do not have the ability to work from home, and research results proved that there is no statistically significant difference in answers of respondents according to working from home in relation to fear of losing their jobs in the following period (the level of fear that all employees feel is approximately the same, regardless of whether they work from home or not). Almost a quarter of respondents are worried about the future of their jobs.

CONCLUSION

COVID-19 represents a great economic burden, and one of the open questions is the proportion of the economic recession into which the world has entered. Since the beginning of pandemic, organizations have focused on reducing risks to the health and safety of employees and consumers, while taking into account the appropriate level of economic activity. Organizations face big challenges in introducing innovations to mitigate risks and overcome the crisis. And the goals of innovation in the work environment are what good companies have always wanted: a safe environment in which people can enjoy their work, collaborate with colleagues and achieve the goals of their organizations (Boland *et al.*, 2020).

Every organization and its culture are distinctive, just as the circumstances of each individual employee. While some enjoyed the new work experience, others could hardly wait to return to the offices. "Experimental" work from home has opened up some new options for many organizations, such as: access to new talents with fewer location constraints, adopting innovative processes to increase employees` productivity, creating an even stronger organizational culture, as well as significant reduction of costs of real estate in function of business premises. Various researches confirm that a significant number of employees enjoy working from home, that they feel less stressed, and that they are motivated and more productive.

The question is to what extent working from home will remain represented after pandemic - weather the working conditions in that sense be maintained even after pandemic, or it is just a temporary change. So, the role of the office is uncertain in the future and the question is whether the organizations will be able to function without physical interaction. As each organization is specific in its own way, there is no universal answer - a solution for all types and sizes of organizations. Even if this question is considered within the organization, the answer would depend on functions (sectors) within those organizations and

necessary conditions for efficient functioning of each part of the company and the entire organization. So, after pandemic, some organizations will consider the opportunity to improve working engagement through working from home, by which is reduced the time that employees spend on commuting, taking into account that a number of employees does not like it because it reduces their possibility to socially interact with colleagues or they do not have the conditions to work from home.

If the risk of infection continues significantly in the future, not only will there be a strong tendency to mitigate the risk of infection, but it can also lead to long-term changes in the behavior of consumers, employees and company leaders. This has significant implications, opportunities and challenges for innovators, technology users, as well as regulators and policy makers.

The trend of transition to digital business, greater interest in health, paying attention to companies that have the same priority, value orientation of consumers, existed before pandemic, but it caused a sharp acceleration of these trends, especially digitalization of business and health care. In the midst of the health crisis, the economic crisis is inevitable, so the trends regarding savings and reduction of consumption are evident in the world, and in Serbia, to a significant extent.

What today is "normal", it is changing rapidly. Organizations around the world are functioning in a new way where personal contact is not always necessary. Organizations which sooner and more actively adopt innovations and new logic/paradigms of business, will be the ones that are more successful. (Vlašić *et al.*, 2020)

The process of adoption of innovations by their users is just as important as innovations, i.e. the process of diffusion. The results of empirical research during the pandemic in Serbia show that the acceptance of innovations by users is a process faster than the one which happens in normal circumstances, when the crisis is not present, and that the number of consumers in the category of innovators is much higher. The number of employees working from home has increased in Serbia by almost 100% since the beginning of the pandemic, which at the same time implies the acceptance of a new way of working and accompanying programs in a very short period of time. Also, it has been proven that this way of working influences the creation of new habits of employees seen also as consumers - 39% of employees who did not work from home before the COVID-19 virus and who adopted innovations necessary for working from home, increased online ordering during the pandemic, even in a higher percentage in relation to those who worked permanently or occasionally from home even before the pandemic, as well as in relation to those who do not work from home.

The limitation of paper refers to its representativeness only for the online population in Serbia because the respondents are digitally literate and filled in the questionnaire in electronic form. The second limitation refers to the unequal distribution of respondents by gender, which entails the impossibility of showing statistically significant differences in relation to this characteristic of respondents.

It would be of importance to periodically survey the level of satisfaction of employees working from home, in terms of their productivity and impact on health, as well as to explore which consumer habits will remain after the current pandemic in order to better understand the innovated consumer behavior and to adequately plan and implement business and marketing strategies of organizations.

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The analysis of situational leadership models: origin, divergence and development

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Abstract: Organisations endeavour to confront and endure many challenges. Rapid and frequent changes characterise the modern business environment. The leader must determine the type of follower and adjust the leadership style he will use embracing differences in follower types, possibilities for changes, and situational factors. The purpose of this paper is to analyse the development and application of situational leadership model, to consider perspectives to reduce the gap in previous research and to elaborate terminological and other differences that exist in the literature. Effectiveness in situational leadership is not only based on setting a vision and achieving goals, but also on motivating and developing followers. There are certain ambiguities caused by terminological and other differences, which are diagnosed by an extensive review of the literature in the domain of situational leadership. The findings provide an opportunity to improve the situational leadership model further and can be useful to leadership researchers, members of top management and the general public.

Keywords: situational leadership, change management, development level, effective leader.

JEL: M12, O15, O30

1. INTRODUCTION

In recent decades, many changes have taken place that affects the business paradigms of organizations, which face numerous challenges (Aničić *et al.*, 2018; Vukotić & Vojnović, 2019). Rapid and frequent changes characterize the contemporary business environment, and Mirčetić *et al.* (2019a) conclude that modern living and business are influenced by globalisation. Jarrett (2008) argue that changes occur in various shapes, forms and intensity, and Hurn (2012) explain that a variety of changes in organizations in all industries caused by the contemporary business environment.

All organizations, regardless of the size, educational, age or gender structure of employees, the activity they are engaged in or whether they perform the same activity in one or more countries, have various challenges within their business.

Čudanov *et al.* (2019) point out that progression of change dynamics is often generated due to digital and innovation disruption, changing social and demographic trends, evolving knowledge-based economy and knowledge workforce development and global economic integration and liberalization. Business organizations strive for the most efficient and effective accomplishment of goals, which causes the need for successful leaders. Vukotić and Mirčetić (2020, p. 481) point out that "effective leadership is one of the preconditions to effective organizations". In theory, the nature of leadership is to encourage, guide and motivate subordinates to achieve previously set tasks and goals (Jaško *et al.*, 2013). Leadership is an important factor of any successful organization (Vujić *et al.*, 2018). One of the core abilities that top management and leaders should embrace is managing global organizations, which is an additional, higher requirement (Cvijanović *et al.*, 2016, p. 204).

Many scholars analysed interdependency between an organization's effectiveness and changes. Brisson-Banks (2010) recognize that essential determinant of an organization's effectiveness is the ability to adapt to the change, while other authors (By, 2005; Čudanov *et al.*, 2012; Cameron & Green, 2015; Jeraj *et al.*, 2015; Al-Haddad & Kotnour, 2015) emphasize that successful change management is a pattern for organizational durability and long-term sustainability. Uncertainty and complexity are characteristic for consistent organizational development and growth requirement, additionally grown by disruptive innovations, the need for acceleration of various types of projects and changes (Tornjanski *et al.*, 2020). Čudanov *et al.* (2019) conclude that managing complexities and uncertainties of the change process impose an increasing necessity for development and adoption of appropriate quantitative approaches and tools in change management procedures to produce successful change outcome.

A modern leader should direct his/her behaviour towards followers in an adapted style that motivates and develops followers and embrace all possibilities of change occurrence. One of the events that could occur and have severe consequences is called "The Black Swan", and it represents a historical economic, technological, personal event that is unexpected, and has a remarkably rare probability of occurrence (Taleb, 2007). Ross (2019) and Dunbar (2019) consider that, in probabilistic terms, this event is often quite impossible to estimate because it is an event with a very low probability of happening. Some authors (Wood & Bandura, 1989; Tornjanski *et al.*, 2014) point out that there is a growing necessity for the synthesis of adequate tools and software packages that include external and internal factors, possible options regarding the managing change process to add value on final change expectations. One of the leadership approaches that embraces adaption and adjustment of leadership style to the situational factors is situational leadership.

After the introduction, the article determines the concept of leadership, underlying the existence of a large number of different definitions of leadership. Next segment of the paper analyses theories of leadership that influenced the creation of the situational leadership model. Consistent with the originators of this model, Hersey and Blanchard, the next chapter deals with the specificities of the situational leadership and original situational leadership model. The following chapter explored terminological and other differences that arose later, as well as later established Blanchard's situational leadership model and Hersey's situational leadership model. The penultimate chapter discusses revalidating the theory and proposals for the implementation of the situational leadership model in practice, underlines limitations of the paper and offers suggestions for later research. The last segment of the article consists of the conclusions of the work, and that is that the effective application of the situational leadership model represents the implementation of an appropriate leadership style depending on the type of followers and situational factors.

The paper is intended for the interested professional and scientific public whose subject of interest is leadership or especially the model of situational leadership, development and its application in practice.

2. EXPLORING THE PROCESS OF LEADERSHIP

2.1. Defining leadership

Leadership is a complex, multidimensional process (Cvijanović *et al.*, 2018) that has existed since ancient times. Grint (2011) states that, for leadership researchers, the beginning of leadership is linked to the beginning of recorded history, and not to the emergence of Homo Sapiens. Bolden (2004) points out that theories simplify and sublimate a large amount of data, which helps shape the way the environment is understood.

Numerous theories and approaches to leadership can be found, which authors define differently. Over more than a century of leadership research (Avolio *et al.*, 2009), numerous authors have analyzed and determined leadership (Northouse, 2014), but there is still no single definition of leadership. Some scholars (Stogdill, 1974; Bolden, 2004) point out that there are as many definitions of leadership as there are authors who have dealt with leadership.

The research conducted by Rost (1991) provided insight into approaches to leadership in the period from 1900 to 1990. The subject of the research was the analysis of more than two hundred definitions of leadership that emerged in that period. Fleischman *et al.* (1991) estimated that there were sixty-five classification methods for analysing leadership.

Certain specifics characterizes approaches and theories, but there are also common characteristics. Sinha (1980, p. 1) underline that an early research on leadership was often directed towards physical and constitutional factors. A comparative analysis of leadership research can lead to the conclusion that there are different theoretical approaches to leadership (Bass, 1990; Gardner, 1990; Rost, 1991; Bryman, 1992; Mumford, 2006; Hickman, 2009; Bryman *et al.*, 2011; Day & Antonakis, 2012).

Within theories and approaches to leadership, some focus on the development of leadership experience and different perspectives on the roles of leadership identity (Shamir & Eilam, 2005; Lord & Hall, 2005; Komives *et al.*, 2005, 2006; Day & Harrison, 2007; Day *et al.*, 2009), but also those who put the development of adaptive leadership capacities in teams in the focus of research (Day *et al.*, 2004; Kozlowski *et al.*, 2009).

Northouse (2018) points out that there are four crucial segments of leadership: group, process, impact, and a common goal. Leaders and followers form an interdependent group which implies that leaders need followers, and followers need leaders (Burns, 1978; Jago, 1982; Heller & Van Til, 1983; Hollander, 1992). A leader does not exist without a follower (Vroom & Jago, 2007), and leadership does not exist without a leader or a follower (Mirčetić, 2018a; Vujić *et al.*, 2019). Therefore, leadership exists exclusively within a group consisting of a leader and followers. Leadership is an ongoing relationship; the interaction between an individual and a group of individuals, followers, leadership is considered a process. A necessary segment of leadership is the existence of a goal that must be common to the group or perceives by the group as mutual (Mirčetić, 2018b).

2.2. Leadership in the situational context

The influence of the leader is twofold. Primarily, the leader directly influences the followers, and then together with the followers, they influence the realization of the goal.

Regarding the before-mentioned four segments of leadership, leadership is defined as a process that represents an interdependent ongoing relationship within a group, between leaders and followers, which aims to influence leaders on followers or jointly influence the group to undertake some doing or performing an action in order to achieve a specific goal that the group perceives as common (Mirčetić *et al.*, 2019b, p. 152).

Leadership in a situational context is considered to be the effective determination of the type of follower and adjustment and using the adequate leadership style concerning the type of follower and situational factors.

One of the indicators of effective leadership is diagnosing the developmental level of the follower and comprehending leadership styles that the leader can use depending on situational factors. Effective leaders do not apply unified leadership style in all situations, yet they adapt their leadership style to situational factors and followers. The way they will adapt to their followers depends on their leadership style (Day & Antonakis, 2012).

Choosing an adequate leadership style has multiple positive effects, the organization will more effectively realize the set goal and be superior to competitors, and followers will be more motivated and competent. Superiority related to competitors is reflected in the fact that leaders create new followers, but also new leaders (Cvijanović *et al*, 2017).

3. SITUATIONAL LEADERSHIP

3.1. The roots of the situational leadership

Leadership theories in which the leader adapts to situational factors and adjusts to a particular situation can be subsumed under contingent theories of leadership. The originator of contingent leadership theory is Fred Fielder, who developed this theory based on analyzing the effectiveness of hundreds of leaders and their styles depending on the situations in which they found themselves (Fielder, 1964, 1967, 1972, 1978).

This research aims to determine which leadership style is the most effective and which is the most inefficient concerning a specific situation. In his Leadership Contingency Model, Fielder (1967) recommended that three significant situational variables determine whether a given situation is good for the leader or not. A personal relationship with group members (leader-member relationship), the degree of complexity of the task to be completed (task structure) and the power and authority that their position brings (position power).

It is interesting to mention that Stogdill (1948) was among the first to say that an adequate analysis of leadership requires research not only of leaders but also of situations. Paul Hersey and Kenneth Blanchard are of great importance in setting up and developing situational leadership models. Toppins (1983, p. 533) highlights 1969 as a "birth of the theory that developed when the authors synthesized behavioural science concepts and applied them to leadership". They published several papers together, and one of the first theories they set up that influenced the further development of the situational leadership model is the leadership life cycle theory (Hersey & Blanchard, 1969).

The origin of this leadership theory name is exciting because it arose from the need to change parental leadership style towards children, how children grow through adolescence to adulthood. This theory emerged as an upgrade of the 3-D

theory of management style (Reddin, 1967), whose early formulation was published by the same author three years earlier (Reddin, 1964). Reddin used Fielder's situational approach, while the basis for the development of 3-D management style theory was a management network designed by Blake *et al.* (1962), which was developed and improved in the following period and with the help of research Blake & Mouton, 1964, 1978, 1980, 1985; Blake & McCauley, 1991; Mirčetić, 2019).

Leadership life cycle theory has been further developed into situational leadership theory (Hersey & Blanchard, 1977), while Paul Hersey points out that it is not a theory but a model, because it can be isolated, replicated and used in different situations (Blackwell & Gibson, 1999, p. 143).

Various researchers have influenced research conducted by Hersey and Blanchard, and studies conducted by Lewin *et al.* (1960) are considered the first important leadership studies (Blanchard *et al.*, 1993). Tannenbaum and Schmidt (1958) also influenced their research.

3.2. Specificities of the situational leadership model

The situational leadership model encompasses four leadership styles and four levels of follower development level and is based on their correlation (Northouse, 2018). Depending on the competencies, which are considered to be broader than the skills (Torrington *et al.*, 2004, p. 420), but also the commitment and motivation (Mirčetić & Vukotić, 2017), there are different development levels of followers.

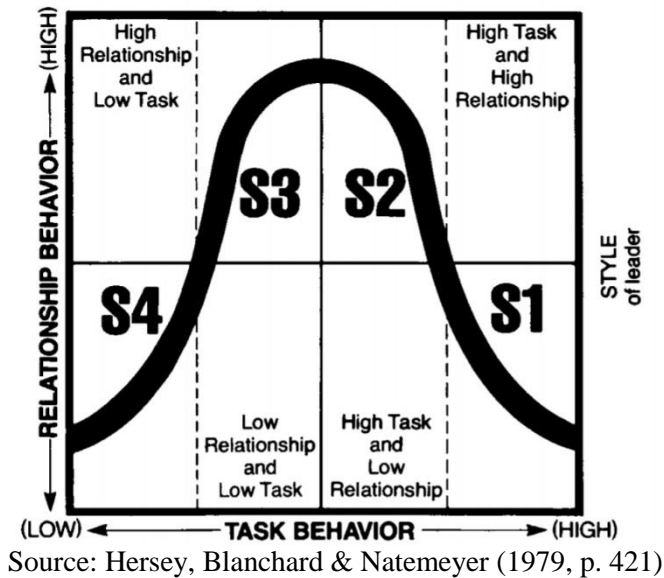
There are certain terminological differences in the literature regarding the designation of leadership style within the model of situational leadership, as well as maturity, i.e. the development level of followers.

Having in mind the genesis of the situational leadership model and all the events that influenced the appearance of new terminological expressions and colour differences in the graphical representations of the model, the question arises whether the differences between original and revised situational leadership are aesthetic or essential.

Within the situational leadership model, there are four leadership styles, and each of the styles represents a combination of task-oriented behaviours and relationship-oriented behaviours.

When introducing the situational leadership model (Hersey & Blanchard, 1977), as shown in Figure 1, the term used to represent the level of development of followers was "maturity" and was denoted by M.

Figure 1. Situational Leadership Model



The maturity of followers determines which leadership style will have the most excellent chance of success. It also determines the sources of power that the leader should use (Figure 2).

Figure 2. Influence of power sources at different levels of maturity



Follower maturity is shown through gradation, so M1 indicates low maturity level, M2 low to moderate, M3 moderate to high, and M4 high follower maturity level. Adequate leadership style for each level of maturity represents the appropriate combination of guidance and support. In later works, the term "maturity" was called "readiness" (Hersey & Blanchard, 1988), and Blanchard (1985a, 1985b, 1985c) replaced these two terms with the development level.

When followers are new to a specific task or organization, their maturity level is low. They need clear, specific directions and supervision. This leadership style emphasizes directive behaviour, and it is called "Telling". Telling includes high task behaviour and low relationship behaviour. Followers who lack the knowledge and therefore are unable to take responsibility need directive behaviour, despite their willingness. Their maturity level is low to moderate. This leadership style is named "Selling", and it includes mutual communication between leader and followers. Selling represents a high task and high relationship behaviour.

When followers spend some time on a particular task, they acquire knowledge regarding that activity, and their maturity level is moderate to high, but they still lack self-confidence or enthusiasm. The leader needs to facilitate and maintain two-way communication to support the followers' ability. Participating includes high relationship behaviour and low task behaviour. Highly matured followers have both ability and motivation; therefore, the leader should provide them with some direction or support. This leadership style is called "Delegating". Followers are individual and permitted to determine how, when, and where to perform. Delegating is compounded of low relationship behaviour and low task behaviour.

Hersey *et al.* (1979) describe task-oriented behaviour as a leader's guideline for telling people what, when, where, and how to perform a particular activity, that is, the leader is the one who sets tasks and defines roles.

According to the same authors, relationship-oriented behaviour is two-way communication and involves listening to and supporting leaders.

4. DIVERGENCE OF THE SITUATIONAL LEADERSHIP

For the development of situational leadership theory, it is important to mention that the cooperation between Hersey and Blanchard lasted until the late 1970s when inevitable disagreements arose regarding the need to improve the theory (Blanchard *et al.*, 1993). After the discontinuation of their collaboration, Kenneth Blanchard together with his wife Margie Blanchard formed Blanchard Training and Development, and continued to develop situational leadership model. Paul Hersey also went from academic to the commercial exploring of leadership and founded The Center for Leadership Studies, where he continued to develop his version of the situational leadership model. In one of the interviews (Blackwell & Gibson, 1999, p. 146), Hersey pointed out that he is "making a greater impact than if he had just stayed in the academic world because of the leveraged effect".

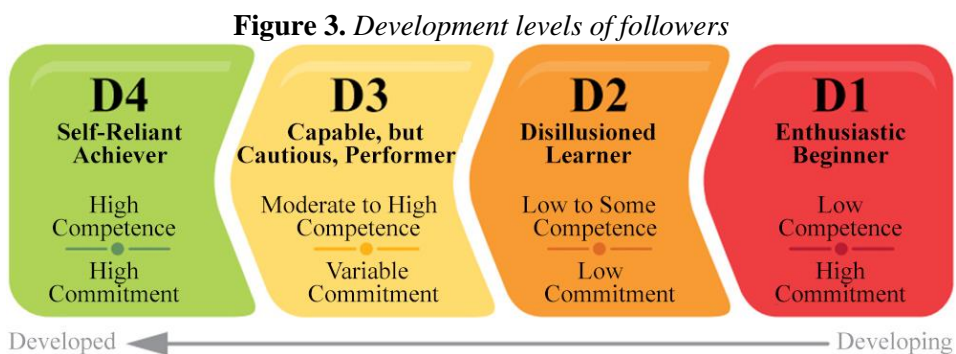
4.1. Blanchard's situational leadership model

Graeff (1983) elaborated certain shortcomings when it comes to the LEAD instrument used in the original model, and Blanchard *et al.* (1982) formed a new instrument called Leader Behavior Analysis (LBA). Shortly afterwards, Blanchard (1985a, 1985b, 1985c) also published three articles in which he presented a revised version of situational leadership, which he called Situational Leadership II. In the same year, Blanchard *et al.* (1985) presented their version of revised situational leadership in a book. Blanchard *et al.* (1993, p. 34) pointed out that, in order to clearly understand research trends related to the situational leadership model, it is necessary to understand that both the model and instrumentation have changed and that there is a distinction between situational leadership model and situational leadership II.

Follower maturity or readiness in this model is named The development level of the follower, and it represents a combination of two factors - competence and commitment.

Competence is proven knowledge and skills related to a goal or task, and commitment is motivation and belief in a particular goal or task. The development level of a follower does not represent an overall assessment of an individual's skills or attitudes but is goal-oriented or task-oriented. In accordance, there are four levels of follower development (Figure 4): (1) Enthusiastic Beginner; (2) Disillusioned Learner; (3) Capable, but Cautious, Performer; and (4) Self-Reliant Achiever.

Development levels of followers with the level of combination of competence and commitment are graphically presented in Figure 3.



Source: Blanchard (2020, p. 10)

As shown in the previous Figure, every type of follower represents a specific mixture of competence and commitment, and diverse development level descriptors can be used to define them (Table 1).

Table 1. Development Level Descriptors

D4	D3	D2	D1
<ul style="list-style-type: none"> • Confident • Consistently competent • Inspired/inspires • Expert • Autonomous • Self-assured • Accomplished • Self-reliant 	<ul style="list-style-type: none"> • Self-critical • Cautious • Doubtful • Capable • Contributing • Insecure • Tentative/unsure • Bored/apathetic 	<ul style="list-style-type: none"> • Overwhelmed • Confused • Demotivated • Demoralized • Frustrated • Disillusioned • Discouraged • Flashes of competence 	<ul style="list-style-type: none"> • Hopeful • Inexperienced • Curious • New/unskilled • Optimistic • Excited • Eager • Enthusiastic

Source: Blanchard (2000, p. 3)

As mentioned before, styles within situational leadership are Telling, Selling, Participating, and Delegating. Blanchard uses a different terminology within the revised situational leadership model and uses custom expressions for leadership styles within situational leadership as well as for follower types.

Blanchard (2000) states that there are two basic leadership styles: commanding behaviour and supportive behaviour, and by combining these two behaviours, four basic leadership styles are obtained (Figure 4): (1) Directing – S1; (2) Coaching – S2; (3) Supporting – S3; and (4) Delegating – S4.

Figure 4. Blanchard's situational leadership styles



Source: Blanchard (2020, p. 12)

The goal of situational leadership is to estimate the maturity level of the follower accurately and to shape leadership behaviour properly. A leader should use the

appropriate leadership style and adapt it as the follower matures. Every one of four leadership behaviours can be described as shown in Table 2.

Table 2. Leadership Style Descriptors

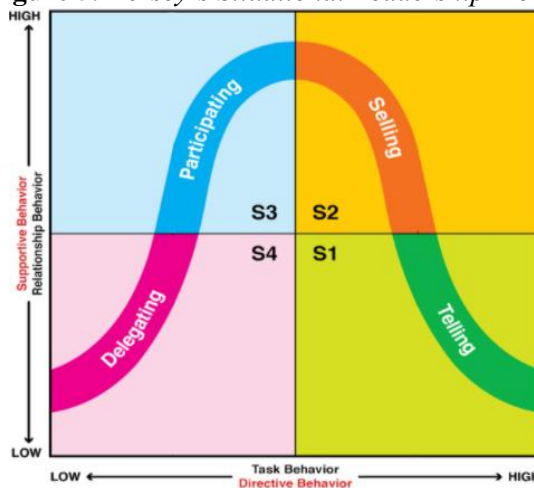
S4	S3	S2	S1
<ul style="list-style-type: none"> • Allowing /trusting • Confirming • Empowering • Affirming • Acknowledging • Challenging 	<ul style="list-style-type: none"> • Asking /listening • Reassuring • Facilitating self-reliant problem solving • Collaborating • Encouraging feedback • Appreciating • Exploring /asking 	<ul style="list-style-type: none"> • Explaining /clarifying • Redirecting • Sharing feedback • Encouraging • Praising • Defining 	<ul style="list-style-type: none"> • Planning /prioritizing • Orienting • Teaching /showing and telling how • Checking /monitoring • Giving feedback

Source: Blanchard (2000, p. 5)

4.2. Hersey's situational leadership model

After Blanchard and Hersey started to develop and practice situational leadership individually, original situational leadership model started to change. Because of the commercial purpose of the model, it had to be more appealing to the broad and general public, so similarly to the Blanchard's model, Hersey (Situational Leadership, 2017) kept some previous terminology, but chose the different colour theme (Figure 5).

Figure 5. Hersey's Situational Leadership Model



Source: Leadership Studies (2017, p. 3)

As it can be observed in the previous Figure, the model consists of four leadership styles that represent a mixture of the behaviour intensity regarding task and relationship: (1) Telling – S1; (2) Selling – S2; (3) Participating – S3; and (4) Delegating – S4.

Relationship behaviour is a supportive behaviour, and it represents two-way communication between the leader and followers, where the leader promotes cooperation and actively listens. Telling and delegating are styles that represent a low supportive level of behaviour, and selling and participating are highly supportive behaviours.

Task behaviour is a directive behaviour, and it represents engaging of the leader in determining roles, structuring activity and giving clear goals and directions for a particular task. Participating and delegating represents low directive behaviours, while telling and selling are highly directive behaviours.

Style 1 is named Telling, but also can be called directing or guiding. This style is "leader driven" and intends to create movement. The leader, using moderate to high amounts of task behavior and moderate to low amounts of relationship behavior, makes decisions, give directions and produce movement, based on his/her experience. Communication is directed from the leader to followers, and the leader should guide followers and provide close supervision to accelerate their development.

Style 2 is referred to as Selling but also can be termed coaching or explaining. This style is "leader driven" and intends to create buy-in and understanding. To ensure understanding, the leader needs to clarify goals and decisions, and a leadership approach that he is using is high on both task and relationship behavior.

Style 3 is entitled Participating, but also can be called facilitating, collaborating or involving. This style fundamentally differs from the previous two styles because it is a "follower driven" style with the intention to create alignment. The leader is using an approach that is high on relationship behavior but low on task behavior, to engage collaboratively and brainstorms options with followers.

Style 4 is labelled Delegating, but also can be termed empowering, monitoring or entrusting. This "follower-driven" style intends to create or enhance task mastery and followers' autonomy. Followers have a fair amount of experience or knowledge and are confident and motivated to perform tasks, and the leader is confident they will deliver at an acceptable level. The leader shows low amounts of both task and relationship behavior.

In his model, Hersey does not use terminological terms for labelling followers. Instead of maturity or readiness, Hersey introduces Performance Readiness, and it is a trademark of Leadership Studies, Inc. Graphical representation of performance readiness is shown in Figure 6.

Figure 6. Hersey's Performance Readiness

HIGH	MODERATE		LOW
R4	R3	R2	R1
Able and Confident and Willing	Able but Insecure or Unwilling	Unable but Confident or Willing	Unable and Insecure or Unwilling
	←		←
	→		→
Self Directed		Leader Directed	

Source: Leadership Studies (2017, p. 3)

As it can be observed in the previous Figure, four different readiness levels differ by the amount of followers' performance readiness. Readiness Level 1 or R1 describes followers who are inefficient; they are unable and insecure or unmotivated to perform their assignment at a satisfactory level. Readiness Level 2 or R2 symbolises the presence of followers' confidence and motivation to deliver the task at an acceptable level, but they are still unable to do it. Readiness Level 3 or R3 represents the readiness level of followers who can perform a specific task, but they lack confidence, commitment or motivation. Readiness Level 4 or R4 is characteristic for followers who are competent, confident and motivated to perform at an adequate level.

5. (RE)VALIDATING OF SITUATIONAL LEADERSHIP

Many authors conducted studies with the purpose of (re)validating the situational leadership (Hambleton & Gumpert, 1982; Graeff, 1983; Goodson *et al*, 1989; Blank *et al*, 1990; Johansen, 1990; Norris & Vecchio, 1992; McLaurin, 2006). Graeff (1983) and Goodson *et al*. (1989) did not find empirical support for the prescriptions of situational leadership, while some scholars (Blank *et al*, 1990; Norris & Vecchio, 1992; McLaurin, 2006) found little or partial empirical support. Empirical support to the theory is founded by Humbleton and Gumpert (1982, p. 240) and they concluded that "there is a definite and significant relationship between leadership style of a manager in a particular situation and manager's perception of subordinate job performance". Hambleton & Gumpert (1982) and Vecchio (1987) published tests that have shown combined support and have various methodological limitations.

Situational leadership theory is tested and validated in Asian countries as well, (Lin, 1999; Silverthorne, 2000; Yoshioka, 2006). Silverthorne (2000, p. 73) point out that "superiors, peers and subordinates are good at identifying adaptable leaders and that adaptability is a positive variable in leadership

effectiveness". Yoshioka (2006) compared Japanese and American employees and indicated that the Japanese prefer stronger relationships between leaders and members. The results of the research exhibited support for the situational leadership model because there is not only one leadership style works for all followers, and a leader needs to change and adapt his/her leadership style according to the followers.

Reconsiderations and re(validation) of situational leadership theory, as stated, have gone through numerous attempts at testing and empirical verification by different scholars. Furthermore, it could be concluded that two polarities in the application of situational leadership theory essentially exist. On the one hand, from complete failure to find empirical support to little or partial support, which is not always grounded in methodology. On the other hand, some authors found empirical support of this theory in practice in Asian and Japanese management has a much greater application and adaptability to situations than is the case in American management. Insisting on stronger relations between leaders and followers is characteristic of Japan.

5.1. Limitations and recommendations for the future research

The paper is limited in some regards, which should be discussed in future analysis. Despite the exhaustive analysis of the literature, there is certainly more research, consideration and testing of situational leadership models in practice, so there is a possibility that there are unexplored areas that directly or indirectly relate to situational leadership.

Recommendations of this article should help both academics and practitioners to present them guidelines on what can they do to breach limitations and increase the impact of this article. Various scholars analysed, explored and tested situational leadership and the ways of research are open. There is a still room for further development of the situational leadership model and explore new types of followers, such as unmotivated, inefficient, unexperienced follower with no adequate knowledge.

CONCLUSION

The performance of the organization, and especially the management of human resources, depends on the efficiency and success of the staff, particularly the managers. Organizations today operate in a business environment whose changes are influenced by numerous factors. Globalization, technical and technological innovation are just some of the factors that create additional challenges for business organizations. Leaders are those who are necessary for organizations in the realization of given activities and goals. Current business conditions have imposed new ways of managing, according to which not every employee should be treated in the same way.

The tasks of a modern leader are also to diagnose the type of follower and to adapt the behaviour and leadership style about the follower and situational factors. In theory, this type of leadership is called a situational leadership model. There are different follower types depending on their competencies and motivation. Authors use different terminology to determine the same condition or action. Depending on the type of follower, the leader will choose his leadership style, and accordingly will order, teach, support the follower or delegate specific tasks to him/her, by the competencies and motivation of the follower, convinced that the task would be accomplished. If human resources are neglected, or the leadership style is not adapted accordingly, followers will not fulfil their potential, and therefore the performance of the organization will not be at the required level.

Regardless of terminological and other differences, there is a justified need for leaders who practice a situational leadership model. Effective application of the situational leadership model represents the implementation of an appropriate leadership style depending on the type of followers and situational factors. A leader who applies this model can determine the type of follower and use the appropriate style of situational leadership. In this way, the followers will develop, and at the same time, they will be motivated and efficient, which will lead to the organization achieving better business results and realizing its goals.

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Millennials' attitude towards gamification in working conditions

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Abstract: Given that the millennial generation will dominate the labour market in a few years, the focus of this research is on the attitudes and needs of those generations. As the mechanism of gamification is based on psychological needs, the aim of this paper is to examine millennials' attitude towards gamification in working conditions and whether millennials are more oriented to meet different internal needs. The empirical research was conducted in July-August 2020. using a survey method on a sample of 207 employees from various organizations from the territory of Belgrade and Novi Sad. Assumption H1 was tested by the cross-tabulation method, while the H2 assay was tested by the Kruskal-Wallis test. The results of the research indicate that millennials are more in agreement with the application of gamification in working conditions, comparing with the other age groups, and them being more oriented towards satisfying various internal needs.

Keywords: gamification, working conditions, needs, motivation, millennials.

JEL classification: M12, M54

1. INTRODUCTION

Working environment is constantly changing. The causes are economic, technological, political and economic changes. Therefore, organizations are more oriented towards hiring workforce that could respond to the challenges of modern business (Kirin *et al.*, 2014), since the key success factors of any organization is the people, their potential and results. For example, in operations, equipment is the unit of production capacity, while in research and development (R&D), the unit of production capacity are people (Tadić *et al.*, 2020). In this regard, the question that attracts the most attention in the professional public and business practice is how to initiate and direct the activity of employees in the direction of achieving the organizational goals. According to Tadić *et al.* (2019, p. 414) "high levels of employee engagement promote retention of talent, foster a sense of belonging, improve organizational performance and increase the

stakeholder ”. So, engaged employee presents a powerful source of competitive advantage.

The diversity of employee needs requires the application of different motivational methods and techniques. For that reason, it is necessary for managers to know the needs of each employee, as well as the differences among them, in order to manage the qualities of employees being more productive. If diversification is approached properly in this way, productivity and overall employee effectiveness can be increased. Conversely, if poorly managed, business effectiveness can be diminished (Janovac, 2020, p.163).

Many factors testify to the factors influencing external motivation (Ali *et al.*, 2013; Achie & Kurah, 2016; Chiu *et al.*, 2002; Doloi, 2007; Haenich, 2012; Jaaskelainen, 2010; Manzoor, 2012; Perry & Porter, 1982; Purwanti & Sitorus, 2018), however, there is insufficient research aimed at meeting internal needs, and initiating intrinsic motivation, which is the main motive of the authors of this paper to examine the internal needs of employees and to apply adequate motivation tool.

Otherwise, the problem faced by managers in practice, regardless of the activities of the organization, is the "periodic" loss of motivation among employees. There are several reasons for the low level of motivation among employees. First of all, the reason may be focused on the application of inadequate methods and techniques of employee motivation. The problem can also refer to the resistance of employees who often do not believe in the system of incentive rewards, in its objectivity and fairness. The essence of the problem is focused on the existing motivational systems that are not flexible enough and adaptable to the requirements of the business environment and the labour market. The development and introduction of a motivational system depends on the analysis of internal factors (such as the analysis of existing jobs and the analysis of employees' potentials, their needs and competencies) and the analysis of external factors (such as political, economic, technological, demographic factors, analysis of market competition and analysis of the structure of the labour force in the labor market). When it comes to the analysis of labour force structures on the labour market, it is estimated that in the next few years there will be a change of generations and that the "millennium generation" will dominate the labour market. It is estimated that these generations will by 2025. make up as much as 75% of the workforce anywhere in the world (Meister, 2015). Since these generations will dominate the labour market in the coming period, the basis for the analysis of the problem is justified. It follows that work organization and the motivation system should be adjusted to the needs and requirements of the "younger generations".

Namely, many researches indicate that generations born at the end of the last and the beginning of the new century are not motivated so much by material incentives, as by new challenges. Given that “millennial generations” have grown up with new technologies, new techniques need to be explored because existing methods and motivational techniques cannot achieve the appropriate effect when it comes to employ performance and achievement (Perryer *et al.*, 2016). The results of the conducted research indicate that minor changes in business processes, which introduce game-based elements, can lead to a significant improvement in employee engagement and contribution (Oravec, 2015). In this regard, the solution being imposed in this case is motivation technique application based on the game, ie the gamified method.

Bearing in mind that the concept of gamification is still not applied in the working process in organizations on the territory of the Republic of Serbia, the main goal of this paper was to examine the attitudes of different organizations’ employees from Belgrade and Novi Sad on the application of this concept in working conditions and to examine the psychological needs driving intrinsic motivation, on which the gamification mechanism is based. Since the millennial generation will dominate the labour market in a couple of years, the focus of this research is on the attitudes and needs of those generations.

2. LITERATURE REVIEW

Motivation is the process of initiating and directing human behavior in a certain direction, towards achieving a goal. It is a complex psychological process of inner feeling or stimulation (Meyer *et al.*, 2004). It can be internal (IM) or external (EM).

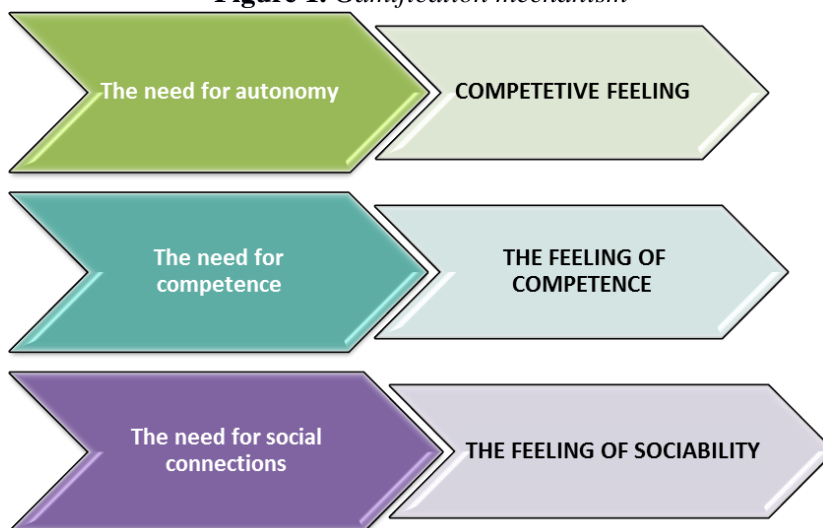
Intra- or intrinsic motivation (IM) refers to motivation that has its source in the person himself and drives him to activity. This includes meeting psychological needs such as the need for self-actualization, the need to achieve personal goals, the need for challenges, the need to acquire knowledge and skills, the need for recognition from others, the need to socialize, the need to help others, the need to compete with others, the need to prove competencies and knowledge.

In extrinsic or external motivation (EM), external stimuli (rewards, punishments or social pressure) activate human activity. According to Charms (1968), external motivation (EM) has a weaker effect than internal motivation (IM) (Ryan & Deci, 2000).

Psychologists Edward Deci and Richard Ryan (1985) developed a theory of motivation, which they called the Theory of Self-Determination (SDT). According to the Theory of Self-Determination (SDT), people tend to be motivated by the need to grow or progress and achieve. In other words, in order for people to be motivated to perform, three types of psychological needs to be

met, such as the need for autonomy, competence, and the need to connect. The need for autonomy is defined as a strong need for a person to be the initiator of his actions and to act in accordance with his will, to have control over his own behavior and focus on personal goals. The need for competence is the need of a person to be effective in relation to the environment, as well as to prove their knowledge and skills, to acquire new knowledge and skills, while the need for connection with others is manifested in the natural tendency of a person to interact with other people, to be attached to other people (Slijepčević, 2018).

Figure 1. *Gamification mechanism*



Source: Author's review

Precisely, gamification is based on the principle of the Theory of Self-Determination (SDT). That is, gamification in the working environment can serve as a tool of motivation, because mechanism of gamification is based on three universal psychological needs such as: the need for autonomy, the need to create social connections, as well as the need for competence (Sailer *et al.*, 2017). Otherwise, gamification generally deals with motivation and uses knowledge from psychology and game design to motivate people to take action in various fields. According to Zichermann, gamification represents 75% psychology and 25% technology. (AlMarshedi *et al.*, 2015).

In working conditions, gamification implies the process of introducing digital elements based on the games included in the work process, ie the use of gamified elements in work conditions. Work "through the game" is designed so that employees do not have procedures, but rules of the game. Through the game, they realize tasks and win prizes. Types of rewards include points, badges, badges or levels reached, filling out a progress bar or obtaining a virtual currency. By placing the achieved rewards visible to other players / employees

or by setting leaderboards, players are encouraged to compete and advance personally. (Sailer *et al.*, 2017).

Authors Kai Huotari & Juho Hamari (2012) consider the application of gamification in the working process having the same psychological effect as any computer game when it comes to results (Hamari *et al.*, 2014). This means that, by applying gamification in the working process, the same way of thinking and solving problems is achieved as in any game. Employees invest energy and effort to solve a problem. It is a designed system that creates a context in which a person willingly and effectively achieves a goal (Kamasheva *et al.*, 2015). Also, the authors Xi & Hamari (2019) point out that gamification can have a positive impact on meeting internal needs such as the need for autonomy, competence and the need to connect, which is an advantage of applying this concept. The advantage is that the attention of employees is maintained for a long time, good interpersonal relationships are built, creativity in employees is encouraged (Kamasheva *et al.*, 2015). As the concept of gamification is based on an interactive software program, the advantage is that it enables interactive learning, quick access to useful information, instant error correction, and most importantly, feedback on the result is obtained (Janovac & Brzaković, 2018). We should also point out that the use of games in the work environment emphasizes personalism, which means that the environment and requirements of the game can be adapted to the competencies, abilities and interests of employees, which is very important for breaking the monotony in routine work. Emphasizing personalism and the possibility of adaptability of this concept to personal characteristics and preferences affects the performance and overall effectiveness of employees.

In the past few years, the application of the concept of gamification has been studied in various fields, most notably in the fields of marketing, tourism and education. Nevertheless, the concept of gamification has been mostly studied and applied in the field of education (Martí-Parreño *et al.*, 2016; Hitchens & Tulloch, 2018; Yildirim, 2017), especially through the application of interactive educational software. Learning through play, through digital technologies, provides a higher level in acquiring knowledge, better motivation, continuity in learning (Janovac & Brzaković, 2018). For this reason, gamification can have a positive effect in the process of educating and training employees.

When it comes to the concrete application of gamification in working conditions, the experiences of many global companies testify positive results of business processes. For example, the company PWC Hungary launched the Multipoly game in order to recruit or attract candidates. The Multipoly game allows candidates to virtually test their own readiness to work in a PWC company by working in teams and solving real business problems. In this way, the company achieved a higher response of candidates in the recruitment

process, better prepared candidates for interviews, better adaptability of new employees (Meister, 2015). And companies like Marriott, Deloitte, Coca Cola, Starbucks, Microsoft, e-Bay, Cisco, Philip Morris, IBM, L'Oreal, Nike, Dell, Ford, Disney, Nissan, Pepsi, Samsung, Volkswagen, Facebook, Alfa-bank , Moven bank, BBVA, Comm Bank, Altoros, and many others apply gamification in the working process. Also, the U.S. military uses gamification methods in the process of recruiting and connecting with potential candidates.

An example of good practice is Walmart, which applies the concept of gamification in the training process of safety and security at work. When examining employee satisfaction with the training, employees were impressed not only by their own ranking in the game, but also by the knowledge gained, as well as the application of this concept, especially in terms of adherence to safety protocols. It is this emotional aspect of gamification that has an impact when it comes to changing employee behavior, which is very important for achieving organizational goals. Likewise, the examples of many other companies that have applied the concept of gamification in the working process speak of impressive results. For example, in eight Walmart distribution centers, the concept of gamification reduced incidents and losses by 54%. Qualcomm has used the concept of gamification to improve interpersonal relationships and encourage collaboration among employees. Qualcomm has used modeled gamification techniques in its working process in which employees receive bonus points for each level of activity and engagement. Also, the examples of many banks such as Alfa-Bank, Moven Bank, BBVA Comm Bank, testify that the concept is applicable in banking in various sectors, such as in the marketing, innovation, sales, and most of all in human resource management.

Bearing in mind that the concept of gamification is still not applied in the work process in organizations in the territory of the Republic of Serbia, the main goal of this paper was to examine the attitudes of employees from different organizations from Belgrade and Novi Sad on the application of this concept in working conditions. and to examine the psychological needs that drive intrinsic motivation, on which the gamification mechanism is based. Since the millennial generation will dominate the labour market in a couple of years, the focus of this research is on the attitudes and needs of those generations.

3. RESEARCH METHODOLOGY

The aim of this paper is to examine the attitudes of millennials (born from 1980-1997.) towards gamification in working conditions, and whether millennials are more oriented of meeting various internal needs such as the need for autonomy, the need for sociability by creating social connections and the need for competence. For that purpose, an empirical research was conducted, which included a sample of 207 respondents (employees) of different ages from various organizations on the territory of Belgrade and Novi Sad. The questionnaire

consisted of three parts. The first part refers to the data on the respondents, the second part of the questionnaire is defined in the context of the Theory of Self-Determination (SDT) and refers to examining various needs of intrinsic motivation, such as the need for autonomy, the need to create social connections, the need for competence. The third part of the questionnaire is aimed at examining the attitudes of respondents about the possibilities of applying gamification in working conditions. The survey of respondents included in the sample was conducted in July and August 2020. The age groups are presented in Table 1.

Table 1. *Age of respondents*

	Frequency	Percent	Valid Percent	Cumulative Percent
Until 22	12	5.8	5.8	5.8
23-40	96	46.4	46.4	52.2
41-54	77	37.2	37.2	89.4
55+	22	10.6	10.6	100.0
Total	207	100.0	100.0	

Source: Author's calculation, SPSS output table

Observing the structure of respondents according to age groups, it is possible to state that almost half of the respondents (46.4%) belong to the age group from 23 to 40 years, the so-called millennials (born 1980 - 1997), followed by the age group from 41 to 54 years (37.2%), and respondents aged 55 and over (10.6%), and the least respondents are up to 22 years of age (5.8%).

Table 2. *Descriptive indicators of the need for autonomy, competencies and creating social connections*

Needs	N	Min.	Max.	Mean	Std. Deviation	Variance	Kolmogorov -Smirnov	Shapiro-Wilk
Autonomy	207	3.25	5.00	4.62	,454	,207	,000	,000
Competence	207	2.50	5.00	4.34	,845	,715	,000	,000
Social connections	207	2.33	5.00	4.38	,732	,536	,000	,000

Source: Author's calculation, SPSS output table

According to the Theory of Self-Determination (SDT), respondents evaluated claims related to examining different needs of intrinsic motivation, such as the need for autonomy, the need to create social connections, the need for competence. Using the Likert scale, respondents expressed agreement with each statement that measures the need for autonomy, the need for competences and the need to create social connections by giving a score on a scale of 1 to 5 (1 –

completely disagree, 2 - partially disagree, 3 - neutral, 4 - partially agree, 5 - completely agree). The variable need for autonomy was obtained as the sum of the results of agreement with the statements: 5, 8, 11, 12, and the total result was divided by the number of statements (4). This, an additional step, made it easier to interpret the results, since the variable - the need for autonomy has been returned to the original form used for all statements (from 1 - I completely disagree to 5 - I completely agree). The variable of competency needs was obtained as the sum of the results of agreement with the statements: 3, 4, 6, 9, 10, 13, and the total result was divided by the number of statements (6). The variable of the need to create social connections was obtained as the sum of the results of agreement with the statements: 1, 2, 7, and the total result was divided by the number of statements (3).

Minimum, maximum, mean, standard deviation and variance were used to obtain descriptive statistical indicators of the need for autonomy, the need for competencies and the need to create social connections (Table 2).

Based on the presented average values, it is noticed that the respondents have the greatest need for autonomy (career advancement, personal success, independent organization of work tasks, efficient performance of activities).

The results of the distribution normality test based on the Kolmogorov-Smirnov and Shapiro-Wilk test indicate that the assumption of the distribution normality has not been confirmed, ie. the significance value is less than 0.05 for all three types of needs, which requires the application of nonparametric statistical techniques.

Based on the analyzed theoretical background and set research goals, the following hypotheses were set:

H1: The application of gamification in working conditions differs according to the age of the respondents, ie. millennials are more likely to agree that the application of gamification would trigger intrinsic employee motivation.

H2: There is a statistically significant difference between respondents of different ages in the needs for autonomy, competence and the creation of social connections, ie. millennials are more in need of autonomy, competence and the creation of social ties.

Testing of the first hypothesis is enabled by applying the cross-tabulation method, while testing of the second hypothesis is enabled by applying the Kruskal-Wallis test. The statistical software in which the data processing and testing of the proposed hypotheses was performed is IBM SPSS version 21.

4. RESEARCH RESULTS AND DISCUSSION

The first task of this research, to determine the difference in the application of gamification in working conditions according to the age of the respondents, was performed using the method of cross-tabulation (Table 3).

Based on the cross-tabulation of categorical variables: "I think that changes in the working process would be more acceptable if they were based on gamification" and the age of respondents, it is evident that most respondents aged 23 to 40 fully agree with this view (50.4%), followed by the age group from 41 to 54 years (35.4%), the age group up to 22 years (9.7%), while the group that is more than 55 years old agrees with this view the least. (4.4%). When it comes to the attitude "I think that the organization would improve the image, if gamification was introduced into the work process of certain sectors", it is evident that most respondents aged 23 to 40 fully agree with this attitude (54.2%), age group from 41 to 54 years (33.3%), age group up to 22 years (8.3%), and age group over 55 years (4.2%).

When it comes to the attitude "I think that the introduction of gamification in the working process would increase the level of motivation", it is evident that most respondents aged 23 to 40 fully agree with this attitude (56.7%), followed by the age group from 41 to 54 years (32.3%), age group up to 22 years (3.3%), and age group older than 55 years (3.7%).

Table 3. *Testing the independence of variables: attitudes towards gamification in working conditions and the age of the respondents*

Attitudes			Age				Total
			to 22	23-40	41-54	55+	
I think that changes in the work process would be more acceptable if they were based on gamification	I do not agree	Frequency	0	0	12	12	24
		% Attitude	0.0%	0.0%	50.0%	50.0%	100.0%
		% Age	0.0%	0.0%	15.6%	54.5%	11.6%
	I have no opinion	Frequency	0	0	8	3	11
		% Recommendations	0.0%	0.0%	72.7%	27.3%	100.0%
		% Age	0.0%	0.0%	10.4%	13.6%	5.3%
	I partially agree	Frequency	1	39	17	2	59
		% Recommendations	1.7%	66.1%	28.8%	3.4%	100.0%
		% Age	8.3%	40.6%	22.1%	9.1%	28.5%
	I totally agree	Frequency	11	57	40	5	113
		% Recommendations	9.7%	50.4%	35.4%	4.4%	100.0%
		% Age	91.7%	59.4%	51.9%	22.7%	54.6%

I think that performing work tasks would be more efficient if gamification was applied	I do not agree at all	Frequency	0	0	4	0	4
		% Attitude	0.0%	0.0%	100.0%	0.0%	100.0%
		% Age	0.0%	0.0%	5.2%	0.0%	1.9%
	I do not agree	Frequency	0	0	16	12	28
		% Attitude	0.0%	0.0%	57.1%	42.9%	100.0%
		% Age	0.0%	0.0%	20.8%	54.5%	13.5%
	I have no opinion	Frequency	0	4	3	3	10
		% Attitude	0.0%	40.0%	30.0%	30.0%	100.0%
		% Age	0.0%	4.2%	3.9%	13.6%	4.8%
	I partially agree	Frequency	1	51	28	2	82
		% Attitude	1.2%	62.2%	34.1%	2.4%	100.0%
		% Age	8.3%	53.1%	36.4%	9.1%	39.6%
I totally agree	Frequency	11	41	26	5	83	
	% Attitude	13.3%	49.4%	31.3%	6.0%	100.0%	
	% Age	91.7%	42.7%	33.8%	22.7%	40.1%	
I believe that the organization would improve its image, if gamification was introduced into the work process of certain sectors	I have no opinion	Frequency	0	0	12	8	20
		% Attitude	0.0%	0.0%	60.0%	40.0%	100.0%
		% Age	0.0%	0.0%	15.6%	36.4%	9.7%
	I partially agree	Frequency	0	18	17	8	43
		% Attitude	0.0%	41.9%	39.5%	18.6%	100.0%
		% Age	0.0%	18.8%	22.1%	36.4%	20.8%
	I totally agree	Frequency	12	78	48	6	144
		% Attitude	8.3%	54.2%	33.3%	4.2%	100.0%
		% Age	100.0%	81.3%	62.3%	27.3%	69.6%
I believe that the introduction of gamification in the work process would increase the level of motivation	I do not agree	Frequency	0	0	16	8	24
		% Attitude	0.0%	0.0%	66.7%	33.3%	100.0%
		% Age	0.0%	0.0%	20.8%	36.4%	11.6%
	I partially agree	Frequency	0	3	8	8	19
		% Attitude	0.0%	15.8%	42.1%	42.1%	100.0%
		% Age	0.0%	3.1%	10.4%	36.4%	9.2%
	I totally agree	Frequency	12	93	53	6	164
		% Attitude	7.3%	56.7%	32.3%	3.7%	100.0%
		% Age	100.0%	96.9%	68.8%	27.3%	79.2%
I believe that interpersonal relationships would be better if gamification was applied in work conditions	I do not agree	Frequency	0	0	8	8	16
		% Attitude	0.0%	0.0%	50.0%	50.0%	100.0%
		% Age	0.0%	0.0%	10.4%	36.4%	7.7%
	I have no opinion	Frequency	0	0	12	7	19
		% Attitude	0.0%	0.0%	63.2%	36.8%	100.0%
		% Age	0.0%	0.0%	15.6%	31.8%	9.2%
	I partially agree	Frequency	1	26	14	2	43
		% Attitude	2.3%	60.5%	32.6%	4.7%	100.0%
		% Age	8.3%	27.1%	18.2%	9.1%	20.8%
	I totally agree	Frequency	11	70	43	5	129
		% Attitude	8.5%	54.3%	33.3%	3.9%	100.0%
		% Age	91.7%	72.9%	55.8%	22.7%	62.3%
education in the organization would be more efficient if it was based on	I have no opinion	Frequency	0	1	10	8	19
		% Attitude	0.0%	5.3%	52.6%	42.1%	100.0%
		% Age	0.0%	1.0%	13.0%	36.4%	9.2%
	I partially agree	Frequency	1	31	30	4	66
		% Attitude	1.5%	47.0%	45.5%	6.1%	100.0%
		% Age	8.3%	32.3%	39.0%	18.2%	31.9%

I believe that gamification in work conditions would encourage a competitive spirit for better personal results.	I totally agree	Frequency	11	64	37	10	122
		% Attitude	9.0%	52.5%	30.3%	8.2%	100.0%
		% Age	91.7%	66.7%	48.1%	45.5%	58.9%
	I have no opinion	Frequency	0	0	16	8	24
		% Attitude	0.0%	0.0%	66.7%	33.3%	100.0%
		% Age	0.0%	0.0%	20.8%	36.4%	11.6%
	I partially agree	Frequency	0	40	24	9	73
		% Attitude	0.0%	54.8%	32.9%	12.3%	100.0%
		% Age	0.0%	41.7%	31.2%	40.9%	35.3%
	I totally agree	Frequency	12	56	37	5	110
		% Attitude	10.9%	50.9%	33.6%	4.5%	100.0%
		% Age	100.0%	58.3%	48.1%	22.7%	53.1%

Source: Author's calculation

When it comes to the attitude "I think that interpersonal relationships would be better if gamification was applied in working conditions ", most respondents aged 23 to 40 years fully agree with this attitude (54.3%), followed by the age group from 41 to 54 year (33.3%), age group up to 22 years (8.5%), and age group older than 55 years (3.9%).

When it comes to the attitude "I think that education in the organization would be more effective if it was based on gamification" most respondents aged 23 to 40 years fully agree with this attitude (52.5%), followed by the age group from 41 to 54 years (30.3%), age group up to 22 years (9.0%), and age group older than 55 years (8.2%). When it comes to the attitude "I think that gamification in the working conditions would encourage a competitive spirit for better personal results" most respondents aged 23 to 40 years fully agree with this attitude (50.9%), followed by the age group from 41 to 54 years (33.6%), age group up to 22 years (10.9%), and age group older than 55 years (4.5%).

Based on the obtained results of cross-tabulation, it can be concluded that millennials are more in agreement with the application of gamification in working conditions compared to other surveyed age groups, and that it leads to the initiation of intrinsic motivation of employees. Therefore, it can be concluded that the proposed assumption H1 is accepted, ie. the application of gamification in working conditions differs according to the age of the respondents, ie. millennials are more likely to agree that the application of gamification would trigger intrinsic employee motivation.

The second task of this research, determining the differences in the need for autonomy, competence and creating social connections according to the age of the respondents, was performed using the Kruskal-Wallis test (based on the results of Kolmogor-Smirnov and Shapiro-Wilk test of normality). The test results are shown in Table 4. The Kruskal-Wallis test is used to compare the results of a continuous variable - the need for autonomy, competence, creating social ties for three or more age groups (up to 22 years, 23-40 years, 41-54

years, 55 and more years). When the significance level is less than 0.05, it is concluded that the difference in the obtained values of the continuous variable between the groups is significant (Coakes, 2013, p. 202). In doing so, accompanying research is applied, which, most often, includes converting the results into ranks, then the comparison of ranks and median's average values. (Green & Salking, 2014, p. 410) (Table 5).

Table 4. Test statistics^{a,b}

	The need for autonomy	The need for competencies	The need to create social connections
Chi-Square	32,397 the most common	32,385 the most common	33,739 the most common
df	3	3	3
Asymp. Sig.	,000	,000	,000
a. Kruskal Wallis Test			
b. Grouping Variable: Age of respondents			

Source: Author's calculation

Table 5. Mean rank and median

	Age	N	Mean Rank	Median
The need for autonomy	Until 22	12	115.58	4.75
	23-40	96	125.08	4.75
	41-54	77	88.71	4.70
	55+	22	59.18	4.13
	Total	207		
The need for competence	Until 22	12	115.54	5.00
	23-40	96	121.97	5.00
	41-54	77	94.82	4.50
	55+	22	51.41	3.00
	Total	207		
The need for creating social ties	Until 22	12	110.71	4.67
	23-40	96	124.90	4.67
	41-54	77	91.65	4.67
	55+	22	52.36	3.00
	Total	207		

Source: Author's calculation

The Kruskal-Wallis test revealed a statistically significant difference in the need for autonomy according to the age of the respondents (Gp1, n = 12: up to 22 years, Gp2, n = 96: 23-40, Gp3, n = 77: 41-54, Gp4, n = 22: 55+), $\chi^2(3, n = 207) = 32.397, p = 0.000$. The need for autonomy is at the highest level among

respondents aged 23 to 44 (Mean Rank = 125.08, Md = 4.75), and at the lowest level among respondents aged 55 and over (Mean Rank = 59.18, Md = 4.13). The Kruskal-Wallis test revealed a statistically significant difference in the need for competencies according to the age of the respondents (Gp1, n = 12: up to 22 years, Gp2, n = 96: 23-40, Gp3, n = 77: 41-54, Gp4, n = 22: 55+), $\chi^2(3, n = 207) = 32.385, p = 0.000$. The need for competence is at the highest level among respondents aged 23 to 44 (Mean Rank = 121.97, Md = 5.00), and at the lowest level among respondents aged 55 and over (Mean Rank = 51.41, Md = 3.00). The Kruskal-Wallis test revealed a statistically significant difference in the need of creating social connections according to the age of the respondents (Gp1, n = 12: up to 22 years, Gp2, n = 96: 23-40, Gp3, n = 77: 41-54, Gp4, n = 22: 55+), $\chi^2(3, n = 207) = 33.739, p = 0.000$. The need of creating social connections is at the highest level among respondents aged 23 to 44 (Mean Rank = 124.90, Md = 4.67), and at the lowest level among respondents aged 55 and over (Mean Rank = 52.36, Md = 3.00).

Bearing in mind that the Kruskal-Wallis test revealed a statistically significant difference in the need for autonomy, competence and the creation of social connections according to the age of the respondents, ie. that these needs are at the highest level in the age group of 23 to 40 years, it can be concluded that the proposed assumption H2 is accepted, ie. between respondents of different ages there is a statistically significant difference in the need for autonomy, competence and the creation of social ties, ie. millennials are more in need of autonomy, competence and the creation of social ties.

The results of this research, in addition to scientific, also have a practical contribution, because they represent a guide for human resource managers when it comes to the projection of new motivational systems.

CONCLUSION

Motivation is a complex and dynamic factor that contributes to business success. It refers to the psychological processes responsible for initiating and directing human behavior. Work motivation is a process through which not only organizational goals are achieved, but employees are given the opportunity to meet their needs.

Gamification is a modern tool for motivating employees. It involves transforming existing and designing new business processes by introducing game-based elements in order to activate creative potential and use human resources more effectively. The mechanism of gamification itself is based on psychological needs.

The application of gamification in working conditions enables employees to meet various internal needs, which directly affects motivational potential

increase and overall effectiveness of employees. The application of this concept enables individual development of employees in terms of expanding knowledge, improving skills, critical thinking and problem solving. Also, the application of gamification enables the improvement of relations between employees and management, as well as between employees, in terms of more effective communication. Thus, gamification can contribute to the creation of team cohesion, as well as increase the level of employee satisfaction. Otherwise, this concept can be applied in economic organizations, in the education sector, army, police, public administration, etc.

Bearing in mind that in the coming period the labour market will be dominated by the "millennial generation" which grew up with modern technologies, the application of this concept in working conditions is justified from several aspects. In this regard, it is recommended that the organization of work and motivation system should be adapted to the requirements of such generations.

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Analysis of the State of Employees Due to the COVID-19 Pandemic: A Case Study

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Abstract: In order to better explain the economic and social consequences of companies in Serbia from the pandemic caused by the COVID-19 virus, the paper presents an analysis of the situation of employees during the introduction of emergency measures. The task of the author is to research the consequences that individual companies face. Providing some kind of information so that the managers of these companies can best overcome the socio-economic consequences of the COVID-19 pandemic. The results of the research provide managers with facts on which they will make the best decisions in overcoming the current economic and social crisis. The analysis of the condition of the employees shows that the consequences of the pandemic caused by COVID-19 affected the employees in different ways. In addition to the security measures recommended by the Government of the Republic of Serbia during COVID-19, the analysis shows that most employees worked from home. The increased number of employees performing work duties during an emergency situation felt the consequences caused by the COVID-19 pandemic.

Keywords: Analysis, Employees, COVID-19 pandemic
JEL: O1, O15, P51

1. INTRODUCTION

As world scientists explain, COVID-19 is a virus that has meanwhile spread to a large number of countries, so to speak, a virus of world proportions. With the advent of COVID-19, it was declared a "global public health emergency" (PHEIC). According to experts, there is still no real information about the virus that causes COVID-19, but it is known that the disease is transmitted by direct contact with an infected person through respiratory droplets (which occur when coughing and sneezing). The disease can also be transmitted by touching infected areas if the face is then touched (eg eyes, nose, mouth) (Lisa Bender , 2020).

Having in mind the continued spread of COVID-19, an analysis of the situation of employees in the state of emergency during the COVID-9 pandemic was made in the paper as a case study of companies in Serbia.

The analysis was done on the basis of the ISO standard 9001: 2015 (ISO 9001: 2015 - quality management system, QMS), which requires the responsibility of the company's management during the emergency measure caused by the COVID-19 pandemic. Also, a quality management system (QMS) requires continuous measurement of a company's performance. Measuring a company's performance requires stakeholder analysis. An analysis of the situation of employees as stakeholders, by surveying, gives you answers to the consequences that arose during the Corona virus pandemic.

The illustration of the situation of employees of companies in Serbia as a Case Study aims to provide support to managers to best overcome the economic and social crisis and properly direct their business.

2. MATERIALS AND METHODS

Today's modern business requires of company managers to monitor their own performance. More precisely, now with the appearance of COVID-19, where it has been declared a "public health emergency at the global level" (PHEIC). In order to do that, company managers must determine in the best way they can come to an analysis of employees from which they would draw conclusions about overcoming the economic and social consequences of COVID-19. The pandemic caused by COVID-19 reveals the weaknesses and many shortcomings of the company in its development and planning strategy. The real picture is expected by the managers of every company only when the pandemic caused by the Corona virus passes. The first consequence of the pandemic caused by the Corona virus is already being announced as a large-scale economic crisis. It is manifested by the rapid growth of unemployment and has deeper roots in economic, social, political and cultural systems (<http://www.centaronline.org/userfiles/files/preuzimanje/blog/fcd-blog-dragoljub-micunovic-pandemija-i-njene-posledice.pdf>. 23.09.2020).

The results of monitoring the analysis of employees are part of the review by management and representatives of the Quality Management System (QMS).

Their common goal is:

1. continuous improvement of company performance,
2. identification of deficiencies.
3. elimination of disagreements during emergency measures and
4. application of emergency measures prescribed during the overcoming of the COVID-19 virus.

Measuring the performance of the quality management system (QMS), company managers monitor informations of the employees condition during the introduction of emergency measures in the time of the COVID-19 pandemic. Measurement and monitoring of employees in the new situation are relevant data from which the company's strategic decisions can be made. The analysis of the condition of employees is based on the review of information related to the implementation of emergency measures during COVID-19. This analysis is used by company managers to measure and monitor the condition of employees during an emergency situation caused by the COVID - 19 pandemic.

The analysis of the condition of employees shows managers that:

- better plan the company's business,
- do not dismiss employees,
- do not bring the company into illiquidity,
- hire employees in such a way that they can do chores from home,
- organize work from home for those employees who can do the work online,
- holding meetings online,
- constant monitoring of the company's performance,
- make fact-based decisions and
- manage COVID-19 emergency measures in accordance with the envisaged emergency measures.

The methods used by QMS representatives in integration with the company's management during the analysis of the condition of employees caused by the Coran virus are:

- Phone calls,
- Surveys and
- Constant communication.

Each of these methods has its advantages and disadvantages. In this paper, the analysis of the situation is done by surveying the employees of a company in Serbia as a case study during emergency measures caused by COVID-19. The target group of this research is all employees of the company. The research was conducted through social networks and mobile devices (digital technology). The rise of new technologies such as social networks and mobile devices make it possible for modern companies to conduct research on their benefits (Fitzgerald *et al.*, 2014; Agushi, 2019).

New technologies and modelling as a technological revolution can provide companies with competitive advantages that contribute to increasing potential profits (Stanojević Šimšić *et al.*, 2014; Stanojević Šimšić, *et al.*, 2015; Mosconi *et al.*, 2019). Digital technologies provide a new way of managing business processes (Reis *et al.*, 2018). Digitization brings new ways of transformation to

key business operations and management practices (Matt *et al.*, 2015). Digital technologies are increasing the importance to IT (information technology) experts (Tomat & Trkman, 2019). Digital transformation brings a new era of business, the digital age. The digital age has been identified as one of the most important trends changing current business (Tihinen, Kääriäinen, *et al.*, 2016). The impact of digital business is very important for companies and many authors call it industrial revolution (Degrise, 2016; Tihinen, Iivari, *et al.*, 2016). Digital technology has enabled us to conduct an analysis of the impact of the COVID 19 pandemic on employees.

Ninety two respondents out of a possible 200 employees participated in the survey. The company's employees have different education profiles and professions. The survey was compiled on the basis of the ISO 9001:2015 standard-the international standard for quality management (QMS-Quality management systems). QMS instructs the representatives of the quality management system to perform external and internal analysis for all stakeholders (Miletić & Stanojević Šimšić, 2018).

The basics of ISO 9001: 2015-QMS are (ISO 9001:2015, Quality managemenats systems-QMS – Requiremen):

- Company quality policy,
- Document management,
- Management responsibility,
- Records management,
- Non-compliance management,
- Corrective measures,
- Preventive measures,
- Internal verification and
- Continuous improvements.

The quality management system as a standard has its advantages. By QMS implementation companies increase their efficiency through the application of a process approach. The advantage is to provide links between individual production processes, sectors and their interconnectedness. Defining the input and output elements of all business processes and defining the necessary resources creates a starting point for managerial planning, as well as feedback on the satisfaction of all stakeholders (Figure 1.)

This model increases the trust of all types of customer products and services. The process model leads the company to a better positioning in the market.

Figure 1. ISO-9001-2015-process-model



Source: (<https://iso9001group.com/iso-9001-2015-a-walk-through-the-2015-revision/iso-9001-2015-process-model-2>)

Process model during implementation: requires knowledge of the organization's process, stakeholder requirements, definition of management methodology, determination of necessary resources and implementation of all procedures with constant improvement, improvement and responsibilities (Miletić *et al.*, 2015). Research has established that by applying the process model, companies achieve the right quality of products and services (Heggset *et al.*, 2015). The process model supports the connection between the dimensions of national cultures and the types of organizational culture (Miletić *et al.*, 2020).

3. ANALYSIS OF THE STATE OF EMPLOYEES

The research was conducted during the state of emergency due to the Corona virus pandemic in May 2020 in one company in Serbia. The company employs about 200 employees. 92 respondents responded to the sent survey. During the state of emergency, most employees were sent to work from home in order to implement the security measures recommended by the Government of the Republic of Serbia. Employees on whom the production process or some laboratory tests depended worked in the company with a constant fluctuation and

safety measures.–As it was already mention in the previous chapter, the survey was conducted as part of the quality management system. The quality management system is compliant with the requirements of ISO standards.

The quality management system is compliant with the requirements of ISO standards and the requirements for continuous measurement of the company's performance. The research helps company managers track the consequences of employees created during the Corona virus pandemic during work.

ISO 9001:2015, managing a quality management system requires the knowledge needed to perform all types of processes. The analysis of the condition of employees during the emergency measures caused by the COVID-19 pandemic is one of the QMS processes.

Survey conducted during the emergency due to the COVID-19 pandemic:

1. Do you feel the consequences of the COVID-19 pandemic on your work?
2. Were you sent to work from home during the emergency (if feasible), or did you continue to come to work as usual?
3. Please choose in what way the epidemic affected your work in the company where you are employed?
4. What do you personally consider the most important problems in the work you are facing, which are the consequences of the virus epidemic?
5. Are you aware of whether your company has suffered financial damage as a result of a virus epidemic?
6. Do you have enough information about COVID-19?
7. Do you consider that your company has taken adequate measures to prevent the spread of COVID-19?
8. Do you think that your company implemented the recommendations of the Government of the Republic of Serbia during the state of emergency due to the COVID-19 pandemic?
9. Are you aware of the rights of employees during a state of emergency due to COVID-19?
10. To what extent do you agree with the above statements?
 - a) Did the company inform all employees about their rights during the state of emergency?
 - b) The Company has implemented all necessary measures to protect employees during a state of emergency?

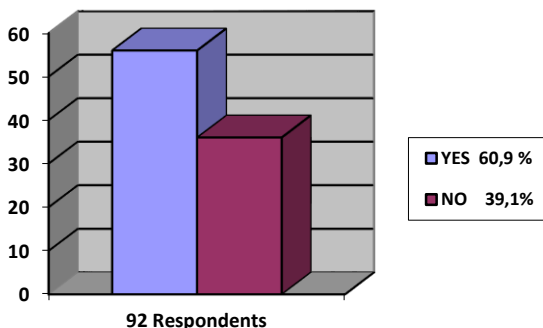
3.1. Survey processing

1. Processing of the first question

Table 1. Review of the analysis of the first question

1. Do you feel the effects of the Corona virus on your work?	92 Respondents
YES	56
NO	36

Figure 2. Graph of the analysis of question 1



The arithmetic mean value is $\bar{a} = 46$

Calculated according to following pattern:

$$\bar{a} = \frac{a_1 + a_2 + \dots + a_n}{n} \quad (1)$$

a_1, a_2, \dots, a_n - given numbers (56, 36).

n - the total number of given numbers (2).

Analyzing Table 1 and Figs. 1, we conclude that out of 92 respondents, 56 answered that they did not feel the consequences and 36 that they felt the consequences of the pandemic caused by Covid 19 at work. The average value is 46, which shows that a larger number of employees feel the consequences.

2. Processing of the second question

Table 2. Review of the analysis of the question 2

2. Were you sent to work from home during the emergency (if feasible), or did you continue to come to work as usual?	92 Respondents
I was sent to work from home – 48,9%	45
It is impossible to work from home, so I continued to come regularly – 16,3%	15
Both depending on the work task – 34,8%	32

Figure 3. Graph of the analysis of question 2

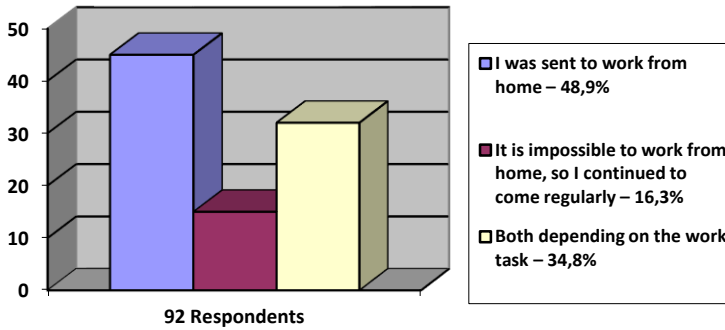


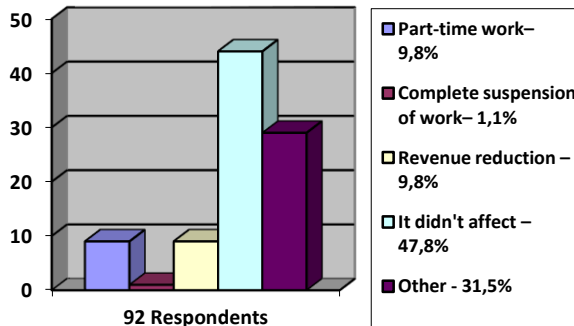
Table 2 and Fig. 3 show that 45 respondents were hired to work from home, 15 worked in the company and 32 worked from home and occasionally worked in the company during the COVID-19 pandemic. The average value is 30.66, which shows that most workers worked from home. Median is 15.

3. Processing of the third question

Table 3. Review of the analysis of the question 3

3. Please choose in what ways the epidemic affected your work in the company where you are employed?	92 Respondents
Part-time work – 9,8%	9
Complete suspension of work – 1,1%	1
Revenue reduction – 9,8%	9
It didn't affect – 47,8%	44
Other - 31,5%	29

Figure 4. Graph of the analysis of question 3



According to the Table 3 and Figure 4, a large number of respondents who performed work tasks in the company were not affected by the COVID-19. Mean value is 18.4, median 9 and mode 9.

4. Processing of the fourth question

On the fourth question, "what do you personally consider the most important problems in the work you are facing, which are the consequences of the virus epidemic", 56 responses were received from 92 respondents.

Answers:

1. Lack of personnel.
2. Uncertainty was given by two respondents.
3. Work from home efficiently. At home I have a better organization of time. The only problem with working from home is the loss of the collective spirit, although I think that is a consequence of the insufficient use of modern communication technology.
4. No problem was answered by ten respondents.
5. Postponement of execution of some contracted works.
6. Safety of employee health.
7. We have no freedom of movement.
8. Insulation.
9. Fear of infection complicates direct communication with associates and clients.
10. Increasing the engagement of individual employees due to the increase in the volume of work and departure of employees to work from home who were hired from other sectors.
11. The biggest problem is that most people work part-time, so it is very difficult to fit a common term.
12. Risk of infection.
13. Fear of an epidemic in the company two respondents gave an answer.
14. Field activities, experimental work, cooperation with business partners.
15. Impossibility of timely communication with colleagues and superiors.
16. Impossibility of fast procurement of consumables.
17. Stress.
18. Impossibility of functional work, work (segments of work from home are incomplete without company support services: printing, copying, ... etc., and this is difficult because you had to go to the company).
19. Operating restrictions during and after a state of emergency.
20. Communication and connection with associates.
21. Difficult communication was answered by two respondents.
22. Prolonged jobs.
23. Technically better communication (online meetings and video conferences).
24. Occasional weakening of concentration due to increased concern about the progress of the epidemic (fear that our beloved, ones with whom we are in contact and who work in their collectives on a daily basis will get sick).

25. 1. Poor quality of internal online meetings with colleagues from the profession. It is easier when the engineering problem is solved through personal contact with, if necessary, manual sketching of the problem. Due to distancing, solving these problems takes significantly more time through the production of shorter reports and drawings, which would be unnecessary if personal occasional contact was possible.
2. Due to the emergency situation in the environment, it is difficult to obtain the necessary bases for work by clients.
3. Apart from the mentioned, working from home did not have a negative impact on the quality of work, on the contrary (less crowds and bigger myths make the situation easier).
26. Impossibility of normal communication, contracting and collection of receivables.
27. All resources and planned activities have protection from Covid - 19 in the focus that puts other areas in the background, and thus opportunities for their implementation (nationally and internationally).
28. The habits we had.
29. The habits we had and security.
30. Habits for collective work.
31. Lack of personal contact (except link).
32. Impossibility of direct contact with clients.
33. Teamwork slowed down.
34. Work from home.
35. Lack of cooperation with colleagues who are sent to work from home.
36. Cooperation through networks.
37. Adapting to the current situation.
38. Problem - Other legal entities in the company work from home, so it happened that they waited a very long time for a response from them to the job requirements.
39. I work more - I earn less.
40. There were no problems, all the work was done successfully.
41. I have no attitude, I do not like contact with colleagues via e-mails, telephone conversations, etc.
42. There are no unsolvable problems.
43. Impossibility of personal communication - Isolation,
44. Lack of direct communication

Analyzing the given answers, we come to the conclusion that the consequences of the pandemic caused by the COVID-19 pandemic affected employees in different ways. But with the preventive measures recommended by the Government of the Republic of Serbia during the Corona virus pandemic, the work was carried out with some of the consequences given in their answers. We use employee responses as criteria for judging consequences. The most pronounced criteria that lead to consequences are: fear, isolation, security and

free movement. These consequences cause reduced work ability and weakening of concentration. The cause of these phenomena is increased concerns about the progress of the COVID-19 pandemic. Employee insecurity is one of the most difficult criteria that leads to employees' fear of losing their job.

Impossibilities:

- normal communication with other employees, users, managers;
- cooperation with colleagues and managers (collective work);
- teamwork that does not exist or has been slowed;
- poorer internet quality;
- contracting jobs and
- collection of receivables.

All the previous criteria lead the company to a financial crisis.

5. Processing of the fifth question

Table 4. Review of the analysis of the question 5

5. Are you aware of whether your company has suffered financial damage as a result of a virus epidemic?	92 Respondents
Yes, I am aware – 13%	12
No, I'm not familiar – 72,8%	67
I have no position on that – 14,1%	13

Figure 5. Graph of the analysis of question 5

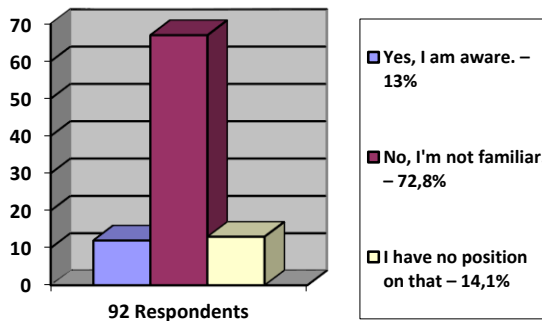


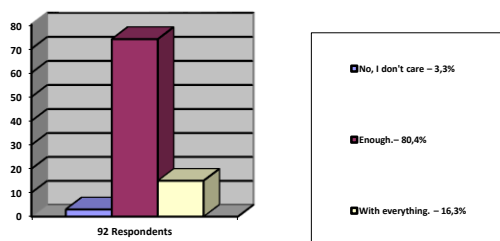
Table 4 and Figure 5 show that 67 respondents were not familiar with the financial situation in company, 13 that they did not have an opinion on it and 13 that they were familiar with it.. The analysis shows that most of the employees are not familiar with the financial situation. The mean value is 30.66 and the median is 13.

6. Processing of the sixth question

Table 5. Review of the analysis of the question 6

6. Do you have enough information about COVID-19?	92 Respondents
No, I don't care – 3,3%	3
Enough – 80,4%	74
With everything – 16,3%	15

Figure 6. Graph of the analysis of question 6



The analysis of the processing of the sixth question shows that the employees had enough information about the COVID-19 pandemic (Table 5, Figure 6). The mean value is 30.66 and the median is 15.

7. Processing of the seventh question

Table 6. Review of the analysis of the question 7

7. Do you consider that your company has taken adequate measures to prevent the spread of COVID-19?	92 Respondents
Completely – 95,7%	88
Partially – 3,3%	3
Not – 1,1%	1

Figure 7. Graph of the analysis of question 7

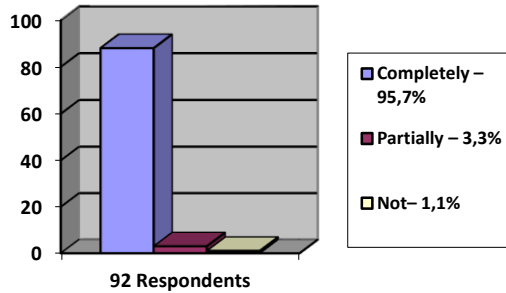


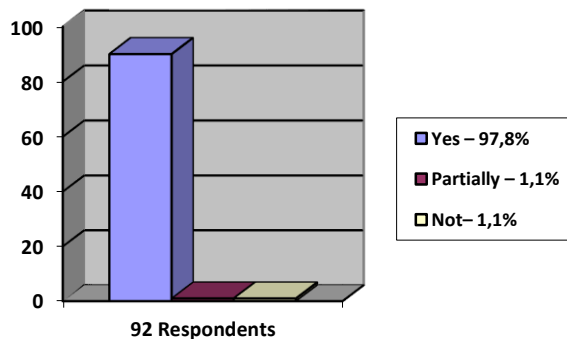
Table 6 and Figure 7 show that the company has taken all adequate measures recommended by the Government of the Republic of Serbia in order to prevent the spreading of the COVID-19 pandemic. The mean value is 30.66 and the median is 3.

8. Processing of the eighth question

Table 7. Review of the analysis of the question 8

8. Do you think that your company implemented the recommendations of the Government of the Republic of Serbia during the state of emergency due to the COVIDA-19 pandemic?	92 Respondents
Yes – 97,8%	90
Partially – 1,1%	1
Not– 1,1%	1

Figure 8. Graph of the analysis of question 8



By analyzing Table 7 and Figure 8, we conclude that the company applied all safety measures recommended by the Government of the Republic of Serbia during the COVID-19 pandemic. 90 respondents answered yes and 1 with a

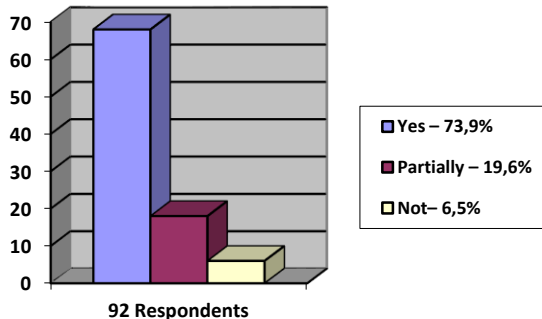
partial and 1 gave a negative answer. The mean value is 30.66 the median is 1 and modus 1.

9. Processing of the ninth question

Table 8. Review of the analysis of the question 9

9. Are you aware of the rights of employees during a state of emergency due to COVID-19?	92 Respondents
Yes – 73,9%	68
Partially – 19,6%	18
Not – 6,5%	6

Figure 9. Graph of the analysis of question 9



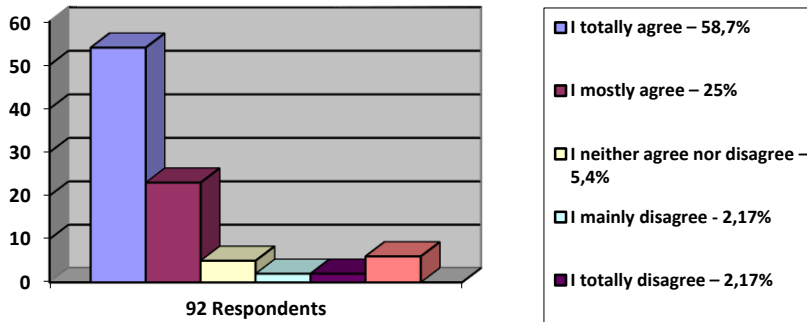
A higher percentage of employees are aware of their rights at the time of the Corona virus, as shown by the analysis (Table 8 and Figure 9). The mean value is 30.66 the median is 1 and modus 1.

10. Processing of the tenth question

Table 9. Review of the analysis of the tenth a) question

10. To what extent do you agree with the above statements? a) Did the company inform all employees about their rights during the state of emergency?	92 Respondents
I totally agree – 58,7%	54
I mostly agree – 25%	23
I neither agree nor disagree – 5,4%	5
I mainly disagree - 2,17%	2
I totally disagree – 2,17%	2
I have no attitude – 6,52%	6

Figure 10. Graph of the analysis of question 10a)

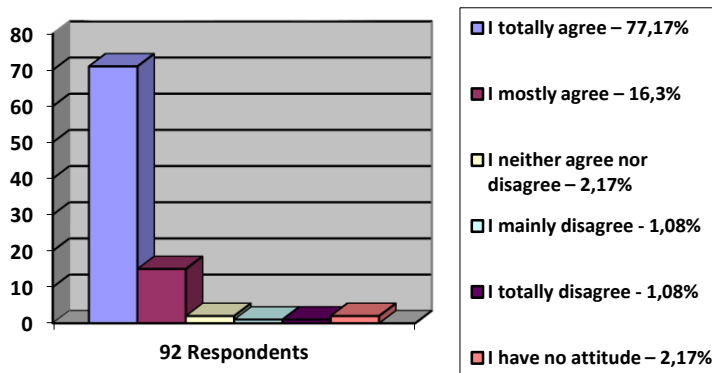


During the state of emergency, the company informed the employees about the state of emergency, where most employees completely agree (Table 9 and Figure 10a). The mean value is 15,33 the median is 5,5 and double modulus 1&2.

Table 10. Review of the analysis of the tenth b) question

10. To what extent do you agree with the above statements? b) Has the company implemented all necessary measures to protect employees during a state of emergency?	92 Respondents
I totally agree – 77,17%	71
I mostly agree – 16,3%	15
I neither agree nor disagree – 2,17%	2
I mainly disagree - 1,08%	1
I totally disagree - 1,08%	1
I have no attitude – 2,17%	2

Figure 11. Graph of the analysis of question 10 b)



By analyzing Table 10 and Figure 11, most employees fully agree that the company implemented all necessary measures during the state of emergency declared due to the consequences of the COVID-19 pandemic. The mean value is 15,33 the median is 2 and modus 2.

CONCLUSION

An analysis of the condition of employees in one of the companies in Serbia during the introduced emergency situation caused by the COVID 19 pandemic conducted a research with digital technology.

Based on the research, we conclude that:

- A larger number of employees feel the consequences caused by the COVID-19 pandemic during the performance of work duties;
- A greater number of employees performing work from home during a COVID-19 pandemic;
- A large number of respondents, who performed work tasks in the company, were not affected by the COVID-19 pandemic;
- The consequences caused by the COVID-19 pandemic affected employees in different ways. In addition to the security measures recommended by the Government of the Republic of Serbia during the Corona virus, the work took place with some of the consequences.
- Consequences caused by fear, isolation, constant fear for safety and prohibition of movement, issued reduced working ability and weakening of concentration, due to increased concern about the progress of the COVID-19 pandemic.

Employee insecurity leads to fear of losing a job.

Consequences of impossibility:

- Inability to communicate normally with other employees, customers, managers;
- Impossible to cooperate with colleagues and managers, collective work missing;
- Teamwork does not exist or has slowed and poor internet quality;
- Inability to contract jobs;
- Unable to collect receivables.

These criteria lead the company to a financial crisis.

- Employees were not in a position to monitor the company's financial situation except for the general manager during the COVID-19 pandemic;
- Employees had sufficient information about the COVID - 19 pandemic;

- The company has taken all adequate measures recommended by the Government of the Republic of Serbia in order to prevent the pandemic COVID - 19;
- A large number of employees are familiar with the rights in the age of the Corona virus that belong to them;
- During the state of emergency, the company informed the employees about the state of emergency where the majority of employees fully agree;
- Most employees fully agree that the company implemented all necessary measures during the state of emergency declared due to the consequences of the COVID-19 pandemic.

The responsibility of managers is a basic obligation to prevent the risks to which employees are exposed during safety and health measures at work. The conducted research can be the basis for further research about the consequences of the COVID-19 pandemic.

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Assessing the financial sector development of EU countries: an entropy-based TOPSIS approach

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Abstract: The financial system, as a set of various financial institutions, financial instruments, and financial market, is an important part of the economy. It plays a significant role in connecting savings and investments through an organized system of institutions, procedures and organizations that enables the flow of funds from entities with a financial surplus to financially deficient entities that have ways to engage funds efficiently. Given the significant role of the financial sector for economic development, it is necessary to monitor and adequately measure its performance. Therefore, this paper aims to assess the performance of the European Union countries' financial sectors by applying the methods of multi-criteria analysis. The results of the analysis indicate that, among European economies, Luxembourg has the most developed financial sector.

Keywords: Financial sector, Banking sector, TOPSIS method, Entropy method.

JEL: C44, G20, G21

1. INTRODUCTION

The recent economic and financial crisis has led to changes in the understanding of financial development in the sense that policymakers have begun to pay more attention to the development of the financial market in order to avoid similar events in the future. The crisis has prompted governments worldwide to take decisive actions to maintain economic activity and prevent the collapse of the financial sector (Tagkalakis, 2014) since the existence of financial instability can significantly impair a country's economic viability (Todorović & Marković, 2016; Marković, 2019). Consequently, it is of great importance to assess the weaknesses and strengths of financial systems, comprehend the importance of the financial sector for macroeconomic stability and recognize suitable policies that will contribute to improving the overall resilience of economies (Xue, 2020).

The impact that financial development has on economic growth is multiple. By increasing the savings rate, facilitating access to foreign capital and optimally allocating capital, the financial sector encourages technological progress (World Bank, 2020). Also, financial development affects the social dimension of development by increasing equality and reducing poverty. Additionally, by financing labor-intensive small and medium-sized enterprises, the financial sector is helping to reduce unemployment.

Bearing in mind the importance of financial development for the economic sustainability of the country this paper builds on financial development indicators in order to estimate the financial system performance and to determine the country with the highest level of financial development. Monitoring and assessment of the achieved level of financial development can provide adequate guidance to policymakers, since based on the assessed level of financial development and comparison with other countries, shortcomings and strengths of the financial sector can be noticed. This paper contributes to the existing literature by offering a novel multi-criteria based approach for the assessment of financial development.

The remainder of the paper is organized as follows: Section 2 is devoted to pointing out the importance of financial development and the ways of its measurement, Section 3 presents methodology and data, while Section 4 is dedicated to the results of the analysis and discussion. Concluding remarks are offered in the last section.

2. SIGNIFICANCE OF THE FINANCIAL DEVELOPMENT FOR THE ECONOMIC DEVELOPMENT

2.1. Understanding the importance of financial development

The development of the financial sector significantly determines economic development. In addition, if there are problems in this sector, it can even lead to currency crises, according to some models (Marjanović & Marković, 2019). When analysing the importance of financial development for an economy, the multidimensional nature of financial development must be taken into account. Numerous elements make up the financial system of a country: banks, insurers, pension and mutual funds, securities markets, market infrastructures and the central bank, as well as regulatory and supervisory bodies (Financial System Soundness, 2019). The essence of the process of financial development is the evolution from self-financing to external finance, followed by the development of intermediation and the financial market development, with improved access to world capital markets (Von Furstenberg & Fratianni, 1996). Financial development occurs when financial intermediaries and financial markets improve their services by reducing transaction costs, information acquisition costs, and contract execution costs (Levine, 2004). Shaw (1973) defines

financial development as the process of accumulating financial assets at a faster rate than the accumulation of nonfinancial assets.

Monitoring the performance of the financial sector has become one of the important research areas in recent decades due to the fact that there is a link between financial development and economic development (Marjanović & Popović, 2020). The development of the financial sector facilitates risk management and ensures the stability of the economy (Easterly *et al.*, 2001). More precisely, there is evidence that financial development contributes to the stabilization of economic volatility through a larger scope of monetary policy actions (Cecchetti & Krause, 2001). King and Levine (1993b) list four ways through which financial sector development influences the economic growth: improvement of productivity through careful selection of entities to be provided with funding, mobilization of external financing for such entities, provision of risk diversification, and identification of potentially profitable investments.

Patrick (1966) states that there are two possible theories about the relationship between financial development and economic growth: the first one represents the supply-leading theory that financial development precedes economic growth, while the second one represents a demand-following theory that financial development is the consequence of economic growth. Most of the previous research on the relationship between financial sector development and economic growth prove it may be twofold. Several authors reported a positive effect of financial development on economic growth (King & Levine 1993a, Andersen, 2003; Zhang *et al.*, 2012; Yang, 2019; Puatwoe & Piabuo, 2017; Christopoulos & Tsionas, 2004; Durusu-Ciftci *et al.*, 2017; Pradhan *et al.*, 2016; Muhammad *et al.*, 2016; Jedidia *et al.*, 2014; Bist, 2018). The effect on growth is achieved through investment, technological innovation and savings (Demirguc-Kunt, 2006). On the other hand, some scholars believe that economic growth is not based on financial development. Lucas (1988) states that financial development is “very badly over-stressed in popular and even much professional discussion” (p. 6). Several other scholars offered evidence of an inverse association between economic growth and financial development (Jayaratne & Strahan, 1996; Zang & Kim, 2007; Ayadi *et al.*, 2015; Ductor & Grechyna, 2015). One of the arguments for the claim about the inverse relationship between financial development and economic growth is that due to financial development, borrowers move from the informal sector to the formal sector, which decreases the credit supply, thus undermining the economic growth (Guru & Yadav, 2019). Adusei (2013) states that there is evidence in the literature about the bidirectional causality between economic growth and financial development (Rousseau & Vuthipadadorn, 2005, Apergis *et al.*, 2007). However, it should be noted that the stated researches have used different proxies of financial development, which has affected the results, since the relationship between economic growth and financial development is dependent on the proxy used for

financial development (Adu *et al.*, 2013). Therefore, the next part is dedicated to different ways of measuring financial development and pointing out the importance of creating a single measure.

2.2. Financial development measurement

There is no generally accepted measure of financial development. The assessment of the achieved level of financial development was mostly performed by “either comparing prices or quantities, specifically, interest rate spreads or stock-flow ratios in which money or debt aggregates are compared with GDP” (Von Furstenberg & Fratianni, 1996, p. 19). Different authors have proposed the use of different indicators. Giuliano and Ruiz-Arranz (2009) applied four different indicators of financial development: credit to GDP, loan to GDP, deposit to GDP and M2 to GDP ratio. Wolde-Rufael (2009) used four different financial development proxies: total domestic credit given by the banking sector, domestic bank credit to the private sector, money supply (M2) and liquid liabilities (M3). Von Furstenberg and Fratianni (1996) provided an overview of various indicators that can be used as a proxy for financial development: the ratio of M3 to GDP, the ratio of domestic money banks’ assets to GDP, market capitalization, domestic credit to the private sector scaled by GDP, the share of earning assets of deposit-money banks in the total assets, and proportion of credit allocated to private enterprises. Khan *et al.* (2019) considered two proxies of financial development in their study: capital to the private sector as a share of GDP, and M2. Kar and Pentecost (2000) used several proxies for financial development: money to income ratio, private credit and domestic credit ratios. However, given the different constitutive elements of the financial sector, these criteria do not cover all aspects of financial development.

Having in mind the diversity of existing indicators of financial development, in order to adequately monitor and evaluate the performance of the financial sector, it is necessary to create a measure of financial development that would simultaneously cover all aspects of the financial sector development. A true assessment of the degree of financial development can be achieved only by integrating individual indicators into a comprehensive index (Marjanović, 2018). Sahay (2015) has tried to create a composite index of financial development based on the indicators that cover several dimensions of the financial sector: depth, access and efficiency. Gupta and Mahakud (2019) proposed an index of financial development that evaluates dimensions related to depth, access, efficiency and stability. Our study represents an extension of the proposed indices, and in addition to the above dimensions, it also considers the surroundings as a dimension of financial development.

3. METHODOLOGY AND DATA

To assess the financial sector development of EU countries integrated approach of Entropy and TOPSIS was applied to the data obtained from the Global Financial Development Database published by the World Bank (2019).

3.1. Entropy method

The Entropy method focuses on the weighting of the criteria based on the information uncertainty which is enclosed in the decision matrix. Criteria weights are determined using mutual contrast among the individual criterion values (Shannon & Weaver, 1949).

The first step in the process of weight determination is the normalization of attribute values using the relation:

$$r_{ij} = \frac{x_{ij}}{\sum_{i=1}^n x_{ij}} \quad (1)$$

where x_{ij} denotes the value of the j^{th} criterion of the i^{th} alternative.

In the second step, based on the obtained normalized attribute values the value of entropy e_j is determined:

$$e_j = -k \sum_{i=1}^n r_{ij} \ln r_{ij}, \quad j = 1, 2, \dots, m \quad (2)$$

where $k = \frac{1}{\ln n}$ denotes a constant.

In the third step the degree of divergence d_j is determined:

$$d_j = 1 - e_j, \quad j = 1, 2, \dots, m \quad (3)$$

where d_j denotes a degree of the criteria C_j contrast intensity. If the value of the contrast intensity is higher, it indicates that there is a significant discrepancy between the initial values of a certain criterion. Consequently, such a criterion is of greater importance for an identified multi-criteria problem. Additionally, if the initial values of a particular criterion are balanced, such a criterion is less relevant to the defined multi-criteria problem.

In the fourth step the criteria weights are obtained using additive normalization:

$$w_j = \frac{d_j}{\sum_{j=1}^m d_j} \quad (4)$$

The main advantage of the Entropy method is that the weighting criteria are obtained directly based on a decision matrix, providing an objective criteria weighting, which eliminates the subjective preferences of decision-makers (Marjanović *et al.*, 2019). On the other hand, there is a drawback related to the size of the decision-making problem where in order to apply the Entropy method the decision matrix must contain an appropriate number of alternatives (Srđević *et al.* 2004).

3.2. TOPSIS method

TOPSIS method (The Technique for Order of Preference by Similarity to Ideal Solution) denotes a method focused on the discovery of the solution that is closest to the ideal solution. The ideal solution represents the point with the largest utility for decision-makers. In other words, this is the point at which revenue attributes are maximized, and expenditure attributes are minimized. TOPSIS method was developed in 1981 by Hwang and Yoon (Hwang & Yoon, 1981) and is used for the evaluation of the alternatives. The essence of the TOPSIS method is to determine the distance of alternatives from the positive-ideal and negative-ideal solution in the geometric sense. The closer the alternative is to the positive-ideal, and the farther from the negative-ideal solution, the better it is evaluated. The TOPSIS method algorithm consists of several successive steps. In the first step it is necessary to form a normalized decision matrix using vector normalization for the attribute values:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}}, i = 1, 2, \dots, m, j = 1, 2, \dots, n \quad (5)$$

In the second step the weighted, normalized decision matrix is formed with coefficients v_{ij} , where:

$$v_{ij} = r_{ij}w_{ij} \quad (6)$$

Criteria weights may be obtained using various methods. For the purpose of this paper, criteria weights will be determined using Entropy method.

In the third step positive-ideal and negative-ideal solution are determined. The positive-ideal solution A^+ consists of the best values for the revenue criteria, and the best values of the expenditure criteria. Values v_i^+ which describe positive-ideal solution A^+ are defined as:

$$A^+ = \{v_1^+, v_2^+, \dots, v_j^+ \dots v_n^+\} = \left\{ \left(\max_i v_{ij} \mid j \in J_1 \right) \wedge \left(\min_i v_{ij} \mid j \in J_2 \right), i = 1, 2, \dots, m \right\} \quad (7)$$

The negative-ideal solution A^- consists of the worst values for the revenue criteria, and the worst values of the expenditure criteria. Values v_i^- which describe which describe the negative-ideal solution A^- are defined as:

$$A^- = \{v_1^-, v_2^-, \dots, v_j^- \dots v_n^-\} = \left\{ \left(\min_i v_{ij} \mid j \in J_1 \right) \wedge \left(\max_i v_{ij} \mid j \in J_2 \right), i = 1, 2, \dots, m \right\} \quad (8)$$

Where J_1 represents the set of revenue criteria, and J_2 the set of expenditure criteria.

In the fourth step Euclidean distances of each alternative from the positive-ideal (S_i^+) and negative-ideal solution (S_i^-) are determined using relations:

$$S_i^+ = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^*)^2}, \quad i = 1, 2, \dots, m \quad (9)$$

$$S_i^- = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^-)^2}, \quad i = 1, 2, \dots, m \quad (10)$$

In the fifth step the proximity index (C_i^*) is obtained. The proximity index denotes relative proximity of alternative to the positive-ideal solution, and is determined using relation:

$$C_i^* = \frac{S_i^-}{S_i^+ + S_i^-}, \quad i = 1, 2, \dots, m \quad (11)$$

Values of proximity index range between 0 and 1, where value of 0 corresponds to the negative-ideal solution, while value of 1 corresponds to the positive-ideal solution. Evaluation of alternatives is conducted based on the values of proximity index where the alternative with the highest value of the proximity index is considered as the optimal solution of the defined decision-making problem.

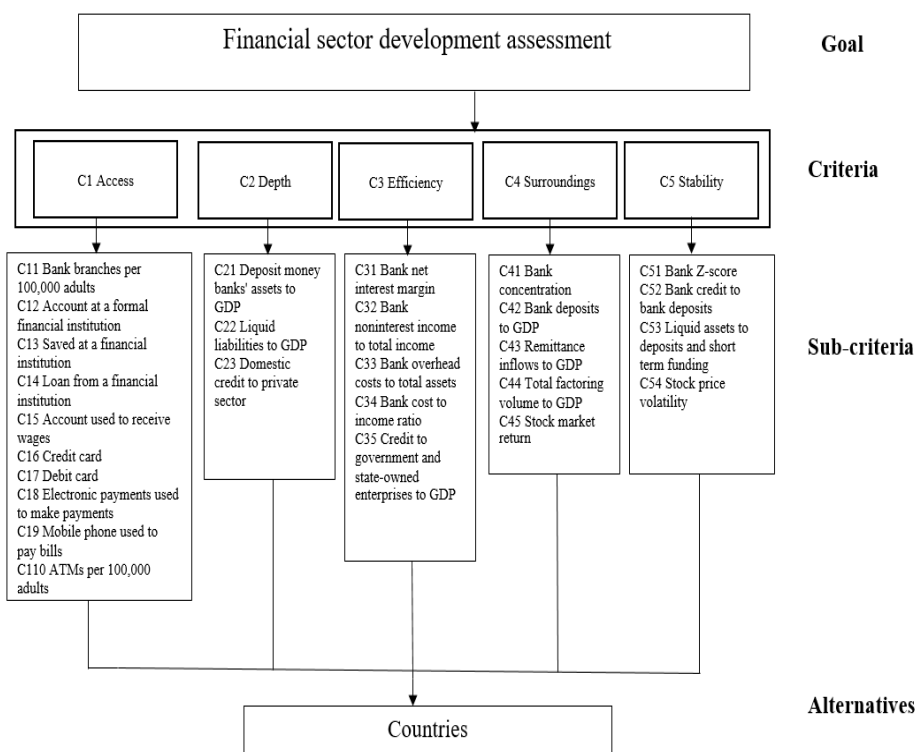
3.3. Empirical data and model development

The evaluation of the financial sector of the EU countries was performed using integrated Entropy-TOPSIS method on the 28 financial performance indicators for the year 2019 obtained from the Global Financial Development Database published by the World Bank (World Bank, 2019). The indicators represent sub-criteria which are further grouped into five categories which represent criteria in the model hierarchy (Figure 1): Access, Depth, Efficiency, Surroundings, and Stability.

The criterion Access refers to the available network of financial institutions in a particular country, as well as the degree of use of financial products by the

population. It represents the ability of companies and individuals to access financial services and consists of indicators related to the number of bank branches per 100,000 adults, percentage of the population aged over 15 with an account at a formal financial institution, percentage of the population aged over 15 that saved at a financial institution in the past year, percentage of the population aged over 15 that has taken a loan from a financial institution in the past year, percentage of the population aged over 15 that uses the account to receive wages, percentage of the population aged over 15 with a credit card, percentage of the population aged over 15 with a debit card, percentage of the population aged over 15 that uses electronic payments to make payments, percentage of the population aged over 15 that uses the mobile phone to pay bills, and the number of ATMs per 100,000 adults.

Figure 1. Hierarchical structure of the model



Source: Authors' preview

The Depth criterion considers the size and liquidity of the financial sector. It includes a comparison of the sizes of banks, other financial institutions and financial markets in the country, taken together relative to the GDP (Financial Depth, 2016). This criterion consists of indicators related to total assets held by

deposit money banks as a share of GDP, the ratio of liquid liabilities to GDP, and domestic credit to the private sector as a percentage of GDP.

The Efficiency criterion represents the efficiency achieved by financial markets and intermediaries in facilitating financial transactions and intermediating resources (Čihák *et al.*, 2012). It entails indicators related to the percentage of bank net interest margin, percentage of bank noninterest income to total income, percentage of bank overhead costs to total assets, banks' cost to income ratio, credit to government and state-owned enterprises as a percentage of GDP.

The criterion Surroundings refers to the measures of concentration and competition in the banking sector and encompasses percentage of bank concentration, percentage of bank deposits to GDP, percentage of remittance inflows to GDP, percentage of total factoring volume to GDP, percentage of stock market return (year-on-year).

The Stability criterion refers to the resilience of financial systems and the stability of financial markets and institutions. A resilient financial system can efficiently allocate resources, adequately manage risks, and maintain macroeconomic stability (Financial stability, 2016). This criterion consists of indicators related to the bank Z-score, percentage of bank credit to bank deposits, percentage of liquid assets to deposits and short-term funding, and stock price volatility.

The descriptive statistics of the criteria are presented in Table 1.

Table 1. *Descriptive statistics of the financial development indicators*

	Minimum	Maximum	Mean	Std. Deviation
Bank branches per 100,000 adults	1,43	71,45	27,2199	16,44100
Account at a formal financial institution (% age 15+)	72,20	99,92	92,1073	8,14295
Saved at a financial institution in the past year (% age 15+)	12,66	75,43	44,7200	14,54111
Loan from a financial institution in the past year (% age 15+)	1,81	23,38	15,1522	5,15309
Account used to receive wages (% age 15+)	31,05	66,43	50,1340	8,97489
Credit card (% age 15+)	11,97	69,80	36,7999	16,36384
Debit card (% age 15+)	55,69	98,81	84,0665	11,23865

Electronic payments used to make payments (% age 15+)	41,24	98,49	83,6186	14,70257
Mobile phone used to pay bills (% age 15+)	2,25	30,50	10,3617	7,34928
ATMs per 100,000 adults	32,01	167,93	83,2377	37,60564
Deposit money banks' assets to GDP (%)	44,63	172,28	90,7002	32,91522
Liquid liabilities to GDP (%)	57,72	655,25	108,7568	116,36005
Domestic credit to private sector (% of GDP)	33,22	162,91	77,8650	32,17193
Bank net interest margin (%)	1,09	4,56	2,5651	1,02661
Bank noninterest income to total income (%)	19,69	54,74	42,7187	9,03222
Bank overhead costs to total assets (%)	1,01	5,90	2,2401	,96101
Bank cost to income ratio (%)	41,48	85,09	59,1951	9,23892
Credit to government and state-owned enterprises to GDP (%)	2,65	34,51	13,4073	7,67468
Bank concentration (%)	42,18	94,17	70,7015	16,46086
Bank deposits to GDP (%)	41,81	399,72	85,6992	69,08094
Remittance inflows to GDP (%)	,18	4,50	1,5589	1,37261
Total factoring volume to GDP (%)	,61	15,93	7,4006	4,39730
Stock market return (% , year-on-year)	,73	39,39	18,0710	10,38278
Bank Z-score	4,12	44,68	14,7626	9,15448
Bank credit to bank deposits (%)	25,62	289,69	104,5849	50,61943
Liquid assets to deposits and short-term funding (%)	6,76	60,63	30,8386	14,70994
Stock price volatility	6,34	26,92	15,7453	5,05656

Source: Authors' calculation

4. RESULTS OF THE ANALYSIS AND DISCUSSION

To assess the financial development of EU countries and to define the benchmark two-stage analysis was applied. Romania and Cyprus were left out from the analysis due to the unavailability of data for several indicators. In the first stage criteria weights were obtained using the Entropy method (Table 2).

Table 2. Relative significance of sub-criteria and criteria in the model

Criteria	Sub-criteria	Sub-criteria weights	Criteria weights
Access	Bank branches per 100,000 adults	0.0362	0.3746
	Account at a formal financial institution (% age 15+)	0.0384	
	Saved at a financial institution in the past year (% age 15+)	0.0377	
	Loan from a financial institution in the past year (% age 15+)	0.0376	
	Account used to receive wages (% age 15+)	0.0382	
	Credit card (% age 15+)	0.0371	
	Debit card (% age 15+)	0.0383	
	Electronic payments used to make payments (% age 15+)	0.0382	
	Mobile phone used to pay bills (% age 15+)	0.0356	
	ATMs per 100,000 adults	0.0372	
Depth	Deposit money banks' assets to GDP (%)	0.0376	0.1097
	Liquid liabilities to GDP (%)	0.0347	
	Domestic credit to private sector (% of GDP)	0.0374	
Efficiency	Bank net interest margin (%)	0.0374	0.1877
	Bank noninterest income to total income (%)	0.0381	
	Bank overhead costs to total assets (%)	0.0374	
	Bank cost to income ratio (%)	0.0383	
	Credit to government and state-owned enterprises to GDP (%)	0.0364	
Surroundings	Bank concentration (%)	0.0381	0.1799
	Bank deposits to GDP (%)	0.0360	
	Remittance inflows to GDP (%)	0.0335	
	Total factoring volume to GDP (%)	0.0361	
	Stock market return (% , year-on-year)	0.0362	
Stability	Bank Z-score	0.0363	0.1481
	Bank credit to bank deposits (%)	0.0372	
	Liquid assets to deposits and short-term funding (%)	0.0369	
	Stock price volatility	0.0378	

Source: Authors' calculation

The results indicate that among the analysed indicators, which represent sub-criteria in the model, the indicator related to the percentage of people older than

15 who have accounts in formal financial institutions is relatively the most important, while the remittance inflows indicator expressed as a percentage of GDP is relatively the least important indicator. However, it should be borne in mind that the difference in the significance of the analysed indicators is relatively low. On the other hand, when considering the significance of the criteria, the criterion Access is of the greatest importance when evaluating financial development. In the second stage of the analysis, the TOPSIS method was applied to obtain evaluation and rankings of countries based on their financial development (Table 3).

Table 3. *Rankings of EU countries based on their financial development*

Country	Proximity index	Rank
Luxembourg	0.59511	1
Denmark	0.41939	2
Spain	0.39483	3
Belgium	0.38527	4
France	0.38433	5
Italy	0.37668	6
Finland	0.36405	7
Portugal	0.35916	8
Austria	0.35818	9
Malta	0.35780	10
Germany	0.35108	11
Croatia	0.34966	12
Netherlands	0.34420	13
Bulgaria	0.34263	14
Estonia	0.32508	15
Latvia	0.30242	16
Poland	0.30235	17
Hungary	0.29053	18
Lithuania	0.28286	19
Ireland	0.27757	20
Czech Republic	0.27466	21
Slovak Republic	0.26501	22
Greece	0.26416	23
Slovenia	0.25505	24
Sweden	0.13006	25

Source: Authors' calculation

What can be noticed when looking at the above list of countries is the dominance of Luxembourg, as a country with the most developed financial system. This is in line with the results of previous research, which indicates that the ranking of countries according to financial development primarily emphasizes the small countries, often tax havens or countries with strict rules of financial secrecy (Svirydzenka, 2016). Luxembourg is ranked sixth out of 133 world countries according to the latest Financial Secrecy Index (2020) created by the Tax Justice Network. Tørsløv *et al.* (2018) state that Luxembourg represents one of the most prominent corporate tax havens.

CONCLUSION

Efforts focused on emphasizing the importance of financial development and creating various policies that would encourage the development of financial systems are ineffective unless there is a way to measure the degree of financial development of a country. The paper builds a single, comprehensive measure of financial development using two-stage multi-criteria procedure on 28 financial development indicators, grouped into five criteria: Depth, Access, Efficiency, Surroundings and Stability. In the first stage, the relative significance of criteria is determined using the Entropy method, while in the second stage the composite index of financial development is created. The results indicate the dominance of Luxembourg, as the country with the highest degree of financial development.

The proposed index represents an improvement over traditional financial development measures, which are mainly based on monitoring an individual indicator that takes into account only one aspect of financial development. The advantage of the developed index is that it includes information on several aspects of financial development.

The conducted study faces several limitations. First, the unavailability of data for all EU countries caused the sample of countries to be reduced. Second, there are certain characteristics of financial development that are not included in the index, such as the organizational network of financial institutions and the financial intermediaries' diversity. Third, the study does not take into account the legal and institutional frameworks of countries that create the preconditions for financial development and can therefore have an impact on the level of financial development achieved. However, although there are certain limitations in constructing the financial development index, it can still serve as a guideline for policy-makers when monitoring financial development and creating policies aimed at developing the financial system of a country.

Further research can be conducted in the direction of monitoring the evolution of the index over time, as well as examining the determinants of financial development using regression analysis.

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Factoring as an important instrument of corporate finance

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Abstract: Factoring is one of the oldest forms of providing liquidity to companies. Positive effects of factoring are most important for small and medium sized enterprises, as well as start-ups. Factoring enables many companies to be competitive and to survive in the market. The aim of the research is to analyze the market of factoring services in the Republic of Serbia. From the analysis of the factoring market we can conclude that there has been a significant increase in the share of the number of banks that offer factoring services. Domestic factoring has been constantly growing, with a registered largest share of total factoring turnover in the recent years. In the total factoring turnover, international factoring has a minor share with the registered significant growth of the share of single factor system in the international factoring. In both domestic and international factoring markets the recourse factoring has an increased share. In the future there is an need to further develop reverse factoring and other types of factoring products as well as the domestic receivables insurance market.

Keywords: factoring, corporate financing, factoring market, banks, Republic of Serbia.

JEL: G21, G23, G32

1. INTRODUCTION

Factoring (from the English word "factor" agent, representative, commissioner, intermediary, commission agent) is a financing mechanism in domestic and foreign business operations, and its basic meaning is to, as a rule, provide small and medium enterprises with the necessary funds, because otherwise the collection of receivables can be realized in a relatively longer period of time. The basic subjects that participate in performing factoring operations, as a rule, are: client, customer and factor (Hadžić, 2007). Factoring agreement is such an agreement by which one party (factor) undertakes to purchase short-term outstanding receivables of the other party (client), and takes care to collect such transferred (assigned) receivables in its own name and for its own account, and to immediately or during a predetermined period, pay to the other party (client)

the value of the receivables, while the client undertakes to pay an adequate fee to the factor. Factoring can be domestic and international, with the domestic participation of three persons from the same country (buyer, factor and seller), and international four entities (buyer, import factor, export factor and seller). The client cedes receivables to the bank, which has against third parties and thus waives all rights to its debtors, but retains the obligation to guarantee the existence of receivables. It also avoids foreign exchange and political risk based on sold receivables without recourse (Spasić, 2009).

The factoring business was developed in the early 1960s in the form of commission sales of European and especially English textile producers on the US market (Krvavac, 2003). In addition to the commission sale of imported goods from Europe, the factor also provided (in its own name and on behalf of the European client) the realization of receivables from American wholesale and retail buyers of textiles. The factor took over the performance of all management and other tasks regarding the collection of the receivables, as well as other tasks related to the realization of the purchase and sale (keeping business books, sending goods, collection operations, etc.). European clients later demanded that the factor take full responsibility for the realization, from the moment the goods were delivered. Therefore, the factor took over the complete management of the receivables and the factoring activity expanded over time to other economic activities. After the United States, the application of factoring spread to Europe in the 1960s, to countries that were major exporters and importers, and in the countries of Central and Eastern Europe and Southeast and East Asia. "There is no direct correlation between the penetration of factoring operations into the financial market and the legislation on factoring in individual countries" (Jović, 53). In the last fifteen years, intensive production of consumer goods and their export to the world market have spurred this trend. Thus, the expressed need for money was created, and the instability of national currencies created a favorable ground for the development of international factoring and the appearance of large banks and factoring houses. Today, factoring is present on all continents. The usual terms of short-term financing through factoring in business practice between 30 and 120 days, depending on the quality of receivables, it is also possible to repurchase receivables of 180 days or more (Ivanović *et al.*, 2011).

For the SMEs the impossibility of securing the necessary funds, high risk and traditionally non-innovative climate and culture in our country has made it difficult to secure liquid funds (Ožegović *et al.*, 2016). „For the industrial and economic development in general, it is necessary to raise the competitiveness, which means that the idea of cheap and underqualified labor and natural resources as bases for development must be reconsidered and abandoned“ (Paunović *et al.*, 2017, p. 1246). The development of the economies of Western Balkans countries relies on increasing their efficiency and performances in industry, service and know-how (Vapa Tankosić *et al.*, 2013). In the

environment of increased competition, integration of financial systems, the financial crisis which destabilized the international economic environment, there are multiple risk factors with which small and medium enterprises encounter in their businesses“ (Kovačević & Vapa Tankosić, 2017, p.719). Nikolić *et al.* (2014) point out that the rural municipalities’ policy, in the Republic of Serbia, should include the active access to finance, identity politics, and continuing education.

According to Lekić *et al.* (2020) the banking sector has a dominant role in the overall economy of the Republic of Serbia, since it has developed substantially in the last ten years as there are twenty-one banks on the market, the majority of which are of foreign ownership. Factoring has been present in the Republic of Serbia since 2006, when the Agency for Export Insurance and Financing (AOFI) started with international factoring, ie. purchase of foreign receivables, which met with a very good response among Serbian exporters. During 2007, it continued by implementing factoring as a new product on the Serbian financial market and promoting it as a form of working capital financing. Then, AOFI started with domestic factoring business, purchase of receivables on the domestic market, as a new financial product that aimed to mitigate illiquidity and difficult collection on the domestic market. In Serbia up to today, the factoring services are provided by domestic and foreign companies, commercial banks and AOFI (Ivaniš, 2013a). The aim of this paper is to highlight the importance of factoring as a contemporary form of enterprise financing as well as to explore the factoring market and identify the main trends in the factoring market. In the next section we discuss revealed relations between the motivational and sociodemographic factors in order to reach relevant conclusions.

2. FACTORING CALCULATIONS

As with leasing arrangements, what is very important for deciding in favor of financing by factoring is the so-called project analysis of the factoring business, based on which both the seller and the buyer of receivables make their respective detailed calculations. For this reason, the buyer of receivables in the calculations may opt for asking guarantees and super guarantees by other companies regarding the collectability of receivables from a particular debtor. When making the calculation for the sale of the receivables or the calculation of the costs for the collection of receivables, the seller of receivables delivers to the factor information such as: information about the credit worthiness of the buyer, correspondence with the buyer, time of collection of receivables and the amount of interest, the level of risk connected to uncollectible debt. Based on all these elements and others relevant for decision making, one can draw a conclusion on costs of the collection of receivables which are acknowledged to the factor and the receivables are sold. In this respect, the determined costs of collection of receivables could be expressed in different ways. Firstly, in a fixed amount for

each receivable, i. for regular ones and separately for disputed receivables. Secondly, in the reduction of the invoiced receivables for the amount of recognized costs in both types of receivables (regular and disputed). Thirdly, in the percentage on the basis of which the factor participates in the collections of receivables (3%, 5%, 10% or 20%) depending on the previously made calculations (Ivaniš, 2012). The calculations of factoring operations represent business documents of the factor and the seller of receivables and are considered confidential until the conclusion of the agreement, which may occur at a later time. Modern practice has shown that the most stimulating solution for both parties is when factoring costs are paid from the collected amount. However, for a more practical understanding of the factoring mechanism, it is best to provide a practical example of financing through factoring, where the key question comes down to the following: is it better for an organization to entrust a factoring company with the collection of receivables, or is it better to wait for payment, i.e. collect the payment using own resources? Accordingly, the main elements for consideration of this hypothetical example are contained in the following data: the accounts receivable on 1/1/2012 amount to 300.000 euro, the payment is agreed for the period of one year, with 12% interest rate (per annum), and the receivables mature on 1/1/2013. Examples of calculations for collection of receivables are given in Tables 1 and 2.

Table 1. *Calculation of in-house collection of receivables*

Indicators	Amount
1. Receivables on 01/01/2012 (mature on 01/01/2013)	300.000
2. Agreed interest rate 12% (regular)	36.000
3. Gross receivables (01/01/2012 = 1 + 2)	336.000
4. Index price of raw materials 135.2 i.e. calculated depreciator (100 : 135.2)	coefficient 0,7391
5. Discount factor I_{12}^1 (table)	coefficient 0,8928
6. Discounts: (a) according to the table 0.8928×300.000 (b) according to the depreciator 0.7391×300.000	267.840 211.730
7. Differences – loss of receivables (a) 1 minus 6/a = discount (b) 6/a minus 6/b = inflation (c) total loss of receivables (a+b)	32.160 46.110 78.270
8. Actualized receivables (3-7c)	257.730

Source: Ivaniš (2013a)

Calculations presented in Tables 1 and 2 clearly show that the amount of receivables in the first case amounts to 257.730 euro, while in the latter case it amounts to 283.432 euro. Similarly, this undoubtedly leads to the conclusion that the collection of receivables should be left to a factoring organization,

because it is more profitable for the company. The main reasons for this decision are as follows: firstly, it is about a higher purchasing power of the same amount of receivables, and secondly, it accelerates the turnover of assets in the company's reproduction process.

Table 2. *Calculation of collection of receivables through factoring*

Indicators	Amount
1. Paid by the factoring contract 01/01/2012 75% of 300.000	225.000
2. The remainder of the receivables in the amount of 75.000 euro paid on 01/01/2013 with 12% interest	84.000
3. Gross collection (1 + 2)	309.000
4. Discounts: (a) according to the table 0.8928×75.000 (b) according to the depreciator 0.7391×75.000	66.960 55.432
5. Differences – loss of receivables (a) 2 minus 4/a = discount (b) 4/a minus 4/b = inflation (c) total loss of receivables (a+b)	8.040 11.528 19.568
6. Factoring fee (300.000 x 2%)	6.000
7. Actualized receivables $[3 - (5c+6)]$	283.432

Source: Ivaniš (2013a)

Considering the relations in the presented calculations, one should bear in mind that the difference shown may be even smaller, assuming that the collection from the debtor can be accelerated by cash discounts, but it can also be much higher if it concerns receivables arising from international economic relations connected to the countries with the currency devaluation. According to the presented example, we see that the factoring organization, apart from the fees of 6.000 euro also charge 12% interest on the amount of 225.000 euro, or a total of 33.000 euro, comprising a total of 11% on the initial (purchased) accounts receivables.

3. METHODOLOGICAL APPROACH

This paper will explore the trends in the factoring market in the context of its potential as an alternative method of SMEs financing in financial markets in Europe and Republic of Serbia the last 7 years. The analysis shall be based on descriptive method, method of comparison, method of analysis and synthesis and analysis of the secondary data from the available from the literature dealing with this topic. Among them are reports and studies of relevant institutions such as Factors Chain International (FCI) and Report on realized factoring turnover in 2019, prepared by the Serbian Chamber of Commerce, based on the submitted data of 18 factors in total (various factoring companies, banks and AOFI).

4. RESULTS AND DISCUSSION

In EU countries, factoring operations are characterized by the process of concentrating on a small number of large factoring organizations, which are mainly owned by banks (Ivaniš, 2013b).

Table 3. Total volume of factoring by European countries in the last 7 years (in millions of EUR)

	2013	2014	2015	2016	2017	2018	2019	Var
Armenia	62	70	75	100	120	135	150	11,1%
Austria	14.110	16.400	18.264	19.621	21.091	24.107	27.220	12,9%
Azerbaijan				13	56	65	112	72%
Belarus			320	330	250	380	570	50,0%
Belgium	47.684	55.374	61.169	62.846	69.641	76.340	84.819	11,1%
Bulgaria	1.600	1.728	1.820	1.947	2.919	3.211	3.532	10,0%
Croatia	3.146	2.498	2.885	2.825	1.340	1.094	1.140	4,2%
Cyprus	2.823	2.671	2.414	2.925	2.830	3.585	3.181	-11,3%
Czech Rep.	5.302	5.912	5.064	4.848	6.121	6.778	7.240	6,8%
Denmark	8.932	10.463	12.606	13.237	14.948	18.637	18.838	1,1%
Estonia	1.899	2.010	2.010	2.495	2.495	3.600	3.900	8,3%
Finland	17.699	20.554	23.095	22.000	24.000	25.800	28.000	8,5%
France	200.459	226.598	248.193	268.160	290.803	320.409	349.714	9,1%
Georgia	0	5	14	14	25	28	137	398,2%
Germany	171.290	189.880	209.001	216.878	232.431	244.300	275.491	12,8%
Greece	12.094	13.017	12.869	12.782	13.151	14.635	15.045	2,8%
Hungary	2.661	2.827	3.779	3.635	5.730	6.911	8.550	23,7%
Ireland	21.206	25.476	25.978	23.952	26.294	26.294	28.617	8,8%
Italy	178.002	183.004	190.488	208.642	228.421	247.430	263.364	6,4%
Latvia	592	680	867	867	720	784	805	2,7%
Lithuania	2.763	5.550	3.150	3.100	3.000	3.660	3.400	-7,1%
Luxembourg	407	339	339	339	339	339	339	0,0%
Malta	178	296	275	275	350	554	696	25,6%
Moldova		13	17	17	3	4	5	25,0%
Netherlands	52.000	53.378	65.698	82.848	89.713	98.368	112.148	14,0%
Norway	16.296	17.182	18.476	21.867	22.682	25.923	26.441	2,0%
Poland	31.588	33.497	35.020	39.396	44.300	56.474	66.141	17,1%
Portugal	22.303	21.404	22.921	24.517	27.008	31.757	33.800	6,4%
Romania	2.713	2.700	3.651	4.037	4.560	5.007	4.854	-3,1%
Russia	41.960	29.170	23.332	28.004	33.792	43.840	45.125	2,9%
Serbia	679	306	445	555	603	650	883	35,8%
Slovakia	1.068	1.036	1.036	1.646	1.646	2.521	2.032	-19,4%
Slovenia	626	563	329	1.000	1.200	1.400	2.000	42,9%

Spain	116.546	112.976	115.220	130.656	146.292	166.391	185.559	11,5%
Sweden	30.544	28.290	26.078	20.481	20.094	19.822	20.625	4,1%
Switzerland	3.100	3.832	3.832	3.832	3.832	593	593	0,0%
Turkey	32.036	41.229	39.310	35.085	34.575	26.894	21.857	-18,7%
Ukraine	1.340	1.035	442	295	295	295	258	-12,5%
UK	308.096	350.622	376.571	326.878	324.260	320.193	328.966	2,7%
Total	1.353.742	1.462.510	1.556.977	1.592.988	1.701.939	1.829.142	1.976.239	8,0%

Source: <https://fci.nl/about-factoring/euf%20yearbook%202016-2017.pdf>

The Factors Chain International (FCI), which has over 400 member companies in more than 90 countries, recorded 7.9% growth in factoring and commercial financing in the EU in 2019, reaching 1.91 trillion. Factoring and commercial financing account for about 11.3% of EU GDP. Total volume of factoring by European countries in the last 7 years (in millions of EUR) is presented in Table 3.

The top five countries in 2019 that make up 73.6% of the total EU market are France (18.3%), the United Kingdom (17.3%), Germany (14.5%), Italy (13.8%) and Spain (9.7%) as seen in the Table 3. Of the countries that joined the EU in 2004, Poland is the largest market for factoring services in the region with a stable growth over the last five years and with a growth rate of 17% in 2019. Russia is the second largest market in the region, with a growth rate of 2.9% in 2019. In 2019, the factoring services market in Hungary recorded a significant growth of 23.7%, while Estonia recorded a growth of 8.3%, the Czech Republic of 6.8% and Croatia of 4.2%. Significant growth of factoring services in 2019 was recorded in Slovenia. (42%), Serbia (35%) and Bulgaria (10%).

In the Republic of Serbia, in 2019, according to the Report on factoring turnover in 2019 (Serbian Chamber of Commerce, 2020) for as many as 18 banks and factoring companies including AOFI, factoring turnover in 2019 amounted to 985.041,252 euros (for 15 factors with complete data, 979.628,032 euros) as seen from Table 4. The total turnover is higher by 25.9% compared to factoring turnover in 2018. Domestic factoring in 2019 amounts to 881.725,723 euros. Compared to 2018, it recorded a growth of 25.0% with a share of 89.5% in total factoring turnover. Compared to 2018, the share of factoring with recourse increased from 39.8% to 41.8%, the share of reverse factoring increased from 35.8% to 36.6%, while the share of factoring without recourse decreased from 24.2% to 21.6%

International factoring in 2019 amounts to 103.315,529 euros, with a growth of 34.6% compared to 2018. One-factor turnover increased by 58.5%, and two-factor has decreased by 26.7% compared to 2018. The share of single factor in international turnover has increased from 71.5% to 84.3% due to the intensive

growth of turnover in the banking sector (297.2%). Two-factor turnover recorded a decrease in the share in total turnover from 28.5% to 15.7%, due to a decrease in the turnover of companies and AOFI (a decrease of 82.3%).

Table 4. *Total volume of factoring in the Republic of Serbia in the last 7 years (in millions of EUR)*

STRUCTURE	2013	2014	2015	2016	2017	2018	2019
Number of questionnaires	14	13	14	14	16	20	18*
Number of banks	6	6	7	8	9	11	10
Number of factoring companies with AOFI	8	7	6	6	7	9	8*
Realized turnover	687,2	412,5	489,7	528,2	610,1	782,3	985,0
Domestic factoring	649,5	369,7	437,6	476,9	548,2	705,5	881,7
Share of domestic factoring%	94,4	89,6	89,4	90,3	89,8	90,2	89,5
International factoring	37,7	42,8	52,0	51,3	61,9	76,8	103,3
Participation of international factoring %	5,6	10,4	10,6	9,7	10,2	9,8	10,5
Two-factor	0,6	10,4	13,7	20,1	22,1	21,9	16,2
Single factor	37,1	32,4	38,3	31,2	39,8	54,9	87,1
Export factoring	37,1	42,8	51,8	51,2	60,4	71,9	81,5
Export with recourse	/	/	/	31,1	38,9	50,4	65,3
Export with recourse% participation	/	/	/	60,8	64,4	70,0	80,0
Import factoring	0,6	0,2	0,2	0,1	0,9	4,6	21,8
Factoring with recourse (total)	407,8	326,1	370,9	231,9	240,4	331,9	434,7
Factoring without recourse (total)	26,02	66,0	100,2	134,8	167,0	197,2	227,4
Reverse factoring	19,6	12,2	14,1	161,5	202,7	253,2	322,9
Discounted invoices	222,4	8,2	4,5	/	/	/	/
Total collection	/	5,8	4,0	0,4	0,6	0,2	/
Collection - domestic factoring	/	5,8	4,0	/	0,1	/	/
Collection - two-factor	/	/	/	0,4	0,5	0,2	/
BANKS - total turnover	257,2	258,6	356,8	428,8	513,0	660,1	868,1
% share of banks in total turnover	37,4	62,7	72,9	81,2	84,1	84,4	88,1
FACTORING COMPANIES + AOFI	363,5	153,9	132,9	99,4	97,1	122,2	116,9
% of companies' share in total turnover	62,6	37,3	27,1	18,8	15,9	15,6	11,9
Discounted bills of exchange	48,6	59,8	70,5	55,8	21,5	12,7	.3
Discounted bills of exchange - factoring companies	13,7	3,2	5,0	3,7	3,0	4,4	4,1
Discounted bills of exchange	34,8	56,6	65,5	52,1	18,5	8,3	5,2

- banks							
% participation of banks in the discounted bills of exchange	71,7	94,7	91,9	93,5	85,8	65,3	55,6

Source: Serbian Chamber of Commerce, 2020

Export factoring, in the observed period, accounted for 78.9% of international turnover, and import factoring for 21.1% of international turnover. Import factoring in the amount of 21.8 million euros, recorded a multiple increase (372.6%) compared to 2018, with an increase in participation in international trade from 6.0% to 21.1%. In 2019 the total turnover of commercial banks amounts to 868.109,854 euros. There was an increased share of banks in the total factoring turnover of 88.1% with an increase in the value of turnover by 26.8% compared to the previous year. At the same time, the share of banks in international factoring has been increased from 33.2% to 61% in 2019.

From the sectoral structure of turnover on the factoring market in 2019 presented in the Table 5, we can see that the largest share has trade with 50.9%, agriculture and food industry with 8.8%, processing industry with 8.6%, followed by construction with 11.7% and services with 6.0%. The sectoral structure of the portfolio in 2019 is mostly stable with minor changes and an increase in the participation of construction and IT sectors. A slight decline in participation was registered in the agricultural and food industry, processing industry, chemistry, pharmacy and cosmetics, trade and other activities.

Table 5. Sectoral structure of turnover on the factoring market (in EUR)

STRUCTURE	% share					
	2019 (eur)	2019	2018	2017	2016	2015
Agricultural and food industry	86.519,995	8,8	10,7	8,6	6,8	6,2
Manufacturing industry	84.125,848	8,6	9,9	12,2	14,6	13,3
Metal and electrical industry	57.256,500	5,8	5,8	4,8	8,3	9,5
Chemistry, pharmacy, cosmetics	18.402,752	1,9	2,1	3,4	4,0	3,2
Construction	114.883,966	11,7	6,1	4,2	3,5	2,9
Trade	498.144,654	50,9	54,2	56,6	55,3	54,2
Traffic and storage	3.912,777	0,4	0,5	1,2	0,5	0,6
Tourism and catering	1.847,140	0,2	0,0	0,0	0,0	0,0
IT sector	47.485,002	4,8	3,4	2,6	3,0	2,0
Services	58.904,120	6,0	5,8	5,3	2,5	2,6
Education	2.355,031	0,2	0,0	0,1	0,1	0,2
Art	0	0,0	0,0	0,1	0,1	0,3

Other	5.790,247	0,6	1,5	0,9	1,3	5,0
TOTAL	979.628,032	100,00	100,00	100,00	100,00	100,00

Source: Serbian Chamber of Commerce, 2020

In the last five years, the growth of participation is evident in the construction sector and the IT sector, and the continuous decline in the sectors of manufacturing and chemistry, pharmacy and cosmetics industry. On the factoring market in 2019, the share of banks in total turnover increased from 84.4% to 88.1%, as presented in the Table 6. In international factoring, there was an increase in the share of banks (from 33.2% in 2018 to 61.7% in 2019), with an increase in participation in both one-factor and two-factor turnover. The share of banks in the bill of exchange discounted amounted to 55,6%.

Table 6. Share of banks and factoring companies in domestic and international turnover and discount in the period 2013-2019 (in millions of EUR)

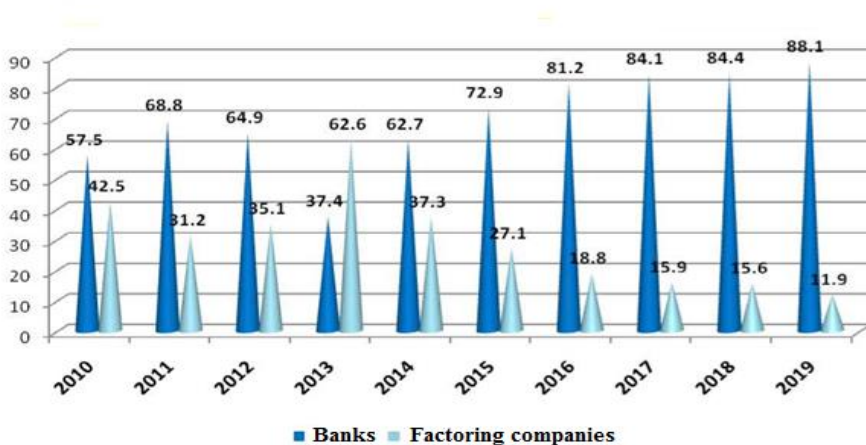
CATEGORY	2013	2014	2015	2016	2017	2018	2019
Domestic factoring	649.529.826	369.688.801	437.646.411	476.870.508	548.222.769	705.529.475	881.725.723
banks	248.971.72	257.808.89	354.215.95	422.885.88	501.020.2	634.575.	804.371.
% share	38,3	69,7	80,9	88,7	91,4	89,9	91,2
Companies +	400.558.10	111.879.91	83.430.461	53.984.627	47.202.48	70.953.6	77.354.6
% share	61,7	30,3	19,1	11,3	8,6	10,1	8,8
International factoring	37.720.217	42.831.519	52.034.952	51.331.882	61.893.775	76.769.190	103.315.529
banks	2.600.000	744.083	2.596.423	5.886.151	11.969.94	25.515.8	63.738.7
% share	6,9	1,7	5,0	11,5	19,3	33,2	61,7
companies + AOFI	35.120.217	42.087.437	49.438.529	45.445.731	49.923.834	51.253.377	39.576.772
% share	93,1	98,3	95,0	88,5	80,7	66,8	38,3
TOTAL factoring	687.250.087	412.520.319	489.681.363	528.202.390	610.116.544	782.298.666	985.041.252
% Share in domestic factoring	94,5	89,6	89,4	90,3	89,9	90,2	89,5
% Share in international factoring	5,5	10,4	10,6	9,7	10,1	9,8	10,5
Banks - total turnover	257.437.765	258.552.972	356.812.373	428.538.804	512.990.228	660.091.650	868.109.854
Companies + AOFI- total turnover	429.812.322	153.967.347	132.868.990	99.430.358	97.126.316	122.207.016	116.931.398

% share of banks in total turnover	37,4	62,7	72,9	81,2	84,1	84,4	88,1
% share of companies in total turnover	62,6	37,3	27,1	18,8	15,9	16,6	11,9
Bill of exchange discounted in mil €	48,6	59,8	70,5	55,7	20,6	12,7	9,3
Banks	34,8	56,6	65,5	52,1	18,5	8,3	5,2
% Bank share	71,7	94,7	92,9	93,5	89,5	65,3	55,6
Companies	13,8	3,2	5,0	3,6	2,1	4,4	4,1
% Company share	28,3	5,3	7,1	6,5	10,5	34,7	44,4
Other products (banks)	11,3* <i>silent factoring</i>	0	00	0	0	12,7	0,0

Source: Serbian Chamber of Commerce, 2020

The Graph 1 presents the share of banks in the total turnover which continues the tendency of continuous growth. On the other hand, the turnover of factoring companies and AOFI recorded a decrease, compared to 2018, by 4.3% (Graph 1).

Graph 1. Share of banks and companies (with AOFI) in factoring turnover 2010-2019



Source: Serbian Chamber of Commerce, 2020

In the last three years, as presented in Table 7, we see that the most significant market share belongs to OTP SERBIA, Banca Intesa, Unicredit Bank, while we can see that the market share of AOFI has been decreased (from 3 to 6th place). Other banks and factoring companies that are present on the factoring market in the last three years are: Gamiko factoring, Credit Agricole, Sberbank, AIK Bank, Telegroup Raiffeisen Bank Erste Bank and Focus faktor plus.

Table 7. *Market share of banks and factoring companies in the factoring services market in the last three years*

No.	2017	2018	2019
1.	OTP bank (SOŽE)	OTP bank (SOŽE)	OTP bank (SOŽE)
2.	Banca Intesa	Banca Intesa	Banca Intesa
3.	Unikredit bank	Unikredit bank	Unikredit bank
4.	AOFI	AOFI	Credit Agricole
5.	Gamiko faktoring	Gamiko faktoring	Sberbank
6.	Credit Agricole	Credit Agricole	AOFI
7.	Sberbank	Sberbank	AIK Bank
8.	Raiffeisen Bank	Telegroup	Gamiko faktoring
9.	Telegroup	Erste Bank	ADDIKO
10.	Focus faktor plus	Focus faktor plus	Erste Bank

Source: Serbian Chamber of Commerce, 2020

As seen from Table 8, the number of employees in the factoring sector, ranges from a total of 65 employees, with 28 employees in banks and 37 in factoring companies and AOFI. In the factoring companies and AOFI see a slight increase in the number of employees working in domestic and international factoring, while the number of employees working in both types of jobs has decreased. In banks, the number of employees working exclusively in foreign factoring remained unchanged. The number of bank employees in both types of work increased and the number of persons working in domestic factoring business decreased. In 2019, the number of active clients increased by 6.7%, compared to 2018. The number of active debtors decreased by 6.3%, while the number of purchased invoices increased by 3.1%. Banks recorded a slight increase in the number of purchased invoices, while companies and AOFI recorded a decrease of 25%. The average amount of total invoices was 15.702,00 euros, with banks 16.748,00 euros, and in factoring companies 10.729,00 euros. In 2019, there was an improvement in collection and a reduction in the number of days of delay domestic customers from an average of 16 to 13 days, and foreign customers from 9 to 4 days.

Table 8. Other information on the factoring portfolio

CATEGORY	FACTORING COMPANIES AND AOFI					BANKS					TOTAL				
	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
Total number of employees	40	35	31	38	37	24	27	27	28	28	64	62	58	66	65
Number of employees-domestic factoring	9	13	10	14	16	15	16	12	13	11	24	29	22	27	27
Number of employees-international factoring	2	5	5	5	8	3	1	1	1	1	5	6	6	6	9
Number of employees domestic + international factoring	29	17	16	19	13	6	10	14	14	16	35	27	30	33	29
Total number of active clients	168	225	281	337	326	1.060	511	680	606	680	1.228	736	961	943	1.006
Total number of active debtors	337	276	405	536	488	346	372	341	450	436	683	648	746	986	924
Total number of purchased invoices	133763	98.510	15.533	14.644	10899	20.143	45.310	43.545	46.226	51835	153906	143820	59.078	60.870	62734
Average number of days of customer	13	14	20	33	20	7	12	7	11	7	10	13	12	16	13
Average number of days of delay of foreign buyers			14	15	6			2	3	2			7	9	4

Source: Serbian Chamber of Commerce, 2020

CONCLUSION

Since its inception, factoring has survived, evolved and adapted to globalization and changes in trade. It was created as a financial instrument that enabled trade between distant parts of the world and mutually unknown partners. It achieved its greatest success at the end of the last century, when distance was no longer a problem due to modern means of transport. As changes are inevitable in the market economy in dynamic environments and high level of competition with the advent of new IT technologies, there was no problem of meeting customers (Ožegović & Ivaniš, 2017). Factoring is the most flexible financial product to support trade, and thus significantly affects the business of companies. The factoring mechanism provides an opportunity for exporters to respond faster to changes in demand in the country and abroad, to have significant cost savings and risk reduction, which they would otherwise bear if they collected receivables themselves. Factoring is one of the oldest forms of providing company liquidity. In developed countries, factoring is only one form of business support. In the last couple of years, factoring has become one of the very important banking businesses. It is present especially in developed countries, although in our country, the adoption of a special Law on Factoring indicates the affirmation of factoring in the Republic of Serbia. From the analysis of the Report on factoring for 2019, we can conclude that there has been a significant increase in factoring turnover as well as the share of the number of banks that deal with factoring. Domestic factoring has been growing, while its share in total turnover has been stable and majority in recent years. In the total factoring turnover, international factoring has a minority share with the growth of the share of one-factor international factoring. In both markets, recourse factoring has an increased share. There is an obvious impact on the growth of the factoring turnover and on the overall effects in economic and financial flows, on faster flows of exports and imports, with a positive impact on the country's balance sheet and on the overall growth of the economy. Factoring and commercial financing account for about 11.3% of EU GDP. Factoring turnover in 2019 in the amount of EUR 985 million represents 2.1% of the estimated GDP of the Republic of Serbia (EUR 45.9 billion), which is an increase in the share compared to previous years (1.8%), although the share in GDP is still always small compared to the European average, which indicates that there is a possibility for further progress in the development of factoring. The share of banks in the domestic market is stable and has been cca 90% in the last years. On the other hand, the market for insurance of receivables against commercial and non-commercial risks in Serbia is still insufficiently developed. This service is extremely important because through the insurance of claims, the creditor is entitled to compensation, if it happens that he does not collect his claim and does not exercise his right against the debtor due to the realization of certain risks. A small number of banks and factoring companies offer the market for insurance of receivables against commercial and non-commercial risks, which indicates that there is a possibility for further development of these services.

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Social Media in Fashion Industry: Empirical Study of Customer Buying Behaviour

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Abstract: Considering the importance of internet and social media, many fashion companies have accepted digital marketing as an indispensable element of their business strategies. The purpose of this paper is to analyse the possibilities of digital marketing in fashion industry, as well as to explore the influence of social media on customer buying behaviour regarding fashion products. The empirical research was conducted in Serbia from January to February 2020 on a sample of 125 respondents. During the statistical data processing, the following techniques and methods were implemented: the descriptive statistical measures (frequencies and percentage), the measures of variability, the correlation method. The survey indicated that the consumers of fashion products in Serbia use online platforms as the first search point in their buying process. The majority of respondents recognized social networks and previous buying experience as the most dominant factor that affect their buying decisions.

Keywords: digital marketing, fashion industry, fashion marketing, fashion brands, social media, social networks

JEL: M30, M31, O30

1. INTRODUCTION

In the period of digital revolution, marketing faces many challenges, driven by demanding consumers, globalization and fierce competition. Therefore, companies must first assess the current situation in relation to the competition to understand their own advantages and disadvantages (Mijajlović *et al.*, 2020). The development of digital technology has drastically affected all the activities and processes of marketing, changing the concept of the marketing mix itself and providing possibilities for building competitive advantage. Regarding the great possibilities that internet has brought to the marketing and commerce, social media have become an important channel that shapes consumer's purchasing decisions. The decisions are made on the basis of a number of inputs that are an integration of qualitative and quantitative criteria (Pribičević *et al.*, 2020).

Social media usage is one of the most popular online activities. According to the official statistics from 2020, more than 3.6 billion people were using social media worldwide, which makes almost 50 % of the global population. In Europe, the highest active social media penetrations are recorded in Malta (91%), Cyprus (83%) and Iceland (82%). In compare to them, Serbia with 42 percent penetration rate is positioned at the lower level of the European social media penetration list (Johnson, 2020).

The influence of social media is particularly evident in fashion industry due to the fact that clothing, sports products and cosmetic products as fashion related product categories dominate in online customer buying decisions. In various markets around the world, consumers of fashion products use online platforms as first point in their search, which help them in purchasing process. Social media platforms provide access to information on a wide range of fashion products, as well as variety of benefits, such as logistics and customer care. Therefore, this article aims to explore the role of social media in customer behaviour regarding fashion products as well as the main factors that affect their purchasing decisions. The starting point in this study was the assumption that social media present a significant factor in the purchasing process and strongly affects customer behaviour. This assumption was related to the theory and practice of purchasing process in fashion industry. In accordance to this, there have been defined the following hypotheses:

H 1: Social media have significant impact on purchasing decisions related to fashion products.

H 2: In the purchasing process of fashion products convenience is the main reason that motivates people to use social media.

The empirical research was conducted in Serbia from January to February 2020 on a sample of 125 respondents.

2. SOCIAL MEDIA IN FASHION INDUSTRY

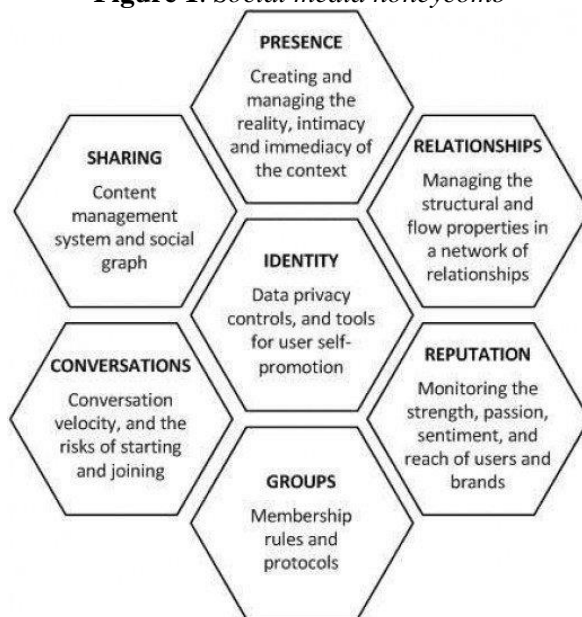
2.1. Social media and modern marketing

From the technological point of view, social media are a set of Internet applications built on the basis of Web 2.0 technologies, which enable the creation and exchange of user generated content (UGC) (Solomon & Tuten, 2018). Web 2.0 technologies were first publicly defined by Tim O'Reilly in his article, pointing out that it is an online technology that provides the freedom and dialogue. In other words, it is a platform that allows users not only to read content, but to actively participate in content creation. This is the essence of the so-called „Horizontal Revolution“. Web 2 is based on openness, innovation and collective intelligence (O'Reilly, 2004).

Jan Kietzmann *et al.* (2011) presented different segments of social media in the form of a honeycomb (Figure 1). The identity functional block represents the

extent to which users reveal their identities in a social media setting. This can include disclosing information such as name, age, gender, profession, location etc. The block of conversions refers to the level of communication between users. Depending on the site, conversation can take place in the form of a like, a tweet, a blog text, comments, pictures, videos, etc. Sharing represents the extent to which users exchange, distribute, and receive content. Block presence refers to the availability of users in a digital environment. This means that the user can indicate whether it is available or unavailable for communication. The relationship block allows the company to see how the users interact with each other. Block reputation refers to the image and position of an organisation or a person in the consciousness of digital users. A large number of factors can affect reputation, such as the consumer's word of mouth, prestigious awards, the quality of the published content, the reputation of people who show confidence in the organisation, integrity and reputation of employees and the owner etc. The groups block represents the extent to which users can form communities and sub communities. The size of the group is measured by the number of likes, followers, friends, contacts.

Figure 1. *Social media honeycomb*

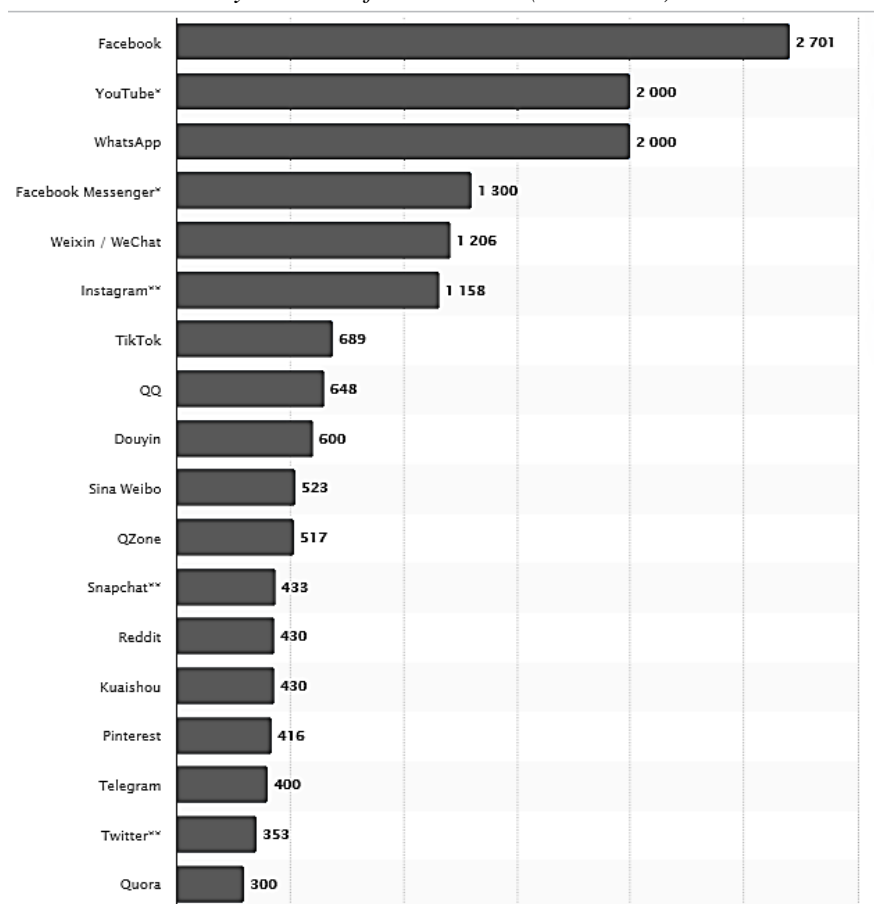


Source: Kietzmann *et al.* (2011)

Social media include blogs, forums, business networks, photo-sharing platforms, social gaming, microblogs, chat apps and social networks. However, one of the most popular online activities worldwide is social networking. According to global statistical organisation, (www.statista.com, 2020), the most dominant social network is Facebook (2,7 billion active users) followed by YouTube and

WhatsApp. Table 1 presents the list of most popular social networks worldwide in 2020.

Table 1. *Most popular social networks worldwide as of October 2020, ranked by number of active users (in millions)*



Source: <https://www.statista.com/statistics/272014/global-social-networks-ranked-by-number-of-users, 2020>

The appearance of social media has made a tremendous influence on marketing, by providing new channels for communication and endless possibilities for product differentiation (Virijević & Doljanica, 2018). Social media marketing is defined as the utilization of social media technologies, channels and software in order to create, communicate, deliver, and exchange offerings that have value for an organisation’s stakeholders (Tuten & Solomon, 2014) . The main goals of social media marketing are:

- to create awareness,
- to support the purchase decision making,

- to stimulate sales,
- to stimulate repeated shopping,
- to satisfy the consumers,
- to develop relationships with brands.

Social media employs mobile and Web –based technologies to share, co- create, discuss, and modify user – generated content (Hollensen *et al.*, 2017).

According to Chaffey and Chadwick (2016) digital media and technology provide new opportunities for the marketing:

- to vary the application of marketing mix;
- to create new possibilities for competitive advantage;
- to build new market positions;
- to enhance innovation and customer relationship management (CRM);
- to provide continuous and instantaneous access to products and services.

In addition, a research by Boston Consulting Group (2012) has shown that investing in digital marketing provides a number of benefits such as:

- Higher brand equity - the use of digital marketing channels increases the perception of the brand by at least 10%,
- Increase in sales - the rate of return increases between 20% and 65%,
- Better service for the consumer - resolving consumer complaints increases by 90%,
- Lower costs - compared to traditional media, digital marketing channels provide savings of up to 80% ;
- Product innovation, digital marketing enables more efficient research and development;
- Higher level of loyalty and high brand awareness.

2.2. The role of social media in fashion industry

According to official statistical data, the most popular product category in online shopping are products related to the fashion industry (Statista Research Department, 2018).

The emergence of digital technologies and the internet has significantly influenced the purchasing behaviour of customers in fashion industry, which takes place in a digital environment. The significance of digital marketing is especially evident when searching for information and evaluating alternatives, as consumers have access to social networks, blogs and web sites on the basis of which they compare prices, quality, make their reservations and payments etc. According to Forte (2020) the fast development of e-commerce, the increasing trust in online payment methods and the rise of mobile telephony are key aspects to the success of online clothing retailing. In the post-purchase phase, the impact

of digital marketing still continues as consumers have been given the opportunity to publicly disclose their comments, recommendations, experiences, which constitute an important segment of the online word of mouth (Virijević & Pijevac, 2018). The segment of sharing is closely related to a social content component of social media, which means that the content can be shared, commented, liked and socialized. However, digital marketing in fashion industry besides the obvious benefits has its negative side. Selling through online platforms sometimes means giving up control over your own brand presentation, and an even bigger threat is that fashion companies sometimes give away important information about their customers.

Over the last five years, fashion brands have become a great inspiration for digital creators who have come up with ideas to integrate technology and fashion. The significance of digital channels in fashion is confirmed in the case of famous brand Zara. By 2018, 12% of Inditex Group's total sales came from the online channel (Moreno, 2020). In compare to traditional branding, the digital branding is based on a two-way communication, which involves the consumer in the discussion, giving him the right to speak up about his satisfaction or dissatisfaction. In that way, marketers have less control over the process of branding because consumers can share their experiences with each other online. According to Jones, Temperley & Lima (2009) new digital technologies have forced the companies to communicate effectively with different audiences in a more transparent way. One of the best examples, which proves this is Fashion Week. The fashion shows integrate styles, designers and brands into so-called “fashion mainstream” where the audience can watch live shows of famous fashion brands live. American fashion designer Alexander Wang hosted a fashion event Fall 2014, held in America in a partnership with brand Uber, which uses the Internet application for its services. Famous fashion brand Rebecca Minkoff joined the Keek Social Media Platform for Fall 2014, in order to enable online sharing of video clips "behind the scenes" (interbrand.com, 2014). Another good example of synergy between innovation, digital technology and fashion is the story of Start-up Rad, showcase of hipster brands in France. This exhibition is presented on the Rad Fashion portal, which shares information about 1,500 fashion-oriented brands for urban population (<https://int.rad.com>, 2020).

Regarding the importance of digital channels in consumer buying behaviour, some well-known platforms have seen their potential for development in the fashion industry. For example, Amazon, Zalando and Myntra have launched their own private label brands of fashion products. According to Wells, Weinstock & Ellsworth (2019) in 2018 Amazon became the largest retailer of apparel in the United States and the second largest in the world, after Alibaba. Zalando, which is successfully launched onto the Berlin start-up scene in 2008, today is one of highest ranking online shop in Germany (Sabanoglu, 2020).

The influence of digital technology in fashion business is particularly correlated with social networks. Therefore, the special statistics is created in order to measure the digital effectiveness of fashion brands. The measures are related to fashion brand likes, followers, tweets, pins, views etc., depending on the type of social network. Table 2 presents rating list of the most successful fashion brands according to the number of their fans on Facebook in 2020.

Table 2. *List of most popular fashion brand on Facebook, 2020*

Fashion brands	
1	Zara
2	H&M
3	Lacoste
4	Burberry
5	The Art of Travel by Louis Vuitton
6	Ray-Ban
7	Chanel
8	Gucci
9	Ralph Lauren
10	Ed Hardy

Source:<https://www.luxuo.com/style/fashion/weekly-facebook-fashion-index.html>, Retrieved 1 November, 2020.

Regarding the impact of digital marketing and social media on fashion industry McKinsey (2020) emphasized in its study that more than two-thirds of fashion players believe that increased exploration of spend on new media platforms vs. ‘traditional’ platforms” will be a top theme in the coming year.

3. METHODS

The starting point in this study was the assumption that social media present a significant factor in the purchasing process and strongly affects customer behaviour in digital environment (Chaffey & Chadwick, 2016; Chaffey & Smith, 2017; Kreutzer, 2018; Githa Heggde & Shainesh, 2018). This assumption is correlated with the purchasing process in fashion industry. In accordance to this, there have been defined the following hypotheses:

H 1: Social media have significant impact on purchasing decisions related to fashion products.

H 2: In the purchasing process of fashion products convenience is the main reason that motivates people to use social media.

3.1. Participants

The empirical research was conducted in the Republic of Serbia from January to February 2020 on a sample of 125 respondents, who purchase fashion product online.

Table 3. *Structure of respondents by gender*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	59	46.8	47.2	47.2
	Male	63	50.0	50.4	97.6
	Prefer not to say	3	2.4	2.4	100.0
	Total	125	99.2	100.0	
Missing	System	1	.8		
Total		126	100.0		

Note. Calculated by the authors.

Regarding the gender, the structure of the sample was the following: male 50% (63 respondents), female 46,8% (59 respondents), prefer not to say 2,4% (3 respondents). Based on the following statistics presented in Table 3 we can conclude that the sample is approximately equalized in terms of gender.

Table 4. *Structure of respondents by age*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18 - 25	63	50.0	50.4	50.4
	26 - 40	32	25.4	25.6	76.0
	41 - 50	17	13.5	13.6	89.6
	51 -65	8	6.3	6.4	96.0
	65-	5	4.0	4.0	100.0
	Total	125	99.2	100.0	
Missing	System	1	.8		
Total		126	100.0		

Note. Calculated by the authors.

Sample description regarding the age of respondents is presented in Table 4. The majority of respondents (50%) belongs to the age category 18-25. On the other hand, the lowest percentage of respondents (4%) refers to the age category 65+.

3.2. Instruments

The research includes the theoretical and empirical approach in order to explore the role of social media in customer behaviour regarding fashion products. During the statistical data processing, the following techniques and methods were implemented: the descriptive statistical measures (frequencies and percentage, arithmetical midranges), the measures of variability and the correlation technique. Pearson Correlation was applied in order to find the relations between the variables. In interpreting the obtained data SPSS program was used, with its functions of descriptive statistics and correlation.

4. RESULTS

The survey indicated that the majority of respondents (39, 7%) use social media as the first search point in their purchasing process of fashion products. Second important search point are search engines (32,5%), followed by transaction websites (23%). These findings are presented in Table 5.

Table 5. *First search points in purchasing process of fashion products*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	search engine	41	32.5	32.8	32.8
	social media	50	39.7	40.0	72.8
	Catalogue	5	4.0	4.0	76.8
	transaction websites	29	23.0	23.2	100.0
	Total	125	99.2	100.0	
Missing	System	1	.8		
Total		126	100.0		

Note. Calculated by the authors.

The research has also examined the motives for purchasing fashion products online. The results (Table 6) showed that the majority of respondents (56,3%) stated convenience as the main motive for purchasing online, followed by transparency (27%).

Table 6. *Motive for online purchase*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Convenience	71	56.3	56.8	56.8
	transparency	34	27.0	27.2	84.0
	low costs	20	15.9	16.0	100.0
	Total	125	99.2	100.0	
Missing	System	1	.8		
Total		126	100.0		

Note. Calculated by the authors.

An interesting finding came from the questioning respondents about the payment method that they usually use when purchasing fashion products online. The majority of respondents (56,3%) declared that they use Cash on Delivery (COD) as a main method of payment (Table 7). This finding was surprising, considering the official statistical data according to which PayPal is the most dominant method of payment in online shopping worldwide (Raynor de Best, 2020).

Table 7. *Method of payment in purchasing fashion products online*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	PayPal	26	20.6	20.8	20.8
	Credit card	28	22.2	22.4	43.2
	Cash on Delivery (COD)	71	56.3	56.8	100.0
	Total	125	99.2	100.0	
Missing	System	1	.8		
Total		126	100.0		

Note. Calculated by the authors.

One of the reasons that affected customers to use COD as a method of payment can be seen in the answers concerning the main risks in using social media for purchasing fashion products. According to the findings presented in Table 8, the majority of respondents (50%) recognised financial fraud as the main risk.

Table 8. *Main risks in using social media for purchasing fashion products*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	false information about the product	22	17.5	17.6	17.6
	financial fraud	63	50.0	50.4	68.0
	data privacy	32	25.4	25.6	93.6
	slow internet connection	8	6.3	6.4	100.0
	Total	125	99.2	100.0	
Missing	System	1	.8		
Total		126	100.0		

Note. Calculated by the authors.

The survey has also indicated that the majority of respondents (50%) stated Instagram as the main social network that they use when making purchasing decisions regarding fashion products. In second place is Facebook (47,6%).

During the research we were particularly interested to find out whether the respondent's age is important when choosing a social network for making purchasing decisions about fashion products. In order to examine the relations between these two variables, we have applied the correlation method. The results presented in Table 9 show the existence of high negative Pearson Correlation ($r = -.705$).

Table 9. *Correlations between respondent's age and the type of social network that they use in purchase*

		Age	What social network do you use in your purchase
Age	Pearson Correlation	1	-.705**
	Sig. (2-tailed)		.000
	N	125	125
What social network do you use in your purchase	Pearson Correlation	-.705**	1
	Sig. (2-tailed)	.000	
	N	125	125

** . Correlation is significant at the 0.01 level (2-tailed).

Note. Calculated by the authors.

Another important research question referred to the factors that affect purchasing decisions on social media related to fashion products. Regarding this issue the study indicated that the most important factors are content (51,6% of

respondents) and reviews and recommendations (35,7%). The results are presented in Table 10.

Table 10. *The most important factor in social media affecting buying decisions*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Content	65	51.6	52.0	52.0
	Influencers	4	3.2	3.2	55.2
	popularity of social media	5	4.0	4.0	59.2
	reviews and recommendations	45	35.7	36.0	95.2
	comparing prices	6	4.8	4.8	100.0
	Total	125	99.2	100.0	
Missing	System	1	.8		
Total		126	100.0		

Note. Calculated by the authors.

In order to examine the correlation between the factors presented in table and the type of social network that respondents use when buying fashion products Pearson Correlation was applied. The results (Table 11) has shown the existence of high negative Pearson Correlation ($r = -.759$).

Table 11. *Correlations between the type of social network and the most important factors in social media affecting buying decisions.*

		Correlations	
		What social network do you use in your purchase	The most important factor in social media affecting buying decisions
What social network do you use in your purchase	Pearson Correlation	1	-.759**
	Sig. (2-tailed)		.000
	N	125	125
The most important factor in social media affecting buying decisions	Pearson Correlation	-.759**	1
	Sig. (2-tailed)	.000	
	N	125	125

** . Correlation is significant at the 0.01 level (2-tailed).

Note. Calculated by the authors.

Table 12. *Respondent's answers related to the question "Did you use social media in order to share your impressions about the purchase?"*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	74	58.7	59.2	59.2
	No	51	40.5	40.8	100.0
	Total	125	99.2	100.0	
Missing	System	1	.8		
Total		126	100.0		

Note. Calculated by the authors.

Regarding the fact that sharing represents an important segment of social media the survey has examined whether customers from the sample share their experience about the purchase. The findings indicated that the majority of respondents (58,7%) use social media in order to share their impressions about the purchase of fashion products online (Table 12).

Bearing in mind the result, marketers in fashion industry have to consider that there is a significant number of respondents who are not ready to openly exchange information about their purchase. In order to engage the passive customers to participate in content sharing via social media, the marketing will have to create effective digital strategies and find adequate motives that will affect the customer online behaviour.

CONCLUSION

The emergence of Web 2.0. and social media have brought new models of communication for consumers as well, who became important spokesmen in the modern digital environment of organisations. Therefore, today we can use the term online or digital customer behaviour. This article had intention to analyse the role of social media in customer purchasing behaviour related to fashion products. The empirical research was conducted in the Republic of Serbia on a sample of 125 respondents, who purchase fashion products online.

The survey indicated that the majority of respondents (39, 7%) use social media as the first search point in their purchasing process of fashion products. The main factors that affect their purchasing decisions on social media are content (51,6% of respondents) and reviews/recommendations (35,7%). The research has also examined the most dominant motives for purchasing fashion products online. The majority of respondents (56,3%) stated convenience as the main motive for purchasing online. While, second important motive (27%) is transparency.

Regarding the type of social network that respondents use when making purchasing decisions about fashion products, the results indicated that Instagram is the most dominant network. Furthermore, these findings have been related to the respondent's age. In order to determine correlation between the variables statistical correlation method was applied. The results has shown the existence of high negative Pearson Correlation ($r = -.759$). Another application of correlation method examined variables such as type of social network that respondents use and the most important factors in social media that affect their buying decisions. The results have indicated high negative Pearson Correlation ($r = -.759$).

The article has also analysed payment methods that respondents use when buying fashion products online. The majority of respondents (56,3%) declared that they use Cash on Delivery (COD) as a main method of payment. This finding was different in compare to the official statistical data according to which PayPal is the most dominant method of payment in online shopping worldwide. One of the reasons that affected respondents to use COD as a method of payment can be seen in the answers concerning the main risks in

using social media for purchasing fashion products. According to the findings presented in this research, the majority of respondents (50%) recognised financial fraud as the main risk.

The presented results confirm the research hypothesis and give insight in online customer behaviour in fashion industry. However, the research has some limitations. One of them is that the survey was conducted before the global covid epidemic. The question is whether the answers of the respondents would differ significantly if it is known that the epidemic led to more intensive use of online shopping. Another limitation refers to the small number of variables. Therefore, further research should provide deeper insight in the problem of digital marketing and online customer behaviour in fashion industry.

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Verification of the LT-contradiction matrix using the TRIZ standards

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Abstract: Contradictions occur when one wants to improve any parameter of the engineering system (ES), which automatically leads to the deterioration of another parameter associated with it. The LT-Contradiction Matrix is a new inventory tool used to find the Ideal Final Solution (IFS) to problems. It contains 64 parameters which are used to describe ES, and whose mutual multiplication gives a solution of 3210 different contradictions. The starting point for the development of this tool is represented by two independent dialectical tools: the TRIZ contradiction matrix and the LT table of physical quantities. Verification of the reliability of the LT-Contradiction Matrix has been proven using 76 standards as a proven TRIZ tool in practice. This paper demonstrates the practical application of the LT-Contradiction Matrix and the TRIZ standards on the same example of the inventive construction of Filtering Protective Suit which leads to similar IFS to problems in both cases.

Keywords: LT-Contradiction Matrix, TRIZ Standards, Inventology
JEL: O1

1. INTRODUCTION

Innovative creativity is crucially influenced by natural physical laws and the laws of development of engineering systems (ES). Bartini-Kuznetsov's LT-table is suitable for mathematical-physical representation of natural conservation laws (Bolshakov & Petrov, 2017). The LT-system or a system based on length (L) and time (T) is based on the axiom of equality between inertial and gravitational mass, using the expression L^3T^{-2} (Bartini, 1965). By applying the LT-system of physical units on a dialectical principle, there is a decrease in subjectivity in the decision-making process because it is possible to accurately, by multiplying the parameters, describe any ES that is innovated (Rajic, 2019a). The disadvantage of the LT-table is reflected in the fact that there are certain fields in it that contain LT units that have not yet been identified.

The theory of inventive problem solving (TIPS / rus. abbr. TRIZ) is an empirical science, created on the basis of the discovery of the laws of development of the EC, which are stored in the patent documentation (Rajić, 2017). It consists of a

set of tools. The contradiction matrix is one of the main tools of TRIZ. The main mechanism is based on the detection of technical contradictions (TC) that exist between the ES and ecological systems and finding ideas for solving problems using the proposed TRIZ principles (Rajic, 2019b). The matrix simultaneously considers the application of 39 TS parameters, 40 TRIZ principles and 6 types of resources (Rajic, 2019b). TRIZ matrix is very efficient in finding solutions to various innovative problems. However, while TRIZ principles for TC removal indicate to the innovator a general path and a fairly broad area within which to seek a solution, TRIZ standards recommend specific actions leading to IFS to problems (Rajic, 2018). Functionally oriented research (FOR) is one of the relatively modern TRIZ tools, and involves the algorithmic use of successfully applied analogy in solving problems taken from distant areas of technology in relation to the area to which the initial problem belongs (Litvin, 2004). In addition to the aforementioned TRIZ tools, it is important to point out the algorithm for solving inventive tasks (ARIZ, rus. abbr.) as the most powerful TRIZ tool that can be used to solve problems of various etiologies and complexities, at any stage of their development (Rajic, 2017, 2019b). The main weakness of TRIZ is that it represents a heuristic methodology based on a logical-descriptive methodology. This contributes to increasing the share of subjectivity in the effort to find the ideal solution to the problem. Since the IFS of a problem can only be one, independent of the authors trying to define it, then it needs to be defined with high mathematical precision. This can be achieved if TRIZ is integrated with an adequate mathematical-physical methodology based on the same dialectical principle. The invariant space-time language given in Bartini-Kuznetsov's LT-table of physical units serves to solve inventive problems on a dialectical basis, such as TRIZ (Rajic, 2020). In TRIZ, the starting point is inductive reasoning, and in LT-system, deductive reasoning. Since both systems dialectically search for the IFS contradictions that underlie each problem, an inventory LT-matrix of contradictions is proposed, which combines these two methodologies and at the same time eliminates their individual shortcomings, thus enabling inductive-deductive reasoning when selecting IFS to problems. Its role is to increase efficiency in finding IFS to problems in relation to the individual use of the above tools.

An attempt to merge ARIZ as the most complex tool of TRIZ and the Bartini-Kuznetsov's LT system is given in several papers (Bushuev, 2004, 2005, 2006a, 2006b; Wei *et al.*, 2009). In Rajic's works, the correlation between TRIZ contradiction matrix and LT-system was confirmed (Rajic, 2019a, 2020). As a final result of these studies, an LT-matrix of contradictions emerged. Since the LT-contradiction matrix is an absolutely new tool of inventology, it is necessary to evaluate it using other, in practice validated tools such as e.g. the TRIZ standard. Therefore, the aim of this paper is to verify the validity of the LT-matrix of contradictions on a comparative case analysis using the TRIZ standards.

2. LT- PHYSICAL UNITS SYSTEM

Maxwell wrote about the possibility of creating systems of units of measure based only on length (L) and time (T) as far back as 1873, relying on Kepler's 3rd law and Newton's 2nd law (Chujev, 2007). If the rotation of the Earth and its inhomogeneity, as well as the deviation from the regular spherical shape, is neglected, the weight (F) of an object of mass (m) on or near the Earth's surface is equal to the gravitational force:

$$F=G (m_1m_2/r^2). \quad (1)$$

where F is force (body weight), G-gravity constant (dimensionless) which equals 1, m_1 -mass of body 1, m_2 -mass of body 2 on the Earth's surface, r^2 -distance between the center of the bodies, or:

$$F=m_1a=m_1m_2/r^2. \quad (2)$$

where m is the mass of the body on the Earth's surface, and the acceleration $a = G (m_2/r^2)$, where a is the acceleration of the Earth's gravity on its surface, which decreases with increasing body distance from the Earth. The force of the Earth's gravity (gravitational pull by the Earth) acts on the body, and the weight of the body acts on the substrate (or other body). Therefore, the mass dimension (m_2) is defined as the product of the acceleration dimension (LT^{-2}) and the dimension of the spatial expansion square (L^2). As a result, the dimension of mass in the LT dimension table looks like this:

$$[M]=L^3T^{-2}. \quad (3)$$

This value uniquely determines the mass of the Sun, or it can be otherwise said that it is determined by it. For the mathematical representation of operations with the combination of different physical properties, a comparative system of kinematic quantities according to Bartini (1965) and the SI system of physical quantities can be compared. It turns out that the interconnectedness of physical quantities does not depend on the system in which they were given (Chujev, 2003, 2004, 2007).

Bartini observed the regular relationships between physical constants and presented them in the form of a kinematic system of physical quantities, and together with Kuznetsov developed a geometric direction in the study of physical dimensions (Bartini & Kuznetsov, 1978). It is intuitively clear that an LT physical size chart could have significant practical value for innovators. However, they did not leave information on its possible practical application, nor did they in any way associate it with TRIZ. If you look at Bartini's Table, it is observed that the vertical columns of the kinematic system contain a series of whole degrees of length (from L^{-2} to L^6) and the horizontal rows contain a series

of integers of degrees of time (from T^{-6} to T^3) (Bushuev, 2008). The intersection of each column and each row gives a dimension of a certain physical size. The dimensions of all physical quantities are represented as a product of the whole degree, $L^n T^m$, where $|n + m| \leq 3$ for three-dimensional space. Bartini's Table expresses the physical laws of conservation.

For example, by equating the dimension of a cell $L^1 T^0$ to a constant, one obtains the law of conservation of the length of a solid: $L = \text{const.}$ Equation $L^{+5} T^{-4} = \text{const.}$ gives the energy conservation law. Equation $L^{+2} T^{-4} = \text{const.}$ reflects Hooke's law. Equation $L^{+3} T^{-2} = \text{const.}$ is Kepler's law (the ratio of planetary cubic radius and square of rotation is constant). A very important and useful feature of Bartini's table is that each cell, or a corresponding law it contains, has a certain volume of object grouped into classes. Indeed, many cells contain not just one physical size, but several. For example, there are two physical quantities in cell $L^{+3} T^{-2}$: mass and amount of charge, in cell $L^{+1} T^0$ there are three quantities: length, capacitance, self-induction, etc. Moreover, many cells can be added even though they are not listed in Bartini's physical size chart. For example, in the SI system, thermal conductivity is measured in $[WT/m \cdot K]$.

If the power dimension $L^{+5} T^{-5}$ is put in place of Watt and instead of Kelvin the temperature dimension $L^{+5} T^{-4}$, then thermal conductivity must be added to the cell with dimension $L^{-1} T^{-1}$. According to the SI system, the mass flow rate is measured in $[kg/s]$. If the dimension kilogram is replaced by the force $L^{+4} T^{-4}$, then the value $L^{+4} T^{-5}$ is obtained. As you can see in the original table (literatura), this size is not so specified. Since there is no kilogram - force in the dimension $[kg/s]$, but there is a kilogram - mass, then $L^{+3} T^{-3}$ is obtained. The strength of classification is that each class contains an "invariant" property, i.e., a property that is represented in all elements of this class. Kuznetsov calls this object an entity or essence. What is the invariance or essence of length, capacity, and self-induction for an innovator in his inventive tasks? The fact is that they all have the same physical dimension $L^{+1} T^0$. Therefore, when there are length, capacity, or self-induction properties in an inventive problem, these properties can be operationally utilized by the same methods. The same is true of something similar to what is called the "similarity criterion", when conservation laws are different in different fields of physics and have the same mathematical structure. For example, if in mechanics there is (in any formula) length expressed by square meter, then in a similar formula for electricity, capacity will also be expressed by squared symbol.

3. TRIZ STANDARDS

TRIZ standards for solving inventive tasks are the rules of transformation of ES, which directly derive from the law of their development (Rajic *et al.*, 2015; Rajic & Cabarkapa, 2016). Therefore, many examples illustrating the effect of the law of evolution of ES can be used as examples of the realisation of the

standard. There are 76 standards, which are divided into 5 large classes and 18 groups (Livotov & Petrov, 2013; Rajić *et al.*, 2016). In order to solve the problem, it is first necessary to find out which class of standards it belongs to, and then to which group. Special attention should be given to the fifth class of standards. It is applied when complications arise in search of substances or fields that are missing. This class increases the degree of idealism of ES on which it is working, because it is focused on the maximum use of resources that exist in the given system. The main disadvantage of the classic implementation of the TRIZ standard is that they generally offer general recommendations for their use, while not considering the ecological aspects of innovation at all. However, using the Eco-Innovative Matrix based on the TRIZ Standards (Rajic, 2018, 2019b), the innovator is making it easier to use this powerful tool and it can be more effective to come up with a solution to the eco-innovative problem which TCs are hiding.

In the paper of Domb *et al.* (1999) the link is shown between 76 TRIZ standards and 40 TRIZ principles, which was used as a starting idea for the creation of the Eco-Innovative Matrix based on TRIZ Standards (Rajic, 2018, 2019b). Working with the Eco-Innovative Matrix based on the TRIZ Standards starts by selecting one of the 39 ES parameters that is to be improved from the ecological aspect in the horizontal line. The type of environmental improvement is listed next to the parameter, by A-G. The Matrix user in the thought process needs to conclude which parameter of the 39 possible ones in the horizontal line of the Matrix will worsen as a consequence of the previous, desired environmental improvement. They are analysed in order of the proposed standards in the Matrix cell resulting from crossing the parameter from the column and the line. In the end, the TRIZ Standards that are most promising in finding the solution to TC problems are being selected.

4. LT- CONTRADICTION MATRIX

Innovators must recognize the feature they want to improve as one of the 39 standardized TRIZ parameters that describe any ES. If they are not able to do so, then they consider the most appropriate TRIZ parameter that corresponds to it essentially. They do the same thing when it comes to identifying a defective parameter. However, the application of the similarity criterion leads to a departure from the substance of the problem, thus making reaching an IFS to problems more difficult. In case of applying the Contradiction Matrix, by intersecting the parameters that are being improved with those that deteriorate automatically, it is proposed in the cells of the matrix to use several different TRIZ principles out of a total of 40 defined, the application of which would most probably resolve the TC. This way, over 1200 different TCs that exist in ES can be solved (Rajic, 2019b). The TRIZ principles in the cells of the contradiction matrix are listed in the order that most likely leads to the solution of the problem, and they were obtained by the statistical study of patents that had

the same TC at the root of their problem. If, nevertheless, no solution is found, then it is suggested to try to find a solution by playing all 40 TRIZ principles (Rajić, 2016). If all the TRIZ principles are completely inapplicable, then the TC should be reformulated so as to achieve some new acceptable concept of a working solution to the problem. These suggestions indirectly confirm the insufficient effectiveness of TRIZ's contradiction matrix. Due to the above facts, certain authors have been trying to create their modified versions of the contradiction matrix, adapting them to various fields of creativity (economics, business, management, pedagogy, chemical technology, etc.) (Rajić, 2017, 2019b). Improvements to the classic contradiction matrix were also attempted by adding or subtracting the number of rows or columns of the matrix, changing the name of the 39 technical parameters, adding new cells to the matrix, or filling in the "empty" matrix cells, adjusting the matrix to the user based on some personal experience, using various mathematical models that would lead to the random selection of matrix cells, etc. (Coelho, 2009; Cherifi *et al.*, 2015; Mann & Dewwulf, 2003). Although such attempts were made with the best of intentions, they did not contribute to a significant improvement in the effectiveness of the adversarial matrix.

The TRIZ matrix cannot guarantee the solution of some complex technical problem without its deeper analysis by the innovator. For the users of the TRIZ matrix, it is therefore recommended to formulate several TCs for a single problem situation, that is, to form a set of recommended principles. Proper implementation of the matrix means that a solution to a technical problem should be sought when the principles are "recommended" more than 3 times during the analysis of a problem situation, and the principle recommended only once should be ignored. In any case, this approach helps to understand and document a number of basic TCs in a system that can be of great importance for problem analysis. One of the main weaknesses of the matrix, but also of TRIZ as a whole, is that it represents a heuristic methodology, based on empirical knowledge and logical-descriptive methodology (Rajic, 2019a, 2019c). This contributes to increasing the share of subjectivity in finding solutions to problems. However, the ideal solution can be only one, independent of the author trying to define it, and therefore it should be defined with high mathematical precision. The use of space-time (LT) - a system of physical units can reduce subjectivity in the decision-making process. Likewise, using the LT system, it is possible to accurately describe not only the engineering parameters and principles contained in the problem, but also the economic, environmental, biological, chemical and some other parameters (Bolshakov & Petrov, 2017). Multiplying the two LT units gives the product a new LT unit that provides "both this and that", which is similar to solving a TC in TRIZ's contradiction matrix. For the mathematical representation of operations with the combination of different physical properties, a comparative system of kinematic quantities according to (Bartini, 1965) and an SI system of physical quantities (Rajic,

2020) can be compared. It turns out that the interconnectedness of physical quantities does not depend on the system in which they were given (Rajic, 2019a; Chujev, 2003, 2004). The paper (Rajic, 2020) proved the existence of 18 of 39 TRIZ parameters as basic LT-units, while the remaining 21 parameters and all 40 TRIZ principles represent state expressions. A detailed description of each individual TRIZ parameter is given in the literature (Domb, 1998; Mann & Dewwulf, 2003; Coelho, 2009). Bartini's LT - table can easily find TRIZ parameters classified as basic physical units (1-11, 15-17, 19, 21, 23 and 27). However, other TRIZ parameters, which are classified as condition expressions, cannot be found in the LT - table. They can be reached through mathematical and physical unless you know the value of TRIZ parameters displayed as LT - size, then multiplication or division two known values identify an unknown parameter or TRIZ parameter or TRIZ principle as condition expression. When combining the use of TRIZ's contradiction matrix and LT table, the basic and derived physical units have a convincingly high frequency of occurrence, i.e., extremely large number of repetitions of one LT - unit, while in the expression of state there are more LT - units that have the same frequency of occurrence.

The LT - contradiction matrix (Table 1) was constructed by combining TRIZ contradiction matrix and Bartini-Kuznetsov's LT table. Crossing the two TRIZ parameters yields a cell containing the suggested TRIZ principles presented in the order whose use is most likely to resolve the contradiction. If these two parameters are presented as LT-magnitudes, then their multiplication (or division), or addition (subtraction) of their exponents results in a new LT-magnitude corresponding to the first proposed TRIZ principle, or one whose application would be most likely provide a solution to the contradiction. This way the 21 TRIZ parameter and all 40 TRIZ principles representing state expressions can nevertheless be displayed as basic LT units. In the Bartini-Kuznetsov's LT table, on the other hand, some LT units are known and studied in detail, so they are taken as such in the LT contradiction matrix. This way the 64 parameters were obtained in the LT - contradiction matrix. Each of these 64 parameters can be seen as a parameter that is either repaired or broken or represents a solution to the contradiction. If the LT product of the parameter being repaired and the one being corrupted is not among the 64 specified LT parameters (eg. $L^{18}T^{-16}$), then this unit L^mT^n indicates that the contradiction solution is in a genetic trend whose value is 2 ($m + n = 18 - 16 = 2$) and IFS problems in the form of the required X-resource can be any member of that genetic group. The parameters belonging to the specific genetic group in Table 1 are indicated by numbers: -3, -2, -1, 0, 1, 2 and 3.

Table 1. *The Part of LT- Contradiction Matrix*

CHARACTERISTICS			Worsening Feature																					
			LT	Gen	1	2	3	4	5	6	7	...												
Improving Feature	1	Pressure change	L^2T^{-5}	-3																				
	2	Pressure gradient	L^1T^{-4}																					
	3	Change angular acceleration	L^0T^{-3}																					
	4	Bulk density gradient	$L^{-1}T^{-2}$																					
	5	Preliminary action	L^7T^{-9}	-2																				
	6	Phase transition	L^6T^{-8}																					
	7	Poynting vector	L^3T^{-5}																					
	8	Pressure	L^2T^{-4}																					
	9	Current density	L^1T^{-3}																					
	10	Angular acceleration	L^0T^{-2}																					
	11	Volume charge density	$L^{-1}T^{-1}$																					
	12	Feedback	L^8T^{-9}	-1						L^{15} T^{-18}	L^{14} T^{-17}	L^{11} T^{-14}												
	13	Inert environment	L^7T^{-8}							L^{14} T^{-17}	L^{13} T^{-16}	L^{10} T^{-13}												
	14	Composite materials	L^6T^{-7}							L^{13} T^{-16}	L^{12} T^{-15}	L^9 T^{-12}												
	15	Change of power	L^5T^{-6}							L^{12} T^{-15}	L^{11} T^{-14}	L^8 T^{-11}												
	16	Change in force	L^4T^{-5}							L^{11} T^{-14}	L^{10} T^{-13}	L^7 T^{-10}												
	17	Surface tension; Acceleration of flow	L^3T^{-4}							L^{10} T^{-13}	L^9 T^{-12}	L^6 T^{-9}												
	18	Electromagnetic field strength; Dynamic viscosity	L^2T^{-3}							L^9 T^{-12}	L^8 T^{-11}	L^5 T^{-8}												
	19	Acceleration; Magnetic displacement	L^1T^{-2}							L^8 T^{-11}	L^7 T^{-9}	L^4 T^{-7}												
	20	Frequency	L^0T^{-1}							L^7 T^{-10}	L^6 T^{-9}	L^3 T^{-6}												
	21	Space curvature	$L^{-1}T^0$							L^6 T^{-9}	L^5 T^{-8}	L^2 T^{-5}												
	22	Permeability	$L^{-2}T^1$						L^5 T^{-8}	L^4 T^{-7}	L^1 T^{-4}													
	23	Changing the physico-chemical parameters of the object	$L^{10}T^{-10}$		L^{12} T^{-15}	L^{11} T^{-14}	L^{10} T^{-13}	L^9 T^{-12}	L^{17} T^{-19}	L^{16} T^{-18}	L^{13} T^{-15}													

	24	Copying	L^9T^{-9}	0	$L^{11}T^{-14}$	$L^{10}T^{-13}$	L^9T^{-12}	L^8T^{-11}	$L^{16}T^{-18}$	$L^{15}T^{-17}$	$L^{12}T^{-14}$		
	25	Intensivity (rate of maneuverability)	L^7T^{-7}		L^9T^{-12}	L^8T^{-11}	L^7T^{-10}	L^6T^{-9}	$L^{14}T^{-16}$	$L^{13}T^{-15}$	$L^{10}T^{-12}$		
	26	Mobility; Loss of energy a mobile object	L^6T^{-6}		L^8T^{-11}	L^7T^{-10}	L^6T^{-9}	L^5T^{-8}	$L^{13}T^{-15}$	$L^{12}T^{-14}$	L^9T^{-11}		
	27	Power; Stationary object energy loss	L^5T^{-5}		L^7T^{-10}	L^6T^{-9}	L^5T^{-8}	L^4T^{-7}	$L^{12}T^{-14}$	$L^{11}T^{-13}$	L^8T^{-10}		
	28	Force; Reliability; Loss of mass a mobile object	L^4T^{-4}		L^6T^{-9}	L^5T^{-8}	L^4T^{-7}	L^3T^{-6}	$L^{11}T^{-13}$	$L^{10}T^{-12}$	L^7T^{-9}		
	29	Loss of mass a stationary object; Flow (rate of mass change)	L^3T^{-3}		L^5T^{-8}	L^4T^{-7}	L^3T^{-6}	L^2T^{-5}	$L^{10}T^{-12}$	L^9T^{-11}	L^6T^{-8}		
	30	Potential defference; Loss of information	L^2T^{-2}		L^4T^{-7}	L^3T^{-6}	L^2T^{-5}	L^1T^{-4}	L^9T^{-11}	L^8T^{-10}	L^5T^{-7}		
	31	Speed	L^1T^{-1}		L^3T^{-6}	L^2T^{-5}	L^1T^{-4}	L^0T^{-3}	L^8T^{-10}	L^7T^{-9}	L^4T^{-6}		
	32	Dimensionless constants; Loss of time of a stationary object	L^0T^0		L^2T^{-5}	L^1T^{-4}	L^0T^{-3}	$L^{-1}T^{-2}$	L^7T^{-9}	L^6T^{-8}	L^3T^{-5}		
	33	Conductivity	$L^{-1}T^1$		L^1T^{-4}	L^0T^{-3}	$L^{-1}T^{-2}$	$L^{-2}T^{-1}$	L^8T^{-8}	L^5T^{-7}	L^2T^{-4}		
	34	Magnetic permittivity	$L^{-2}T^2$		L^0T^{-3}	$L^{-1}T^{-2}$	$L^{-2}T^{-1}$	L^3T^0	L^5T^{-7}	L^4T^{-6}	L^1T^{-3}		
	35	Partial or excessive actions	$L^{10}T^{-9}$		$L^{12}T^{-14}$	$L^{11}T^{-10}$	$L^{10}T^{-12}$	L^9T^{-11}	$L^{17}T^{-18}$	$L^{16}T^{-17}$	$L^{13}T^{-14}$		
		36	Antiweight		L^9T^{-8}	1	$L^{11}T^{-13}$	$L^{10}T^{-12}$	L^9T^{-11}	L^8T^{-10}	$L^{16}T^{-17}$	$L^{15}T^{-16}$	$L^{12}T^{-13}$
37		Flexivity (rate of operability)	L^8T^{-7}	$L^{10}T^{-12}$	L^9T^{-11}		L^8T^{-10}	L^7T^{-9}	$L^{15}T^{-16}$	$L^{14}T^{-15}$	$L^{11}T^{-12}$		
38		Maneuverability (displacement of mobility)	L^7T^{-6}	L^9T^{-11}	L^8T^{-10}		L^7T^{-9}	L^6T^{-8}	$L^{14}T^{-15}$	$L^{13}T^{-14}$	$L^{10}T^{-11}$		
39		Extencia (Use of energy by moving object)	L^6T^{-5}	L^8T^{-10}	L^7T^{-9}		L^6T^{-8}	L^5T^{-7}	$L^{13}T^{-14}$	$L^{12}T^{-13}$	L^9T^{-10}		
40		Temperature; Energy spent by a stationary object	L^5T^{-4}	L^7T^{-9}	L^6T^{-8}		L^5T^{-7}	L^4T^{-6}	$L^{12}T^{-13}$	$L^{11}T^{-12}$	L^8T^{-9}		
Impro	41	Mass of mobile object; The law of conservation of impulses	L^4T^{-3}		L^6T^{-8}	L^5T^{-7}	L^4T^{-6}	L^3T^{-5}	$L^{11}T^{-12}$	$L^{10}T^{-11}$	L^7T^{-8}		

	42	Weight of stationary object	L^3T^{-2}	1	L^5 T^{-7}	L^4 T^{-6}	L^3 T^{-5}	L^2T^{-4}	L^{10} T^{-11}	L^9 T^{-10}	L^6 T^{-7}	
	43	Length of moving object; Kinematic viscosity	L^2T^{-1}		L^4 T^{-6}	L^3 T^{-5}	L^2T^{-4}	$L^1 T^{-3}$	L^9 T^{-10}	L^8T^{-9}	L^5 T^{-6}	
	44	Length of stationary object	L^1T^0		L^3 T^{-5}	L^2 T^{-4}	L^1 T^{-3}	L^0T^{-2}	L^8 T^{-9}	L^7 T^{-8}	L^4 T^{-5}	
	45	Period; Duration of action by stationary object	L^0T^1		L^2 T^{-4}	L^{12} T^{-13}	L^0 T^{-2}	L^{-1} T^{-1}	L^7 T^{-8}	L^6 T^{-7}	L^3 T^{-4}	
	46	Equipotentiality	$L^{10}T^{-8}$	2	L^{12} T^{-13}	L^{11} T^{-12}	L^{10} T^{-11}	L^9 T^{-10}	L^{17} T^{-17}	L^{16} T^{-16}	L^{13} T^{-13}	
	47	Application of phase transitions	L^9T^{-7}		L^{11} T^{-12}	L^{10} T^{-11}	L^9 T^{-10}	L^8T^{-9}	L^{16} T^{-16}	L^{15} T^{-15}	L^{12} T^{-12}	
	48	Operability	L^8T^{-6}		L^{10} T^{-11}	L^9 T^{-10}	L^8 T^{-9}	L^7T^{-8}	L^{15} T^{-15}	L^{14} T^{-14}	L^{11} T^{-11}	
	49	Expancia (area spread of power)	L^7T^{-5}		L^9 T^{-10}	L^8 T^{-9}	L^7 T^{-8}	L^6T^{-7}	L^{14} T^{-14}	L^{13} T^{-13}	L^0 T^{-2}	
	50	Linergia	L^6T^{-4}		L^8 T^{-9}	L^7 T^{-8}	L^6 T^{-7}	L^5T^{-6}	L^{13} T^{-13}	L^{12} T^{-12}	L^9 T^{-9}	
	51	Angular momentum; Action	L^5T^{-3}		L^7 T^{-8}	L^6 T^{-7}	L^5 T^{-6}	L^4T^{-5}	L^{12} T^{-12}	L^{11} T^{-11}	L^8 T^{-8}	
	52	Magnetic Moment; Moment of mass; Linear transport work	L^4T^{-2}		L^6 T^{-7}	L^5 T^{-6}	L^4 T^{-5}	L^3T^{-4}	L^{11} T^{-11}	L^{10} T^{-10}	L^7 T^{-7}	
	53	Area of moving object; Loss of substance	L^3T^{-1}		L^5 T^{-6}	L^4 T^{-5}	L^3 T^{-4}	L^2T^{-3}	L^{10} T^{-10}	L^9 T^{-9}	L^6 T^{-6}	
	54	Area of a stationary object	L^2T^0		L^4 T^{-5}	L^3 T^{-4}	L^2 T^{-3}	L^1T^{-2}	L^9 T^{-9}	L^8 T^{-8}	L^5 T^{-5}	
	55	Distance duration	L^1T^1		L^3 T^{-4}	L^2 T^{-3}	L^1 T^{-2}	L^0T^{-1}	L^8 T^{-8}	L^7 T^{-7}	L^4 T^{-4}	
	56	Surface time	L^0T^2		L^2 T^{-3}	L^{11} T^{-11}	L^0 T^{-1}	$L^{-1}T^0$	L^7 T^{-7}	L^6 T^{-6}	L^3 T^{-3}	
	57	Dynamicity	L^9T^{-6}		3	L^{11} T^{-11}	L^{10} T^{-10}	L^9 T^{-9}	L^8T^{-8}	L^{16} T^{-15}	L^{15} T^{-14}	L^{12} T^{-11}
	58	Volupower (3D volumetric spread of power)	L^8T^{-5}	L^{10} T^{-10}		L^9 T^{-9}	L^8 T^{-8}	L^7T^{-7}	L^{15} T^{-14}	L^{14} T^{-13}	L^{11} T^{-10}	
	59	Arergation (area spread of energy)	L^7T^{-4}	L^9 T^{-9}		L^8 T^{-8}	L^7 T^{-7}	L^6T^{-6}	L^{14} T^{-13}	L^{13} T^{-12}	L^{10} T^{-9}	
	60	Moment of action	L^6T^{-3}	L^8 T^{-8}		L^7 T^{-7}	L^6 T^{-6}	L^5T^{-5}	L^{13} T^{-12}	L^{12} T^{-11}	L^9 T^{-8}	
	61	Moment of inertia; Power transfer	L^5T^{-2}	3	L^7 T^{-7}	L^6 T^{-6}	L^5 T^{-5}	L^4T^{-4}	L^{12} T^{-11}	L^{11} T^{-10}	L^8 T^{-7}	
62	Volume of a mobile object	L^4T^{-1}	L^6 T^{-6}		L^5 T^{-5}	L^4T^{-4}	L^3T^{-3}	L^{11} T^{-10}	L^{10} T^{-9}	L^7 T^{-6}		

63	Volume of stationary object	L^3T^0	L^5	L^4	L^3	L^2T^{-2}	L^{10}	L^9	L^6	
			T^{-5}	T^{-4}	T^{-3}		T^{-9}	T^{-8}	T^{-5}	
64	Surface velocity	L^2T^1	L^4	L^3	L^2	L^1T^{-1}	L^9	L^8	L^5	
			T^{-4}	T^{-3}	T^{-2}		T^{-8}	T^{-9}	T^{-4}	

Source: Author

5. A CASE STUDY

The Filtering Protective Suit (FPS) is a filtering means that protects user's body from high toxic materials (HTM) (Figure 1). Comparative tests of basic physical-mechanical characteristics FPS-M00 (manufacturer "Mile Dragić Production", Zrenjanin, Serbia) and FPS-M2 (manufacturer "Trayal Corporation", Krusevac, Serbia) have been conducted. This paper deals with experiments that were conducted to test the basic physical and mechanical characteristics of PFS-M00 and PFS-M2 as two representative models which, due to their best characteristics approved by tests, were shortlisted for the final incorporation into the weapons and military equipment (WME) of the Serbian Army (Rajic *et al.*, 2019). FPS was tested for the raw materials, surface mass, thickness, breaking forces, intermittent elongation and splitting/ripping forces. Air permeability and water vapor tests were also performed to test the basic functional characteristics of the FPS. The protective power of FPS against HTM was tested using a sophisticated dynamic gas chromatographic method, and the protection time for the effect of HTM drops was determined using S-yperit in dynamic working conditions.

The testing of the heat transfer process through various materials embedded in the FPS was carried out in laboratory and field conditions. The appropriate anthropometric and ergometric indicators and measured thermoregulation characteristics were tested as well. This made it possible to compare the materials according to all the relevant thermoregulation parameters of the body. Results have shown that protective suits FPS-M2 and FPS-M00 represent a significant improvement compared to domestic FPS of previous generations. Both FPS models are on the level of modern means of personal percutane protection when all the examined characteristics are taken into account. Testing of the protective properties of FPS against the effects of HTM was conducted by the total process of penetration of S-yperit through their materials. However, from a practical value point of view, it is necessary to determine values of key parameters that are important for calculating the FPS. Due to this, Table 2 comprises main parameters of FPS which are important for evaluation of ideality: average heart frequency, surface mass, comfort and price on the market. Multi-criteria ranking of characteristics of physiological suitability and functional characteristics determined suitable ponder relative to their importance for the final user. The highest ponder belongs to the heart frequency as the most important physiological parameter which directly impacts the safety (life) of the

user, followed by surface mass, wearing comfort and price. Parameters that go the maximum ponder value were taken for the calculation of ideality.

Figure 1. Camouflage type FPS



Source: Author

FPS-M2 model reached ideality of 69.98%, and model FPS-M00 66.01% (Table 2). This result is surprising in a way considering that FPS-M00 average heart frequency, comfort and Price were better compared to FPS-M2. Applying the methods of optimization of the listed parameters according to the paper, FPS-M00 was chosen as a completely better means. However, applying the formula for calculating ideality (Rajic *et al.*, 2019) showed that the difference in mass, as an unwanted parameter, was so much better for the FPS-M2 that this parameter was the prevailing factor in deciding the greater total ideality of this means.

Table 2. Achieved Degree of Ideality in Construction of FPS-M2 and M00

FPS	Average heart frequency (bpm)	Mass (g)	Comfort, points (1-5)	Price, Euro x100	IFS, %
P (M2)	124.93	485	4.42	2.75	
P (M00)	120.92	595	4.85	2.19	
Pmin-Pmax	89-132	400-600	1-5	2-5	
K	1.0	1.0	1.0	1.0	
L	0.3	0.2	0.3	0.2	
S/% (M2)	46.2	87.1	68.9	86.6	69.98
S/% (M00)	55.9	39.7	93.2	91.5	66.01
R/% (M2)	48.4	11.6	27.9	12.1	∑100%
R/% (M00)	36.8	50.4	5.7	7.1	∑100%

Source: Rajic *et al.* (2019)

Increasing ideality of both FPS models can be achieved by increasing their individual parameters. In the case of FPS-M2 the work is needed on constructional changes which would contribute to the lower value of heart frequency (R=48.4%), and in case of FPS-M00 the work should be done on fixing the parameter of surface mass i.e. total mass (R=50.4%). It is called technical improvement or innovation of a lower inventiveness level. However, one of the possible ways for achieving the greatest possible ideality of FPS could be choosing the self-decontaminating material of the outer layer impregnated

with nano-particles TiO₂ (Senic *et al.*, 2013) or some other nano-material, which would represent a totally different conceptual approach to the development of this WME means. This approach would represent a FPS innovation of a higher level of inventiveness.

This means that the key TRIZ parameter to be corrected is no. 2A (mass of the stationary object). If the mass of the stationary object decreases, the parameters no. 23A, C (loss of matter), parameter no. 36D, F (device complexity) and parameter no. 37F (control complexity) all worsen (Table 3). Thus there are three different contradictions: TC1 (2Ax23A, C), TC2 (2Ax36D, F) and TC3 (2Ax37F) (Table 3). To overcome TC1, the use of several standards is suggested, whereby standard 1.1.2 is selected: the introduction of a new substance in the ES; 1.1.4: use of the external environment and 3.1.4: translating a bi-sistem into a mono-system. In this case, the introduction into the existing FPS system of the new refrigeration system is considered, as discussed in the paper (Rajic *et al.*, 2019).

Table 3. Principally specific eco-innovative solution of the FPS design

TRIZ Parameters as TC	TRIZ Standards (1-76)	Generic solution	Specific Solution
TC1 (2Ax23A,C)	1.1.2-1.1.5; 3.1.4; 2.4.6; 2.2.6	<u>1.1.2</u> : Introduction of a new substance in ES; <u>1.1.4</u> : Use of the outer environment; <u>3.1.4</u> : Translation of bi-system into a mono-system	TiO ₂ or introduce a cooling system; Sun; Impregnation of only one outer layer of FPS with the use of TiO ₂
TC2 (2Ax36D,F)	5.1.2; 2.2.2; 2.2.4; 3.2.1; 4.1.2; 1.1.3; 1.1.5	<u>2.2.2</u> : Increase of dispersity degree (mulching)	Cooling fluid distributed among the cells
TC3 (2Ax37F)	5.4.1; 2.4.8; 2.2.1; 2.4; 2.4.11; 4.2; 1.1.2; 2.2.4	<u>2.2.1</u> : Increase managing possibilities	Temperature sensors

Source: Author

The second, more promising solution is to eliminate the inner protective layer from the existing FPS system which is impregnated with spherical particles of activated carbon, and instead introduce a new TiO₂ compound. This substance is able to decontaminate HTM in the presence of sunlight (Bauk *et al.*, 2012). The choice of self-contamination material of the external layer impregnated with nanoparticles of TiO₂ (Senic *et al.*, 2013), or some other nanomaterial, presents a completely different conceptual approach to the development of FPS. The eco-innovative principle of the FPS could be based on one of the two possible

solutions: using a cooling system, using a temperature sensor or impregnating the outer layer of the FPS fabric with TiO₂ (Table 3). Of course, the application of TiO₂ is closer to the concept of ideality. Namely, in view of the previous preliminary investigations carried out (Bauk *et al.*, 2012; Senic *et al.*, 2013), it has been found that textile substrates are being created by modification of the standard military textile with TiO₂ nano-particles, and that those substrates have a property of self-decontamination under certain experimental conditions.

If the FPS mass is low (desirable characteristic), then the heart rate is lower, but the protection against HTM is weaker (undesirable characteristic).

If the protection against HTM by FPS is good (desirable characteristic), then its mass is too large (undesirable characteristic), causing physiological problems such as heat stress. There is a need to find for a solution that is a FPS with both, good protection (TC1) and low mass (TC2). If LT - physical units system is used in the FPS construction in case of searching for IFS, then it is evident that the mass of the stationary object should be reduced. This parameter is indicated by no. 42 in the LT - Contradiction Matrix (Table 1 and 4). This is the size of L^3T^{-2} . Another parameter that needs to be fixed is protection time. This parameter is indicated by parameter no. 45 and this is the size L^0T^1 (Table 1 and 4). Multiplying these two parameters in the LT - Contradiction Matrix gives the parameter no. 53 or L^3T^{-1} (Area of moving object or Loss of substance) as recommended in order to obtain the highest likelihood of IFS. As the mass needs to be reduced, this means that one layer of FPS, internal or external, should be discarded. If the outer layer of FPS is retained, then the desired goal can be achieved if it is e.g. impregnated with TiO₂ layer. Given this, the choice of a single layer FPS impregnated with TiO₂ could solve the mass problem and improve the protection system against HTM. This yields a principled design solution for FPS that is well above 70% of ideality, which is closer to the notion of IFS. TiO₂ is able to decontaminate HTM in the presence of sunlight (Bauk *et al.*, 2012). The choice of self-contamination material of the external layer impregnated with nanoparticles of TiO₂ (Senic *et al.*, 2013), or some other nanomaterial, presents a completely different conceptual approach to the development of FPS. The eco-innovative principle of the FPS-MX could be based on one of the two possible solutions: using a cooling system, using a temperature sensor or impregnating the outer layer of the FPS fabric with TiO₂ (Rajic *et al.*, 2019). Of course, the application of TiO₂ is closer to the concept of ideality. Namely, in view of the previous preliminary investigations carried out (Senic *et al.*, 2013), it has been found that textile substrates are being created by modification of the standard military textile with TiO₂ nano-particles, and that those substrates have a property of self-decontamination under certain experimental conditions. With FPS, this could mean that by ejecting the inner protective layer, the classic war uniform should be reactive in terms of HTM protection. This can be achieved if the outer layer of the war uniform is impregnated with TiO₂ nanoparticles, which in contact with the sun's rays

decontaminate the HTM molecules that reach the surface of the uniform. A similar solution of a TC in this case can occur if the TRIZ-contradiction matrix (Rajic *et al.*, 2018, 2019) and TRIZ standards matrix (Rajic, 2019a).

Table 4. A segment of the LT-Contradiction Matrix based on used for the case analysis

CHARACTERISTICS			Worsening Feature		
			L^mT^n	Gen	45
Improving Feature	42	Weight of stationary object	L^3T^{-2}	1	L^3T^{-1}
	45	Period; Duration of action by stationary object	L^0T^1		L^0T^2
	53	Area of moving object; Loss of substance	L^3T^{-1}	2	L^3T^0

Source: Author

CONCLUSION

In inventology, two types of matrices have been developed. The first uses the TRIZ principles for the resolution of TCs that occur between ecological system and ES. The second applies TRIZ Standards for this purpose. Based on the calculation of the idealities of the individual ES parameters, the worst initial characteristic of ES is chosen to be corrected. It is renamed in one of the 39 parameters of TRIZ, and then the Eco-Innovative Matrix based on TRIZ Standards is used. With it, the main mechanism is based on the discovery of the TC that exists between the ES and ecological system, and finding the idea for solving the problem using the proposed TRIZ Standards. This paper confirms the existence of a correlation between the elements of the TRIZ contradiction matrix and the LT system of physical units. Based on this, the LT-matrix of contradictions was constructed. Since the LT-contradiction matrix is an absolutely new inventory tool, its validity was verified on a comparative case analysis using the TRIZ standard.

Subjectivity when using the TRIZ contradiction matrix and the LT - system's excessively high accuracy have been successfully reduced or completely eliminated by using the LT - contradiction matrix as a new tool of inventology. The LT - contradiction matrix has 64 parameters that get repaired, malfunction, or present a solution to the contradiction problem that arises when one wants to improve a feature of an engineering system. Its implementation has synergistically increased the capacity to find IFS to different problems arising from 3210 possible contradictions. The application of the Contradiction Matrix based on the TRIZ standards and the LT-Contradiction Matrix on the same example of the inventive construction of FPS led to similar IFS to problems in both cases.

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Strategic Importance of Agriculture in the Republic of Serbia During the Pandemic Caused by the Corona Virus

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Abstract: Agricultural production is a strategic branch of the economy in the Republic of Serbia, so that its positive growth can not only mitigate the economic decline of our economy as a whole, but it is also necessary for the existence of the population. Historically speaking, agricultural production has proven to be in all difficult situations, as well as this epidemic caused by the corona virus, as a stabilizing factor not only of the economy but of society as a whole. Primary agricultural production in Serbia should take place in a normal way, so that at the end of the year, in addition to other favourable factors (climate, as well as adequate agricultural policy measures), it results in the supply of agricultural products to the population. We believe that in this situation of epidemics, conditions for the work of grain mills must be created, dairies and other plants in the food sector, in order to ensure a regular supply to the population. The aim of the research in this paper is to collect data with the help of a survey conducted by telephone, with regard to the groceries citizens made home supplies of during the pandemic caused by the corona virus.

Keywords: Agricultural production, corona virus, population, survey.

JEL: K11, K13, I18

1. INTRODUCTION

In order to keep Serbian agricultural production growing, an optimal and sustainable use of production capacities is necessary. Also growth and change of structure benefiting capacities that are dedicated to the export of high quality products is necessary too. All of this is required in order to satisfy domestic needs as well as the export. Serbia should focus on manufacturing capacity restructuring, technological upgrades, improvement of the efficiency, as well as improvement of competitiveness to achieve agricultural production growth. All of this should be done while following the latest standards in ecology, energy and economy. Higher efficiency and bigger agriculture production volume should go hand in hand with the research and application of existing and latest

technologies and know-how. Beside favorable pricing, agricultural products should meet high quality norms and be safe for human health.

Development of Agriculture in Serbia should be focused in modernization of the production facilities, in a way to acknowledge and address market trends and to improve overall agricultural efficiency. Once these changes are applied, especially using other countries experiences, there will be no need for government interventions such as directing farmers what crops to grow, nor will the government need to guarantee purchase from the farmers when the market conditions are not favorable. Experience coming from EU countries shows that a commercial agricultural farm is the best model for agriculture production of a country. Privatization that was applied in Serbian economy also affected agriculture production in various segments.

One of the impacts of corona virus will be the world economy decline, which will also be applicable to Serbia, due to high level of losses in most industries this year, but possibly in the years to come. The production was completely stopped in some industries, while some industries are barely surviving manufacturing only as little as necessary. Successful agricultural production could be very good stimulus to reducing negative effects of the overall economy decline, especially considering that agricultural industry in Serbia takes a large share of the overall economy. Therefore, with increased agricultural production, overall Serbian economy could recover sooner.

2. IMPORTANCE OF AGRICULTURE IN SERBIA'S SUSTAINABLE DEVELOPMENT

A share of arable land in the total land area is fairly high, which in turn represents a good potential for development. Serbia has 4.128.000 hectare of arable land, with an average of 0.56 hectare per capita (Birovljev *et al.*, 2009). When compared to EU countries, it can be seen that this ratio is significantly better. Considering relatively low level of technology use in agriculture, small share of annual budget devoted to agriculture, competitive environment, the only way to support sustainable development is rational use of resources.

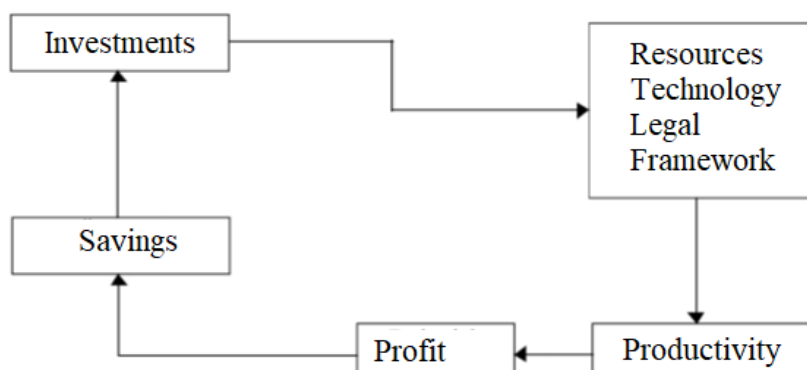
The initial stage of economic development analysis relates to the analysis of a country's potentials. Potentials for a country's development can be sorted in three groups:

- Resources (human, natural and capital),
- Technology,
- Legal/Institutional framework of a country.

The optimization process starts with the first phase of the development process and requires rational use of resources to the highest possible level. The optimal use of resources (human resources, natural resources and financial resources)

combined with technology and proper legal framework opens up opportunity for productivity increase. Increased productivity makes a country more competitive on the world market. The more competitive the economy is the higher yields it is going to create, satisfying basic needs and allowing for capital accumulation and savings. Savings defines "development possibilities" (Dragutinović *et al.*, 2005) of a country or province, since savings defines the level of investment that further defines economy growth. Economy development monitoring (Figure 1) (Dragutinović *et al.*, 2005) shows that this is of a complicated nature, with multiple layers, requiring definition of impact factors that predominantly determine growth intensity.

Figure 1. *Economy development monitoring*



Source: Dragutinović *et al.* (2005)

Analysis of natural resources from the economy standpoint is important for underdeveloped countries or territories, and the developing ones. Due to lack of financial resources, and in order to catch up with technological development, these countries often show their development potential through natural resources. Historically, economy development was based on the resources that were in the ground or water. Their optimal use offered a possibility for a country to become more competitive, that in turn make them more developed. Optimal use of resources leads to the development of certain industries. Topsoil is a limited agricultural resource. On the other hand, the agriculture development strongly defines the level of industrialization.

Serbia has a large volume of installed processing capacities, which are underused. Their full use would lead to an increase in economic development. Therefore, the development of economic production has a multiplier effect on the overall economic development, because the increase in agricultural production directly affects the volume of the processing industry.

Today, even in the conditions of the crisis, agriculture has a significant place in the contribution to the economic development of Serbia. Agriculture is the most important economic area, which contributes to the creation of a social product. There are various indicators and procedures in determining the importance of agriculture in economic development. The three most common criteria are:

- Participation of agriculture in the structure of the GDP;
- Share of agriculture in the total population and
- Share of agriculture in total exports of the country.

Summarizing the impact of agriculture development to the overall economy growth, the following indicators should be mentioned: (Birovljev et al., 2009)

- Increasing the supply of food and raw materials;
- Enabling inter-sectoral transfers of capital and labor;
- Ensuring the expansion of the market for industrial and infrastructure products;
- Facilitates international trade through the export of agricultural products and improving the balance of payments.

While analyzing above mentioned, it can be concluded that the agriculture has significant, multiple impacts on the economy growth. Agricultural growth positively impacts tourism, especially rural tourism. In Serbia, being mostly rural country, agriculture has important role in the economy. That is why, it is essential to apply the right tools for the agriculture development to achieve sustainable economy growth. Some of these tools are creation of large agriculture producers, larger portions of the budget set for agriculture and provision of subsidies for crops that are important for other industries. Agriculture development can be seen not only in the results of agriculture industry but also in the results of other industries such as manufacturing and tourism.

In order to make Serbian agriculture more competitive, it is necessary to introduce entrepreneurial spirit within it. Considering challenging circumstances, it is very important for all agricultural stakeholders to adjust to the current changes. That is why development of skills, knowledge and agility is crucial in surviving on the market. The National Competitiveness Council (2007) defined the term of international competitiveness as: "Competitiveness is country's ability to achieve success on the world market, that will in turn provide better life conditions for all. It is impacted by many factors, especially the competitiveness of companies, good legal/institutional framework and market environment that supports new products and investment in new products. All these factors combined lead to increased level of productivity, better profits and sustainable development." Being more competitive is conditioned with

innovations, with the emphasis on the concept of "organization that is able to learn" i.e. accepting innovations, their applicability, with the main goal to achieve market oriented culture and open concept of agricultural organization (Ivanović, 1998). The agricultural stakeholder leader's role is to successfully respond to upcoming challenges, meaning that they need to experts in their area of expertise, to have knowledge that is well respected by their team and to organize and motivate the team to achieve good business results. The leader is a visionary, whose vision should be achievable and applicable. He is the initiator of changes, compared to the manager whose main task is to through planning, organization and control enables adjusting to the changes, all in order to achieve set goals.

Restructuring of manufacturing and updating technologies, as well as raising productivity in agriculture and better competitiveness on both domestic and international markets will be based the ecology, energy and economy. Considering the overall structure of agriculture, and aiming to set better competitiveness on the market, one should focus on the following three categories of stakeholders:

- Large agricultural corporations – that are leaders on the domestic market, but that should also strengthen their position on the international market. These corporations have high yields. Their advantage is high concentration of capital, and wide recognition on both domestic market and potentially on the international market.
- Commercial farms – they are market oriented, but they can hardly survive independently on the international market. Therefore, they usually work with others who help them.
- Small farms – this is the third group of stakeholders who, beside meeting their own needs have certain amount of surplus products. Their partners are usually wholesale companies, unless they are part of cooperative organizations. They sell their products mostly on green markets.

Serbia needs to adjust its economy on the model of the EU market economies, through the development and strengthening of the small and medium enterprises (SMEs) sector. In order to develop the SME and entrepreneurship sector, the Republic Agency for the Development of Small and Medium Enterprises and Entrepreneurship was established in Serbia in 2001, with the following activities:

- In the areas of SMEs in agriculture and processing of agricultural products, manufacturing, tourism and electronic business to develop programs which will impact the development and coordination with various ministries responsible for these sectors;

- Creation of programmes that support high quality and innovation in SME, as well as establishing network between SME and research and development system, including Universities, and on top of that support for SME to achieve better position on the local market through coordination with ministries in charge;
- Coordination and support for various regional and local agencies that support development of SME;
- Support in marketing and PR activities for SME and
- Planning and introduction of IT systems and services in SME sector.

Entrepreneurial approach is an essence for development of SME sector, creation of network with research institutions, introduction of IT systems that improve this sector, but also marketing of agricultural products, or creation of brands recognizable on a large scale to the consumers. The bottom line is that an entrepreneur should use their authority and vision to lead his employees in the direction that will take them to achieving their goals. Unfortunately, many agricultural products cannot find their proper place on the market for this reason, i.e. due to lack of entrepreneurship which is exactly something that needs improvement in order to provide survival for these companies. Companies in the agricultural sector should strive to achieve sustainable level of business that is based on ecology, good quality, free market and innovations that are all in balance with needs and possibilities of economic, social and cultural surrounding. In gastronomy, the emphasis is on the healthy, natural food, traditional production and processing of products derived from plants and animals (Radanov *et al.*, 2017).

3. AGRICULTURE – THE PATH FROM TRANSITION TO THE MARKET ECONOMY

With the fall of Berlin Wall, decomposition of Soviet Union, a new era of economic development has started. The transition from planned economy to market economy became reality. Transition is the process that can be seen from various angles, such as economic, political, legal etc. From economy perspective the transition process is the one where markets transition from undeveloped and inefficient to developed and efficient. It is a process in which the element of the socialistic economy is replaced with market oriented. Serbia has entered the process of transition later when compared to some other Eastern European countries. By default, the transition is lengthy and tough process with the ultimate goal of achievement of high efficiencies in companies. This process is extremely important for agriculture of any country, since this industry is vital for the existence of every country as it provides food supply security. In Serbia the structure of agriculture is not very favourable and represents one of the most impactful problems for Serbian economy. If we take a close look at the structure of agricultural land, we can say that the majority is represented with small properties that are recognizable with unreliable agricultural productions.

Enlarging properties is one of main tasks in this sector. Considering the fact that agriculture is very specific, the process of transition is also very specific. If we look at the effects of the transition that was completed so far, we can notice the success rate is fairly low. These effects can be seen in two ways (Pejanović *et al.*, 2007):

- Transition effects on the large scale – there has not been significant change of the role of agriculture in the economy. The portion of agriculture in macroeconomic indicators of the economy growth is significant, but that is not very encouraging considering that agriculture portion in GDP is growing while some other industries' portions in overall GDP are in decline.
- Transition effect on the small scale – agricultural producers have not gone through the process of restructuring, new institutions are nonexistent, the role of government in providing subsidies of agricultural products is not at the appropriate level.

The necessity of transition of agriculture can be seen through the following factors (Jelić *et al.*, 2009):

- The ownership structure of properties;
- Uncultivated area and
- Problem of privatization.

The strategy of agricultural development since 2005 is directed towards the commercialization of agricultural farms. Agriculture is important, maybe even the key problem in the negotiations with EU, OECD, CEFTA etc.

The transition process in agriculture can be seen from the two viewpoints: (Zakić *et al.* 2008) in one, it is redefinition of agriculture politics – providing information, advices, favourable loans to the stakeholders and in the other it is about changes reflected through change of ownership, the structure of producers etc.

The transition of agriculture in Serbia has a goal to restructure large agricultural corporations, food industry and other subjects and on the other hand making small farms more competitive and commercially oriented. Privatization of large agriculture corporations introduces development of entrepreneurship.

Common feature of Serbian agriculture, but also some neighboring countries is significant number of small farms with fairly small arable land parcels. This feature lowers agriculture productivity, as well as the level of agricultural production and in turn profits for these farms. Low profits of these farms, also means low standard of living, not only for these farmers, but also for whole regions where these farms are dominant type of business. As additional problem of Serbian agriculture, a growth of uncultivated areas must be noted. In Serbia there are 4.218.000 ha of arable land, but almost 200.000 ha uncultivated, which

is almost 5% of arable land. However, compared to the countries of the region, Serbia has the lowest percentage of uncultivated land compared to the total area of arable land. Bosnia and Herzegovina has almost 30% of uncultivated land of the total arable land. In Serbia, agriculture contributes with more than 20% in the national GDP, almost 30% in export, while almost 30% of population works in agriculture sector.

Increasing liberalization of the market and acceptance of membership request in CEFTA, shows that not only final agricultural products, but also raw materials can be subjects of export. The example of raw material exchange can be viewed through sale of sugar beet produced in Serbia to the sugar plants in Croatia, because of higher prices there. However, export of raw material products with underuse of existing processing capacities, leads to closure of some companies that process raw material. Export of raw materials can be beneficial to the economy in short term, but economy will benefit more with the export of highly processed products.

Problem of transition is especially visible considering the average size of farms in Serbia, which is approximately six times smaller than the average farm in EU countries.

This feature typically drives the productivity levels low. There are significant differences in productivity levels between developed countries compared to the developing countries. These differences are consequences of many factors: larger area of land per active farmer, new technologies, higher investments per land area unit or per farmer etc.

Agriculture development in Serbia should focus on modernizations and processing structure change towards market orientation and efficiency enhancement. Once structure changes are done, if based on the experiences of developed countries the government will not be providing instructions to farmers what crops to grow, nor will be obliged to purchase agricultural products, as these actions usually result with negative results. European experience shows that commercial farms are the most optimal way of organization. Privatization is still ongoing in Serbian economy, agriculture included as well as many other segments.

4. AGRICULTURE AND RURAL DEVELOPMENT IN SERBIA

Rural areas in Serbia are mostly neglected, both due to the inactivity of the state to work on their development with appropriate policies, and due to the large migration of the population to urban areas in search of a better future. The goal of rural policy is to enable the development of rural areas through appropriate socio-economic activities. This primarily refers to agriculture, lately there are

great potentials for the development of organic agriculture, because rural areas are mostly unpolluted, and represent a suitable ground for tourism development. Given that Serbia no longer has access to the sea, it must direct all its efforts towards raising the quality of the offer of rural tourism. Given the rapid pace of life, most employees tend to flee from urban areas to rural areas to relax, and this is in favor of farmers, so that visitors, in addition to healthy air, recreation, can consume healthy and quality food. We should work on promoting rural tourism because it is a synonym for a healthy lifestyle, that is, a connection is established between man and nature. We have to make a market segmentation, creating marketing mix, and its implementation and control (Djokić *et al.*, 2013).

Among the mentioned areas that should be a pillar of development of rural areas, they include forestry, hunting and fishing, crafts, trade, education and training, health, mining, etc. So, the rural economy is an integral territorially rounded rural economy filled by mutual rural activities and other activities. Agrarian and rural policy are interconnected, by the fact that quality agricultural policy affects the development of rural areas by creating a favorable environment for efficiency, competitiveness and profitability of agro-economic entities, and the appropriate rural policy allows employment of surplus agricultural labor. There is no doubt that the key activity of the rural population is agriculture, with the aspiration to switch to organic agriculture, which enables ecological balance and protection of the environment, we are moving towards sustainable development of agriculture. High unemployment in rural areas, both in agriculture and in other activities, is caused by economic and cultural backwardness. All this has affected the impoverishment of the population, with the exception of some successful rural areas. The aim is to stimulate employment in rural areas and improve the living standards of the rural population by:

- Increased employment and income;
- Environmental protection, as well as preservation of national heritage and
- Better health services, education, social services, as well as infrastructure.

The possibilities of our rural areas are great, we just need to organize, motivate what is most important, in order to prevent the migration of the younger population. If these chances were missed, and Serbia is in a great crisis anyway, that would be disastrous. That is why time is a key factor, because a lot of it has already passed unfinished and unused. The potential of rural areas is great, it is only important to take appropriate actions, which would affect its development. The potential of rural areas is great, it is only important to take appropriate actions, which would affect its development. In order to take appropriate measures, it is necessary to determine the condition of rural areas, which was done with the help of SWOT analysis (presented in the framework of the rural development strategy plan 2009-2013). The SWOT analysis provides the strengths and opportunities of rural areas that should be maximized while minimizing weaknesses and threats

Benefits:**Natural/Climate related**

- Serbia is one of 5 European centers of biodiversity;
- Borders with 3 EU;
- Has areas of extraordinary natural characteristics;
- High number of spas and geothermal water wells;
- Forests, rivers, lakes, hunting, fishing.

Commercial

- Farm inclination for export;
- Raw materials secured with domestic production.

Social

- Strong domestic companies;
- Potential for rural tourism and other special types of tourism;
- Dynamic producers of specialized products;
- Existent local tradition and rural areas.

Legal framework / Political

- Existent systems of quality standards for products;
- Country's status as country candidate for EU;
- Traditional hospitality in Serbia.

Weaknesses:**Natural / climate**

- Inadequate waste management;
- No sea access (traffic restrictions).

Commercial

- Lack of entrepreneurs in rural areas;
- Lack of experts in rural areas;
- Low research and development level in many companies;
- Limited domestic market;
- Low diversity level in industries in rural economy;
- High inflation rate, compared to EU.

Social

- Low production volume compared to the competitors on the world market;
- Nonexistence of national urban plan;
- Inadequate infrastructure (especially in rural areas);
- Low education level in rural areas;
- High unemployment rate in rural areas;
- Low income per capita in rural areas;
- Lack of social capital;
- Low employment perspective in rural areas;
- Poverty in rural areas;
- High pressure on natural resources in some rural areas;
- Organization weaknesses of SMES in rural areas;
- Poor coordination between various ministries with regards to rural politic;

- Slow law enforcement;
- Corruption.

Legal Framework/Political

- Problems with some branches of government;
- Limited capacity for quality control of food products and application of safety standards;

Opportunities:

Natural

- Opportunities for better environment protection;
- Subsidies for agriculture producers for environmental protection.

Commercial

- Growth in world tourism, all tourism branches;
- Changes in consumers demands and new trends on the market, for example higher demand of organic food products, domestic food products and traditional food products with geographic origin;
- Possible competitive advantage coming out from market requirements in terms of food safety, environment protection and animal protection;
- Opportunities in tourism and recreation;
- Development of SMEs in rural areas.

Social

- Cooperation of companies enabling options for production growth and food products sales;
- Higher diversification of rural areas;
- Availability of IPA funds for investments;
- Cross-border cooperation and projects.

Legal Framework / Political

- Open world market opening opportunities for export but also presenting threats if companies are not competitive;
- Status of country candidate for EU membership, that should help on the EU market.

Threats:

Natural / Climate

- Deforestation;
- Negative environmental impact.

Commercial

- Quick changes with regards to the needs of consumers and trends of consumers;
- Higher levels of competition on the international markets;
- Lack of labour in some specialized parts of rural economies (for example in tourism);
- Pressure on profit margins dictated by multinational companies;
- Expenses and problems with setup of new companies;

- Emerging international brands on the EU market can be a threat to Serbian service industry;

Legal Framework / Political

- Slowdown in the development of infrastructure;
- Limitations with regards to the environmental protection;
- Hard access to markets due to safety and hygiene concerns.

In order to successfully implement programs intended for agriculture and rural development in the interest of the majority of the population, the following conditions are needed, namely (Rikalović, 2004):

- Increasing the amount of food products and promoting the distribution of the benefits of agricultural development, implies that the structure of the farm and ownership patterns are adjusted accordingly.
- Government support is needed, especially for small-scale agriculture, to realize its benefits. Providing support in the form of programs is to open economic opportunities for farmers through the necessary initiatives, to enable the realization of expanding the product range, but also to increase productivity by accessing loans and funds.
- Although the development of small farms affects rural development, the idea is to increase income on the farm by joining forces, but also outside the realization of jobs, rural industrialization, as well as to pay more attention to education, healthy food, housing and other social issues.

We need to reduce the differences between the village and the city, and in order to achieve that, it is necessary to accelerate the mentioned improvements. Rural development policy takes all measures towards multifunctional agriculture, which includes competitive and efficient agriculture, environmental protection, improving the quality of life in rural areas and stimulating the diversification of the rural economy. The land can be protected by applying legal measures in agriculture, as well as by reducing the amount of solid waste, recycling waste and building sanitary landfills (Radanov, 2016).

5. AGRICULTURE AND THE IMPORTANCE OF NATURAL RESOURCES

The impact of climate change affects agriculture. The world is facing the consequences of global warming caused by the accumulation of carbon dioxide and other greenhouse gases in the atmosphere. All of this has influenced many countries to work on a strategy to slow down the human factor that contributes to climate change. Development contributes to reducing the potential effects of global warming strategies to reduce emissions of carbon dioxide and other greenhouse gases. All of this is covered by the Kyoto Protocol, which aims to reduce greenhouse gas emissions in developed countries by a certain percentage compared to the 1990 level. A conference on this topic was held in Copenhagen in 2009, where it was emphasized that the reduction of emissions by developed

countries must be undertaken, and that developing countries are expected to limit them, but no declaration was adopted due to disagreements between countries. An agreement was reached to limit the growth of global temperature below 2 degrees Celsius until 2050 (temperature rise is the main indicator of climate change, which is 2-4 degrees Celsius).

The EU's assumption is that countries will reduce gas emissions by 20%, and if other countries decide to do so, then by 30%. Serbia, which is a potential candidate for EU membership, is obliged to take over the reduction of greenhouse gas emissions. Serbia currently does not have an inventory of greenhouse gases, as well as action measures and analysis of financial resources needed, and emission estimates are at the level of 1990, and it is expected that by 2020, according to national strategic documents, it will increase significantly.

Gaining time is very important for any strategy, in order to enable a transition period from the use of fossil fuels to alternative energy sources. The question is when such technologies will be available and to what extent they will be adopted or affordable, especially for developing countries. Reducing climate change aspired by regulation may affect agriculture by raising fuel prices and providing initiatives for agricultural activities to reduce carbon emissions. Agriculture will be affected by rising energy prices in several ways (Zilberman *et al.*, 2002). First, there will be an increase in the price of inputs such as fertilizer, and especially nitrates, which require a large amount of energy for production. Then, the costs of mechanical activities, including plowing, can lead to an increase in the use of chemicals, especially herbicides. Irrigation is also affected by the increase in energy prices, which is reflected in the increase in the price of pumping, which reduces the financial efficiency of irrigation. Due to the higher price of irrigation, farmers will strive more towards the adoption of newer irrigation technology, i.e. drop by drop or will turn to water conservation practices, using computers and other advanced technologies applied to agricultural management. Agricultural activities cause significant amounts of carbon in the atmosphere during plowing, but also due to poor land use. In order to reduce the amount of carbon (even the specification of the levels prescribed by the Kyoto Protocol is greatly reduced), it is necessary to switch to planting trees and crops, as well as the practice of shallow sowing. All this requires a lot of money, but at the same time it is a challenge. Then, the level of carbon absorption is limited and final in agriculture and forestry, but it is still claimed that agriculture will play a significant role in reducing growth and possibly total carbon in the next fifty years, resulting in less dependence of the economy on fossil fuels. All of these can be achieved relatively quickly and serve to gain time until new technologies for energy production are found. Reducing carbon emissions from the agricultural population can be seen as an environmental service, which can bring some profit. Changes that can happen, and that is the transition from intensive plowing to cessation of plowing, which can be caused

by one acre (US unit) can reduce about 5 tons of carbon and 10 tons of carbon dioxide at a cost of 25 US cents per tonne and thus would generate revenue of 250 dollars per acre. Such a change is very significant and can contribute to various other acceptable social goals such as improving water quality and reducing soil erosion. In addition, farmers' profits may increase during the period of transition to alternative tillage technologies, as the soil is depleted and productivity is reduced from the constant use of intensive plowing. The value of the soil will increase if the quality of nutrients in the soil can be improved during the transition period. It should be emphasized that there are different understandings regarding the need for plowing by scientists and farmers, but most farmers will accept this novelty if they are offered good benefits. In order to encourage farmers to accept innovations, it is necessary to create a quality program that implies that farmers are paid to change their attitude towards intensive plowing, and that those who return to intensive plowing pay penalties for emitting carbon in the atmosphere. But before programs can be created, it is necessary to examine the soil and the amount of carbon absorption, which varies depending on the location. In order for the program to be successfully implemented, it is necessary to monitor behavior, as well as to apply punishment if the conditions of the program are violated. Acceptance of carbon reduction activities by farmers can be realized through several mechanisms that would stimulate them. It is the government that would pay for the various activities under the program, and this is considered very important because it counts on credit, according to the Kyoto Protocol. Farmers and their associations can participate in the carbon reduction market and emissions trading, which means that they could sell emission rights to individuals or legal entities (experiments have already been performed). Again, everything depends on international agreements on climate change, as well as whether agricultural activities can help achieve the goal that affects the reduction of harmful gas emissions.

Climate change has an adverse effect on the environment, so it is up to each country to mitigate these changes as much as possible, because the whole society benefits from the preserved environment. Serbia has high quality arable land that is very productive in relatively good climatic conditions (Tomić *et al.*, 2010). The configuration of the land is favorable, and Serbia also has large fertile lowland areas, which results in significant agricultural potential per capita. High soil quality and favorable climatic conditions are prerequisites for the development of organic food production. Many natural benefits (fertile land, favorable climate and water resources) have not been valorized as they should have been due to the wrong agricultural policy and neglect of rural potentials for many years (Rikalović, 2004). All this affected the fact that agriculture and other rural sectors did not contribute to the economic development of the country in the way they could. Serbia has very good natural conditions for the development of farming, fruit growing and viticulture. Also, thanks to the quality natural basis, it is suitable for the development of all branches of livestock production,

as well as beekeeping and fishing. In Vojvodina, arable land is mainly represented, while pastures and meadows are on the territory of central Serbia and Kosovo and Metohija. From all this, it can be concluded that it is logical that Serbia is tied to agriculture and the rural sector, which should be used as much as possible, because that can, if managed properly, bring economic prosperity.

6. IMPORTANCE OF AGRICULTURE AT THE TIME OF CORONAVIRUS

Macroeconomic trends in the global world economy indicate a decline in overall economic activity, which can be compared to the Great Depression of the last century, from 1929 to 1933. All existing and realistically observable elements of the current economic situation show that the coronavirus will leave serious impacts on the economy and the world economy as a whole.

The consequences of the corona virus will lead to a drastic decline in the world economy, because all economic branches, including the tertiary sector, will make big losses this year, and possibly in the coming ones as well. Namely, production has been completely stopped in certain areas of the economy, and in some sectors only what is necessary to preserve the functioning of the economic system is produced. Also, activities in tourism, transport and other service activities have been completely suspended, which will cumulatively lead to a drop in the rate of economic growth and development. In such conditions, it will be extremely difficult for the economy to recover after the end of the epidemic. We see the reasons for that, first of all, in the private sector of Serbia, which will not be able to pay salaries to employees due to stopping production, and that will ultimately lead to a significant dismissal of workers. In such conditions, when all employees, as well as those in the private sector, do not have the paying power to buy goods and pay for services, that will be one of the important reasons that will negatively affect the recovery of the economy.

Measures of the Government of Serbia designed so that small and medium enterprises receive assistance from the state in the payment of minimum wages should have a positive effect on mitigating the dismissal of workers, and thus reduce unemployment. The application of these measures will enable easier starting of production and tertiary activities. What is positive for Serbia is the fact that the Central Bank can issue primary money in that way to place certain financial resources in certain sectors in order to mitigate the consequences of the epidemic. Some estimates that in a powerful economy such as Germany, the growth rate will fall by about -8%, and in Serbia by about -2% to -3%.

In order to somehow reduce the harmful consequences for the economies of countries, many countries will be forced to invest a large amount of money from the primary emission in order to mitigate the decline in economic growth. It is

already quite clear that all countries of the world will end up with negative growth rates at the end of this year.

In the conditions of economic crisis, successful agricultural production can have a very positive effect on mitigating the negative effects of falling economic growth rates. Given that agriculture has a large share in the structure of the Serbian economy, its unhindered production can stimulate the stabilization of the entire economy. Primary agricultural production in Serbia should take place normally, which at the end of the year, along with favorable other factors (climate, as well as adequate agricultural policy measures), will result in a full supply of our population with agricultural products. Therefore, we believe that in this situation of epidemics, conditions must be created for the work of grain mills, dairies and other plants in the food sector, in order to enable regular supply to the population. In addition to all the devastating effects of the epidemic on the Serbian economy, due to a combination of agricultural policy measures, agriculture can mitigate the negative consequences for our entire economy.

Therefore, it is necessary to create conditions during the epidemic caused by the virus covid 19 to enable the uninterrupted organization and conduct of agricultural production, and at the same time it is necessary to take into account the recommended health safety measures. This is possible in our country because the existing estates are fragmented on average from 2 to 3 ha (especially in hilly and mountainous areas) where production is possible without the negative impact of the epidemic and its spread. Also, in lowland areas such as Vojvodina, where the properties are much larger, it is possible to organize productive agricultural production because it is largely mechanized and therefore there is no need for concentration of labor. From all the above, it can be concluded that the uninterrupted organization of agricultural production is possible on both small and large estates.

Increasing agricultural production is possible with adequate agricultural policy measures, which are reflected in the fact that the state provides favorable credit conditions, subsidies, tax breaks, etc. (Tomić *et al.*, 2010). Also, in these specific conditions, it is necessary to organize an uninterrupted supply of agricultural producers with fertilizers, chemicals and diesel fuel.

The fact is that in our country, agricultural production is relatively little dependent on imported components, and given that the crisis occurred in early March, it is realistic to expect that the country has already imported everything needed to import, and the rest can be provided from our domestic production. Thanks to the adequately planned agrarian policy and with the help of various other economic measures, the government should organize production in those sectors that produce for the needs of our agricultural and food industry.

Agricultural production in Serbia is a strategic branch of the economy, so that its positive growth can not only mitigate the economic decline of our economy as a whole, but it is also necessary for the existence of the population. Agricultural production, observed throughout history, has shown itself in all difficult situations, such as this epidemic, as a stabilizing factor not only of the economy but also of society as a whole. Thus, the successful organization of agricultural production will enable the reproduction of individual farms, which will result in positive economic and sociological conditions in rural areas. It seems contradictory at the first glance. First of all, it refers to the part of the population that lives in large cities with a low standard of living, so returning to the village would improve the economic and sociological conditions of existence. This crisis could force many of them to make the right decision and return to the countryside. Adequate measures of the government can motivate that part of the population and help them return to the countryside, which will benefit only returnees but the whole society. It is economically unjustified to keep, especially in our large urban centers, a population that is not adequately educated and does not provide adequate income for a normal existence. It is known that at this stage of economic development, the cost of living in cities is much higher than in the countryside, so we consider returning to the countryside a necessary economic process. In that way, the inherited family estates will be cultivated, and that will lead to an increase in agricultural production and a gradual increase in the living standard of returnees from the city to the village. Lack of financial resources makes it impossible for that part of the population to use the cultural, sports and other benefits provided by large urban centers. Their return to the countryside will be very useful because they can organize organic agricultural production on their farms, which will have a positive impact on their health, as well as on their earnings. The ambience in the village (it is far better than in apartment blocks) enables above all clean air, quality water and healthy food, which in a synergistic sense has a positive effect on health, human spirit and quality of life.

It is known in the world that there is a demand for organic agricultural products, and those united in cooperatives in the village and several villages nearby can create an adequate amount of organic products and improve their sales, which will be of interest to large retail chains. Thanks to the contacts and knowledge of the cultural patterns of the urban population with a higher level of education, which in the coming period could be helpful in making a decision on starting the processing of organic agricultural products, and over time there would be an increase in profits. In these early stages of developing this type of business, an adequate marketing aspect is important, which could include promoting these products through social networks and other channels that do not require large investments. Also at this stage it would be necessary to design an attractive packaging and other promotional activities that would contribute to a successful market presence.

In preserving, improving and encouraging agricultural production, we achieve not only the economic significance of that production itself, but also of the entire economy.

7. RESULTS OF THE RESEARCH

During the research, during the data collection, the research instrument of surveys was used. The main purpose of the research is to gather information on which foods the citizens of the Republic of Serbia bought the most in 2020 and from which foods they made home stocks during the pandemic caused by the corona virus.

The result of the research is the data obtained after processing and analysis of data from the survey. The survey was conducted in the period from August 10, 2020. until August 31, 2020. The survey included 1000 respondents - citizens of the Republic of Serbia of different sex, age and education because we believe that a sample of 1000 respondents in 10 cities in the territory of the Republic of Serbia, Belgrade, Novi Sad, Niš, Pančevo, Subotica, Kragujevac, Kruševac, Užice, Prijepolje and Bor is suitable. A questionnaire containing questions was used during the survey, which was conducted through a telephone survey.

In the survey conducted within this research, we set the following hypotheses.

- Hypothesis 1: Consumers at the time of the corona virus bought more basic necessities than luxury products
- Hypothesis 2: Consumers have made food stocks caused by the Corona virus
- Hypothesis 3: Corona virus has influenced the change in consumer buying habits

Respondents' answers to the questions asked through a telephone survey:

Table 1. *Who shops most during the corona pandemic?*

Women	63%
Men	37%

We notice that the female sex buys as much as 63%, compared to the male sex of 37%, which indicates the traditional pattern of behavior in Serbia.

Table 2. *When did you shop most?*

Weekdays	57%
Weekend	43%

Consumers bought the most on weekdays of 57% compared to 43% on weekends.

Table 3. *Where did you shop the most?*

Supermarkets	38%
Green markets	33%
Online	29%

We notice that the high percentage of online shopping - 29%, which was still affected by the Corona virus, but consumers still buy the most in supermarkets (38%) and markets (33%).

Table 4. *What has most influenced your online shopping?*

Fear of going to closed supermarkets	20%
Work from home	32%
Avoid crowds in front of the supermarket	31%
Limited supermarket opening hours	17%

Given the growing trend of online shopping, consumers mostly opted for this type of shopping due to the introduction of work from home (32%), as well as time savings due to crowds in front of supermarkets (31%), as well as the presence of fear and limited working hours of supermarkets (17%).

Table 5. *Your experience with online shopping:*

Good	85%
Bad	15%

Based on the estimates, it is clear that consumers have an excellent experience (85%) with online shopping, and a very small percentage (15%) had a bad experience.

Table 6. *How satisfied are you with the supply of food in retail chains?*

Satisfied	80%
Unsatisfied	20%

It is clear that the retail chains were well organized at the time of the corona, because consumers expressed their satisfaction (80%), and a small percentage of those were dissatisfied (20%).

Table 7. *What food products did you buy the most?*

Grain products	18%
Dairy products	19%
Meat products	15%
Canned food	17%
Fish products	5%
Fruits	11%
Vegetables	15%

Consumers mostly bought dairy products (19%), followed by grain products (18%), canned food (17%), meat products (15%), vegetables (15%), fruits (11%) and fish products at least (5%).

Table 8. *What influenced you the most to make food stocks?*

Unavailability of products on the market	27%
Time savings	15%
Increased price	40%
Psychological reasons	18%

Consumers made the largest stocks of food due to rising product prices (40%), followed by unavailability of products on the market (27%), psychological reasons (18%) and time savings (15%).

Table 9. *What bothered you the most when shopping at the time of the Corona virus?*

Increased prices of products	55%
Queues in supermarkets	29%
Product availability	7%
Presence of nervousness in people	9%

It is obvious that consumers were most bothered by the increase in product prices (55%), queues in front of the supermarket (29%), the presence of nervousness in people (9%) and product availability (7%).

Based on the obtained results, we can conclude that 63% of females were the ones who made the purchase. The purchase was mostly done on working days, which was confirmed by 57% of the respondents. There is a noticeable growth trend of online shopping of 29%. Satisfaction with online shopping is as high as 85%, which shows the trend of consumers turning to this type of shopping. All this shows us that due to the root of the virus, many consumer habits are changing. The traditional type of shopping in our country is still more present in supermarkets and markets (71%). Retail chains showed good organization because most of the products were available to consumers, and therefore the satisfaction of consumers was as high as 80%. The products that were bought the most were dairy products (19%), and the least luxurious, such as fish products (5%). Consumers were most affected by the increase in prices (40%) to make stocks, as well as what bothered them the most when buying (55%).

CONCLUSION

During the periods of economic crises, agriculture as an industry showed that it is more resistant to recession compared to other industries of the economy, it even employed a part of the labor force that remained unemployed in other

economic branches. Agriculture and food production are significantly more vital than other sectors at the time of the corona virus-induced pandemic. In the first days of the crisis, consumers bought larger quantities of basic agricultural and food products. Demand for more luxurious groceries is declining because consumers are looking for only the groceries they need to survive. The Republic of Serbia is one of the countries that are exporters of food products. Current forecasts are that the consequences after the pandemic will be bad for the world economy. Agriculture and the food industry do not offer high wages but show stability in times of economic crisis. That is why governments and financial institutions are helping the sector with additional measures, and private investors will surely find their interest in investing in the agricultural/food industry in these circumstances.

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Public Investment in Innovative Potential in Conditions of SARS-CoV-2

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Abstract: The COVID-19 pandemic and the recession are accelerating innovation. Countries that have managed to preserve and enhance their innovative potential will fight the epidemic faster and more successfully. The Republic of Serbia was recognized by the prestigious European organization OECD as one of the TOP 5 countries in terms of the number of innovations in the fight against the pandemic caused by the SARS-CoV-2, and was invited to join the Declaration on Innovation in the Public Sector. The paper will provide an analysis of the development of innovation potential with the help of which this significant result was achieved, as well as guidelines for maintaining and further improving public innovation policy in the Republic of Serbia.

Keywords: Innovation, Innovation Performance, SARS-CoV-2, COVID-19, Innovation Policy, Pandemic

JEL: O30, O31, O36, O39

1. INTRODUCTION

The world does not know how long the corona virus will continue to lead to significant disorders in everyday life. It is expected that society will change significantly and that many innovations that help slow down the spread of the virus today will be useful in future "normalcy". But, according to Djurovic Petrovic and Lozanovic Sajic (2019), national prosperity is not inherited. It is the result of constant encouragement of innovation. That is why it is very important for each individual country and the world to constantly invest in the innovation infrastructure and keep it constantly awake. The world urgently needs innovative solutions to combat and mitigate the epidemic, hence the goal of starting research as soon as possible. New solutions must be available and accessible to all as soon as possible, in line with the principles of the Global Coronavirus Response.

The Republic of Serbia has achieved a significant result in that field, because it is among the five countries in the world that have the largest number of

innovations in response to the Covid crisis. Namely, on the official website of the Organization for Economic Co-operation and Development-OECD on May 28, 2020, 22 innovative solutions implemented in Serbia were presented in response to the fight against SARS-CoV-2, due to which Serbia is ranked in the TOP 5 countries. Because of these results, the country received a more than deserved invitation to join the OECD Declaration on Innovation in the Public Sector, despite not being a permanent member of that reputable European organization. The declaration was signed in 2019 by 35 OECD member countries with the aim of encouraging innovation in the public sector and affirming an innovative approach to solving new challenges. According to the OECD statement, Serbia implemented a large number of innovative solutions in the short term during the state of emergency. In response to the crisis caused by the virus and thus found itself at the very top of the countries in the world with the largest number of innovations during the Covid-19 crisis.

The establishment of innovative technological solutions and electronic services was aimed at achieving optimal coordination of health care, education, security and other key systems in times of crisis, timely and accurate information of citizens, as well as continuous provision of services to citizens and the economy. The OECD, whose Public Sector Innovation Observatory monitors governments' innovative responses to the COVID-19 virus crisis.

2. SUCCESSES OF THE INNOVATIVE SECTOR OF THE REPUBLIC OF SERBIA IN THE FIGHT AGAINST SARS-COV-2 PANDEMIC

2.1. Cooperation from the Innovation Sector of the Republic of Serbia with the United Nations Development Agency (UNDP) and the World Health Organization (WHO)

The United Nations Development Program (UNDP), in collaboration with the World Health Organization (WHO), has issued a Public Call for Innovative Solutions or Replication of Existing Solutions Applied in Other Parts of the World to Protect Service Providers and Crown Virus Careers. Consequences of infection and reduce the risk of virus transmission. The United Nations Development Program in Serbia has invited legal entities to propose new ways of producing or procuring innovative products, technological solutions, and new value chains to produce innovative equipment. During the state of emergency, as many as 50 applications were received, which were evaluated by the UNDP and WHO commission, and selected projects that were considered ready for implementation were given the opportunity to co-finance implementation costs. national services to obtain the necessary permits and promote selected solutions as examples of good practice.

In addition to this significant result of the innovative sector of the Republic of Serbia, there are many other examples that support the claim of the authors of this paper that systematic decades of investment in innovative structure gave the expected result in the global crisis caused by COVID-19 virus.

2.2. The success of the innovators of the Republic of Serbia at the world competition INVENTIONS vs CORONA

Another in a series of examples was achieved at the world competition "INVENTIONS vs CORONA - Invention Contest for the Benefit of Humanity Against COVID-19", the competition was held under the auspices of the International Federation of Inventors Associations (IFIA), and the research group prof. Pavlovic, who has been working at NASA for ten years, was the only participant from Serbia. In addition to Dr. Vladimir Pavlovic, full professor at the Faculty of Agriculture, University of Belgrade and scientific advisor at the Institute of Technical Sciences SANU, the multidisciplinary research team also included Dr. Branislav Vlahovic, full professor at the Central University of North Carolina (USA), Dr. Vera Pavlovic, associate professor in Belgrade, Dr. Suzana Filipović, research associate at the Institute of Technical Sciences of SANU, Dr. Pavle Mašković, associate professor at the Faculty of Agriculture in Čačak, University of Kragujevac and Dr. Predrag Petrović, full professor at the Technical Faculty in Čačak, University of Kragujevac.

The team patented the development of antiviral and antimicrobial materials to prevent the spread of coronavirus in ventilation devices, and this type of material could be used on surfaces that are not part of ventilation systems, because titanium dioxide gives glass the ability to self-clean.

2.3. The success of the innovation sector of the Republic of Serbia in the European research area

A new opportunity to prove its readiness for the Serbian innovator was given by the European Commission, which through the Horizon 2020 research and innovation program offered another 122 million euros for urgently needed research on the corona virus. Her new call for expressions of interest is in line with the Commission's promise that 1.4 billion euros will be sent to the Global Coronavirus Initiative initiative, launched by the President of the European Commission. The call is the latest addition to a series of EU-funded research and innovation actions to combat coronavirus and complements earlier actions to develop diagnostics, treatment and vaccines by strengthening capacity to produce and implement readily available solutions to respond quickly to urgent needs.

This special call under Horizon 2020 complements previous actions to support 18 projects with € 48.2 million for the development of diagnostics, treatment, vaccines and epidemic preparedness, as well as € 117 million invested in 8

diagnostics and treatment projects through the Innovative Medicines Initiative and measures to support the innovative ideas of the European Innovation Council. In addition, it implements Action 3 of the ERAvsCoron Action Plan, a working document resulting from the dialogue between the Commission services and national institutions.

Through this call, Serbia, as an equal partner since July 2014, since the beginning of participation in the Horizon 2020 program, has received 311 projects with a total value of 102.6 million euros. How Horizon 2020 will be replaced by a new program for long-term financing in the field of research and innovation - Horizon Europe, which should start its implementation on January 1, 2021. The European Union provides a new chance to the innovative and research sector in Serbia. And through the project Support for participation in EU programs that helps potential applicants to develop a project not only for Horizon, but also for all other EU programs available in Serbia, Serbian innovators will be able to show their innovative potential.

2.4. Successful cooperation between the research institute and the economy

Mihajlo Pupin Institute and the company SmartResearch have developed five prototype devices for mechanical ventilation, so-called respirators. The operation of these devices is based on technological solutions that should be used in the future in the production of Serbian respirators for the treatment of patients infected with the corona virus. The design of these devices is adapted to fast production technologies, such as 3D printers, CNC machines and laser cutters, and most of the components are manufactured in Serbia. So far, five prototype devices have been produced, and after the validation of these devices by the competent state institutions, the production capacity of the Mihajlo Pupin Institute could be ten complete devices per day.

Our young innovators have shown that we can produce something in Serbia that has so far been the only way to buy abroad. This is a great achievement of our engineers from the Mihajlo Pupin Institute. The devices that were produced are intended primarily for the Serbian health system, but they could also have export potential in the future because no one in the region and this part of Europe has developed these technologies yet. With this respirator, Serbia can strengthen its capacities in the fight against coronavirus or some new epidemiological crisis in the future.

2.5. Success of innovators at the national level

The Fund for Innovation Activity approved 53 million dinars for financing 12 innovative projects of the company. Despite the short period of time, close to 300 proposals for innovative projects arrived at the public call, which showed the high potential of our innovative companies.

Table 1. *Overview of financial support to innovative projects of the Innovation Fund*

Program name	Number of applications	Number of supported projects	Total project value (in €)	Amount of approved funds (in €)
EARLY DEVELOPMENT PROGRAM	942	120	11.167.912	8.887.275
INNOVATION CO-FINANCING PROGRAM	366	36	13.354.416	8.382.527
INNOVATION VOUCHERS	614	514	3.196.019	2.681.839
TECHNOLOGY TRANSFER PROGRAM	36	25	-	540.350
PROOF OF THE CONCEPT	269	26	-	481.665
COVID-19	229	12	552.793	468.907

Source: www.inovacionifond.rs

In a short period of time, one month, all 12 solutions were developed and available for use, the goal of which is to suppress the effects of the coronary virus pandemic. All innovative projects have been successfully implemented, and the products and services of the company have been donated throughout

Serbia, to institutions and institutions of public importance. Innovative solutions that are supported through the public call of the Fund, will remain applicable and useful to the Republic of Serbia even after the pandemic.

The Republic of Serbia has also opened a public call for proposals for innovative projects of companies for the Early Development Program and the Innovation Co-financing Program.

The early development program is intended for young companies that are developing technological innovation for which there is a need on the market, and up to 80,000 euros are allocated per project. The funds within this program are intended for micro and small companies established in Serbia, in majority private Serbian ownership and not older than five years, as well as teams. The funding allocated by the Fund covers a maximum of 70% of the total eligible costs of the project, and the duration is up to 12 months.

The Innovation Co-financing Program provides financial support of up to 300,000 euros per project, and the beneficiaries are micro, small or medium enterprises with majority private ownership registered in Serbia. The support enables companies to develop new products, services and technologies with high added value and encourage the commercialization of research and development of existing innovative companies, as well as the establishment of cooperation with international companies. The funding allocated by the Fund covers a maximum of 70% of the total eligible project costs for micro and small enterprises, and 60% for medium enterprises.

Funds for this public call were provided within the budget of the Republic of Serbia, from the Ministry of Education, Science and Technological Development, and through the Project for Improving Competitiveness and Employment (based on the Loan Agreement between the Republic of Serbia and the World Bank).

2.6. Success on the Covid-19 special program

The special research program COVID-19 aimed to finance scientific research projects that contribute to an effective innovative response to the current pandemic caused by the SARS-CoV-2 virus and enable better preparedness and response of society. The program includes the development of applicable solutions, applied scientific research, creation of interdisciplinary and multidisciplinary teams and consortium submission of project proposals.

The Program encourages projects that offer solutions that contribute to the achievement of the Program's objectives in the shortest possible time. During the pandemic, research teams with as many as 129 project proposals applied to the Public Call, which opened on May 22, 2020. During the administrative review,

56 proposals met the administrative review and were sent to the first round of evaluation, and 26 to the second round, 16 project proposals in the field of (bio) medical sciences, 3 from (bio) medical engineering and information technologies, 7 from economic, sociological, psychological research and management of complex systems. The best ranked projects are financed within the available funds of the Program, whose total budget is 2,000,000 euros, and the funds are provided from a loan from the World Bank, the SAIGE project.

Other countries have also issued calls for national and international programs inviting scientists and university professors to apply for projects based on basic research, but also to apply for projects in cooperation with the economy. Additional funding is provided for these programs.

Eureka network also has open call for funding projects focused on Covid-19. Eureka network is an international network supporting innovation beyond borders, they believe in that when people work together, extraordinary things can happen, and situation with this global challenge can be solved.

One of the first call was Multilateral call for the next human high-impact pandemic, and projects are already funding.

National initiatives in cooperation with Eureka network have launched following countries: Argentina, Austria, Canada, Croatia, Cyprus, Denmark: IFD, Lundbeck Foundation, Novo Nordisk Foundation, Estonia, Finland, France, Germany, Hungary, Ireland: SFE, HRB, Luxembourg: SMEs/ large companies, startups, PPP, Malta: Malta Enterprise, Plumtri, Norway, Poland: NCBR, Lukasiewicz Research Network, ABM, Portugal, Romania, **Serbia**, South Africa Spain, Sweden, Switzerland: SNF, Innosuisse, Turkey, United Kingdom.

3. INVESTMENTS OF THE REPUBLIC OF SERBIA IN THE PRESERVATION AND DEVELOPMENT OF INNOVATIVE POTENTIAL

The success of the Serbian innovation sector, detailed in Chapter 2, would not have been possible without the strategic commitment and decades of financial support from the state. In the period of the 90s, the wars in the former Yugoslavia, UN and NATO sanctions, all indicators of innovative activities were declining.

The special result of innovation policy is the activity related to the patent. Table 2 shows the trend of patent application by domestic and foreign inventors. It could be seen that this activity was quite weak and that it particularly decreased around 2000, and after that it began to recover but was still insufficiently compared to the activities of during the 1990s. The number of foreign patents

was particularly high during 1990s, then it significantly dropped around 2000, less than the number of domestic patents, and recently it has exceeded the number of domestic patents. Table 3 provides a similar review of the number of small patents application.

Table 2. Figures of applied patents in Serbia

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Domestic	156	161	96	70	112	59	3	31	73	86	65	127	72	81
Foreign	518	350	186	133	137	49	-	11	58	93	110	138	101	126
Total	674	511	282	203	249	108	3	42	131	179	175	265	173	207

Source: Intellectual Property Bureau

Although this number fell in 2000, there has been a strong growth trend, except for domestic patents that are almost exclusively dominant here. The number of applied patents has significantly decreased during the period of UN sanctions, which can be seen in Table 2.

The same conclusion can be drawn for small patents in the same period, as shown in Table 3.

Table 3. Figures of small patents in Serbia

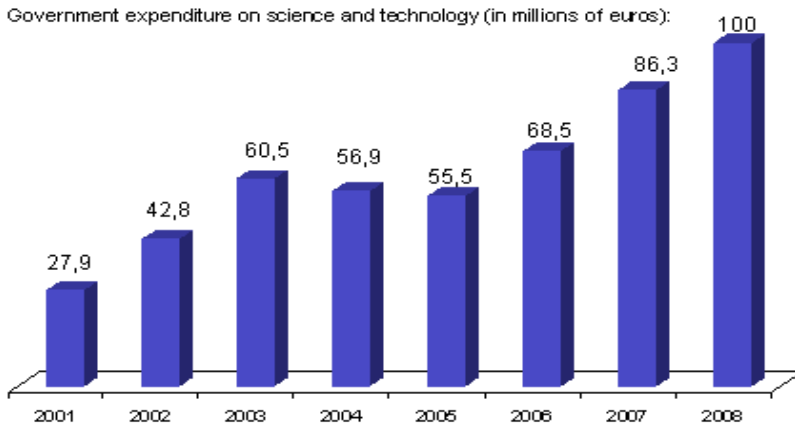
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Domestic	54	88	92	65	5	111	86	100	82	88	91	89
Foreign	0	2	1	2	0	1	3	0	1	2	2	2
Total	54	90	93	67	5	112	89	100	83	90	93	91

Source: Intellectual Property Serbia

According to Đurović Petrović and Lozanović Šajić (2019) in the period after 2001. investment in science, and therefore in innovation, has increased significantly, according to the available data from the Archives of the Ministry of Education, Science and Technological Development, as given in Figure 1.

Figure 1. Investments in R&D from 2001 to 2008

PUBLIC R&D EXPENDITURES HAVE BEEN RISING SINCE 2001



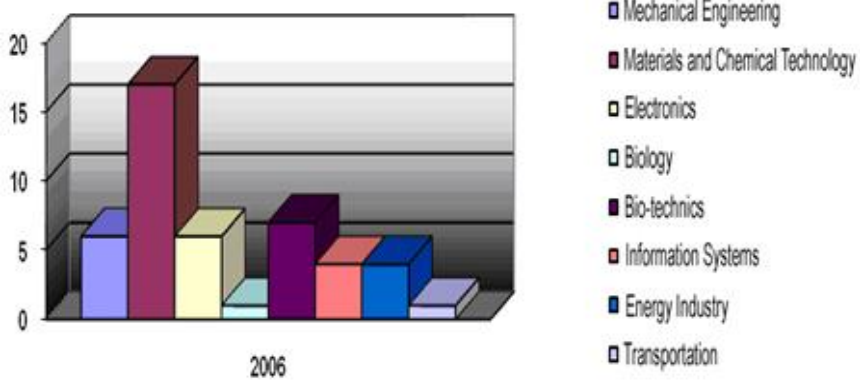
Source: Ministry of Science and Technology Development (2008)

With the adoption of the Law on Innovation Activity and the introduction of the Register of Innovation Entities, the Republic of Serbia has made significant progress in the positive conditions for the development of innovation infrastructure. Innovative activity has been achieved and enhanced. What marked this period was the passage of the Law on Innovation Activity together with the supplementary rules and regulations that finally brought the long-awaited legal regulation in this area. This Law is a crucial starting point for any further action.

After the first public call, 53 innovation projects of legal entities were funded in the total amount of RSD 169,933,970.00 out of them seven are infrastructure projects in the total amount of 27,370,095.00 dinars and 16 applications by private entities innovators in the total amount of RSD 9,340,890.00. The overview of funded innovation projects of legal entities by their registered areas is given in Figure 2.

After the second public call, 95 innovation projects of legal entities were funded in the total amount of RSD 337,966,864.00 out of them 15 are infrastructure projects in the total amount of RSD 49,563,331.00, and 34 applications by private entities innovators in the total amount of RSD 22.434.424, 00. The overview of the funded innovation projects of legal entities by their registered areas is given in the Figure 9. Some 1,200 innovators were engaged after the second public call and its projects.

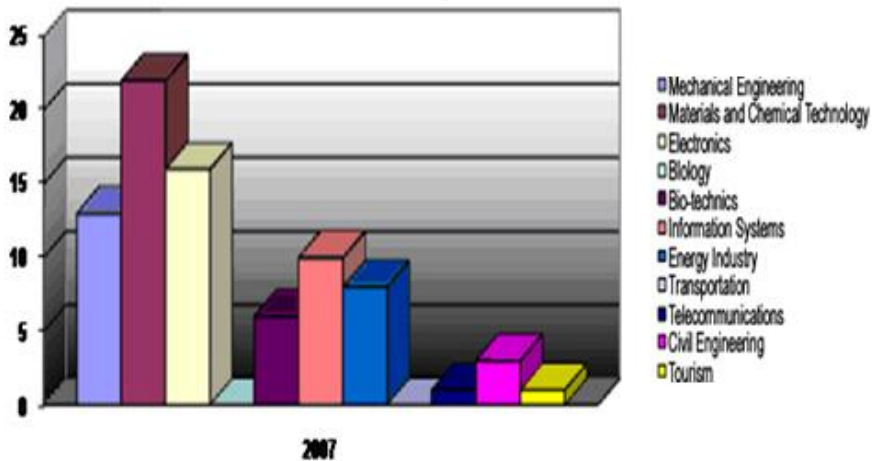
Figure 2. Overview of the funded innovation projects of legal entities by areas (the first public call)



Source: Ministry of Science and Technology Development (2007)

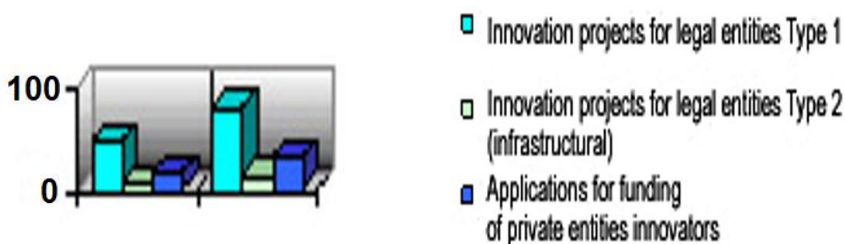
Comparative analysis of parameters of the first and the second public call is given in Figure 3.

Figure 3. Overview of the funded innovation projects of legal entities by areas (the second public call)



Source: Ministry of Science and Technology Development (2008)

Figure 4. Overview of the funded projects and private entities applications by the public calls

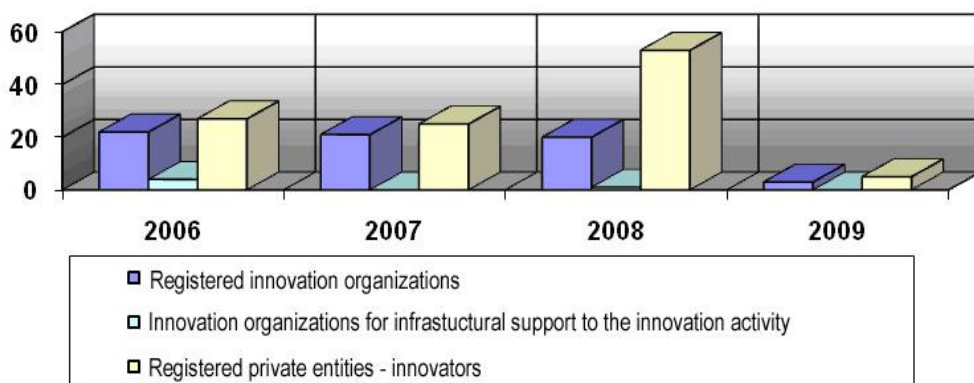


Source: Ministry of Science and Technology Development

In accordance with Article 11 of the Law on Innovation Activity, the Ministry of Science and Technology Development established the Register of Innovation Organizations and the Register of Private Entities Innovators, as well as procedures required for the entry of interested organizations and private entities in the Register. The dynamics of the registration of innovation organizations and private entities innovators by years is given in Figure 5.

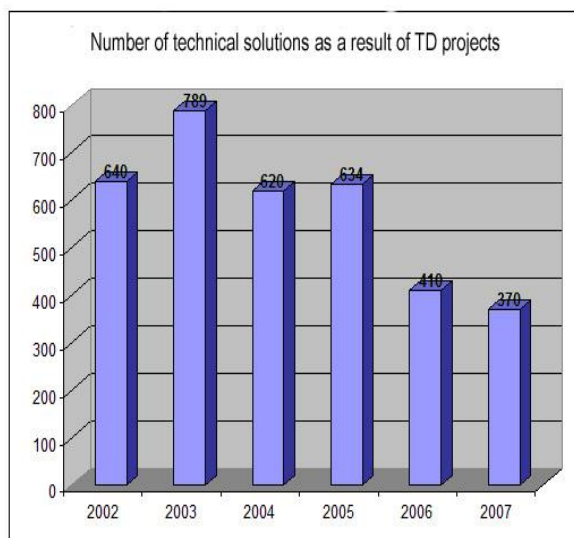
According to the basic definition and purpose, the technological development projects should provide the applied technical solutions, patents; pilot plants, new varieties, innovations, and technological advancement, and those are the results that have direct application. Some 3,400 technical solutions were completed in the field of technological development between 2003 and 2007 (according to the preliminary data (Figure 6).

Figure 5. Overview of the dynamics of innovation organizations and private entities innovators registration by years



Source: Ministry of Science and Technology Development (2006-2009)

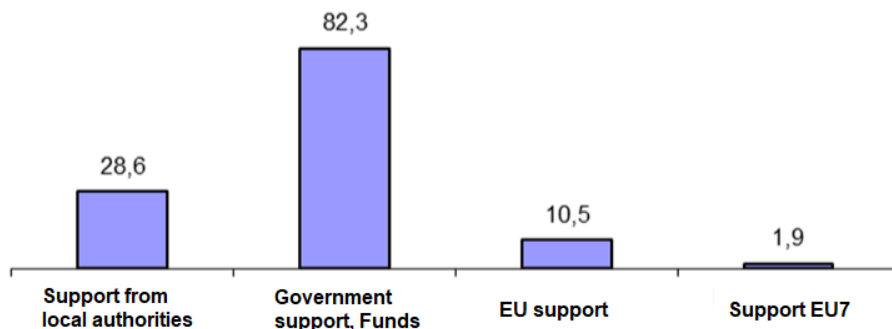
Figure 6. *Number of technical solutions as a result of technological development projects in the period from 2000 to 2007*



Source: Ministry of Science and Technology Development (2008)

The largest number of innovators received financial assistance from state instances and the least from EU funds (Figure 7).

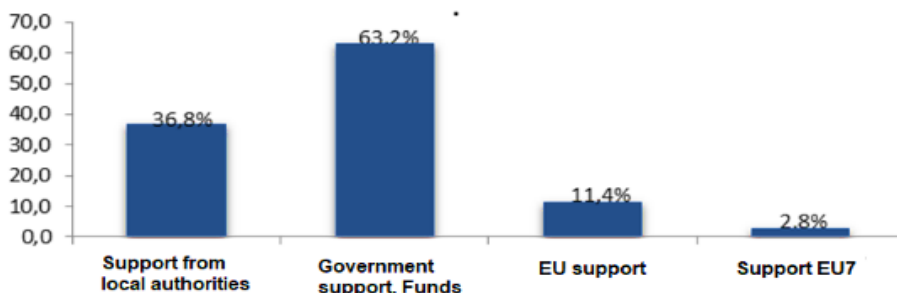
Figure 7. *Financial support structure for innovators (%)*



Source: Ministry of Science and Technology Development

The survey of indicators of innovative activities in the Republic of Serbia from 2012 to 2014 showed 63,2 % of innovators received financial assistance from state instances (Figure 8), which indicates that the Republic of Serbia was able to improve the innovative environment in the observed period compared to previous years.

Figure 8. *Financial Aid Structure for Technology Innovators 2012-2014*



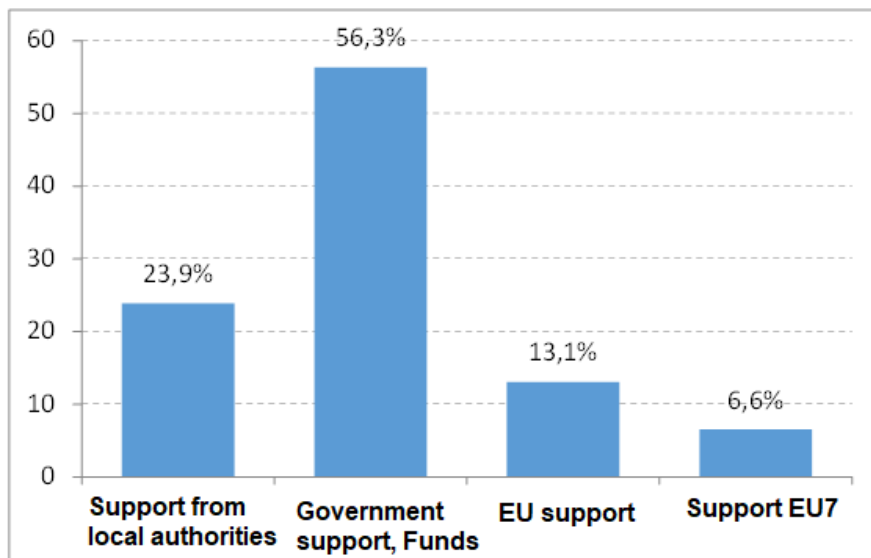
Source: Ministry of Science and Technology Development

Unlike the previous period in the 2014-2017 period, the partial share of funding for innovators changed by significantly increasing EU7 support from 2.8 to 6.6%, and reduced government support from 63.2 % to 56.3% and local governments from 36.7 to 23.9% (Figure 9).

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Figure 9. *Financial aid structure for technology innovators 2014-2017*



Source: Ministry of Science and Technology Development (2008)

These data are a kind of confirmation of the strategic commitment of the Republic of Serbia to significantly not only support the innovative research potential with the funds allocated from the budget, but also strengthen it.

4. GUIDELINES FOR THE POST COVID-19 ERA

With this in mind, it can be expected that in the post-Covid-19 period, the importance of innovation will become more and more effective. The global supply chain will merge into resilient ecosystems, which will empower global platforms using sophisticated technologies such as 5G, robotics and blockchain. In addition, digital bureaucracies will become mainstream, as the advent of Covid-19 has caused government bureaucracies to activate faster than ever before. China broke records by building hospitals in just 10 days in Wuhan. South Korea quickly tested over 200,000 of its citizens and used smartphones to mark the movements of the infected - alerting the uninfected to movements through real-time updates.

All these efforts, as well as transparency or biological impact, could be improved in the so-called smart cities. As only 27 out of 5,500 large cities are considered "smart", according to research from the University of Glasgow, investments will be redirected in their favor in order to better manage future crises. The key players that would benefit would be the so-called smart governments, as well as digital startups in cities across Europe and the United States. As it is very likely that the conditions of the pandemic will affect the

morale, productivity and mental health of the people, the world's support for mental health will be provided in the digital sphere for which states must prepare. Covid-19 is predicted to accelerate telecommuting as well as online education. On the other hand, it is very difficult to predict what will happen after the majority of the knowledge-based workforce needs to work together remotely, indefinitely. In that direction, in all areas, starting from food production, through energy, to preserving health, the post Covid-19 needs to be adjusted to the weather, even in the area of innovation, which must be even faster and even stronger.

CONCLUSION

It is becoming quite clear that both pandemics and recessions are accelerating innovation. Serbia has once again shown that it is a leader in this part of Europe in the development of innovations and new technologies, and that this is a sector that we must continue to develop most strongly. Today, that investment brings results, in the rapid deployment of local scientists and technology in the fight against COVID-19. All of this is another great lesson that highlights the importance of investing in science and research.

Science and innovation play a key role in fostering long-term growth in low- and middle-income countries. A highly skilled workforce, such as researchers, is a prerequisite for the state's ability to tackle complex challenges such as the coronavirus epidemic.

Innovative thinking has proven to be a necessary approach in a critical situation, and that our investments in technology and innovation so far have been investments in the resilience and agility of our system, and the creativity and innovation of these solutions have shaped the rapid and effective response to the virus. and that this innovation will help accelerate economic development even after a pandemic.

The post-coronavirus world of Covid-19 is a terrible shock to the global economy, as well as to the thousands of individuals and families it has affected. States, through their innovation potential that they have built in the pre-19 era, need to ensure that the health and safety of citizens come first. The authors believe that over a long period of time, Covid-19 has irreversibly changed the way states and their governments will think in the next decade.

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Patent implementation as a factor of increasing the national competitiveness

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Abstract: The scientific justification of this paper is reflected in the fact that the field of patent protection in function of competitiveness of the national economy, is insufficiently or very little studied in our economic theory. The consequence of a lack of well-conceived innovation policy was an unfavourable structure of the resident applied patents, in a period from 1945 till 2019, whereby the most patent applications were submitted by individuals, then the enterprises and lastly the institute and universities. Such an unfavourable structure of resident patent applications confirms that patents do not constitute a generator of development, neither of intellectual property nor the technological and economic progress in Serbia. From the perspective of applied and granted patents in the world, it is clear that the leaders in introduction of new technics and technology are the enterprises. Therefore, the implementation of non-price competition forms, such as the patents, is a modern business imperative.

Key words: patent application, patent protection, patent implementation, competitiveness, enterprises, individuals, institute and universities

JEL: 031, 034, 038, 013, 019

1. INTRODUCTION

Development of a country does not depend solely on intellectual property rights, but it is certain that a country's favourable technological and industrial foundations guarantee the economic development. The intellectual property right is of key importance in creating such foundations. The intellectual property rights application has a task to enable and facilitate a technology transfer through the patents, as well as a free movement of goods and services with the application of trademarks, design and designation of origin, in a way that is sufficiently stimulant for the holders of such rights, both for resident natural and legal persons, and the non-resident ones.

Nowadays, the economic experts and decision-makers have largely taken a stance that a productivity increase depends more on technological changes and

use of knowledge than on the capital investments. The only revolution that many countries have been recognising today is the scientific and technological revolution. It is no longer possible even to imagine life without knowledge and technology, even though in practice the following postulate has been often ignored – that for the sake of development, the knowledge is more important than the capital investments.

How important for a technological development and economic growth is to have contemporary legislation in the industrial property area, is best illustrated on China's example. China had introduced its first patent law no sooner than 1984, which resulted in a take-off in terms of economic and especially technical development. Country that only a decade before was an example of a backward, dogmatic, closed and a non-market economy, has become one of the most progressive countries in terms of knowledge and one of the most attractive knowledge markets. By clearly defining a country's economic development strategy, along with the adequate legislative infrastructure and enormous investments in marketing activities, China had set to conquer the international market. When Deng Xiaoping had spoken his famous sentence "Let a thousand flowers bloom", he had provided an amazing impetus to private entrepreneurship and economic development.

2. DATA SOURCES AND METHODOLOGY

The scientific justification of this paper is reflected in the fact that the field of patent protection in function of competitiveness of the national economy, is insufficiently or very little studied in our economic theory. This research offers a very objective presentation of the situation because the entire analytics is based on the actual data from the public registries of the Intellectual Property Office of the Republic of Serbia and the World Intellectual Property Organization (World Intellectual Property Organization - WIPO).

This paper does not deal with the analysis and proposal for improvement of laws and legal regulations in the field of intellectual property, although they have been kept in mind throughout the paper. Regarding to the patent protection in Serbia is an area of law which is harmonized to a very large extent with the European Union and the TRIPS Agreement (Agreement on Trade Related Aspects of Intellectual Property Rights). Due to the fact that the laws in this area are relatively recent, today we can talk about the work related to continuation of harmonization. The problem of our economy is the low level of domestic patent protection and consequently the lack of awareness and willingness of economic entities to implement and enforce the law from this field.

From general scientific methods for processing quantitative data we used statistical methods and modeling method. Through statistical analysis we explained the structure, dynamics, mutual conditioning and impact of patent

protection on enhancing competitiveness. Given that this research deals with phenomena from the sphere of social sciences and in order to explain certain facts, trends and to check certain positions we also used the method of modeling to establish a connection and to determine the importance of the patent protection for the growth and development of the economy as a whole.

From the special scientific methods we used the method of analysis and synthesis for the comparison of development of the national competitiveness by the subject of patent protection. The most frequent forms of analysis in this paper are: structural, functional, genetic and comparative analysis.

3. ECONOMIC MOTIVES FOR PATENT PROTECTION

At the time of economic globalization the tradition and proven values are gaining more and more importance. Therefore, when promoting the quality of a particular product in the market it is insisted on specific natural factors or traditional production method which is used in the area from which the product originates and which give a special, specific quality to that product (Simin & Novaković, 2019).

As a reward for discovering their own inventions, the patent system offers to patent holders the exclusive, pre-emptive market rights, aiming to encourage a commercial use of their protected inventions. According to the patent law terminology, an invention is defined as a new and inventive technical problem solution. That may refer to a creation of brand new device or product, procedure or process, or it may simply represent an incremental improvement of an already known product or procedure. Therefore, it is reasonable to say that Innovation has always been the yeast of a technological progress, its most important ingredient and an answer to the numerous development problems (Fukujama, 1997).

An invention represents a technical solution of a technical problem. It may be an innovative idea or it may be realised as a working model or prototype. An innovation represents a translation of an invention into a product or procedure which can be marketed. Key reason for protecting the inventions with patents include the following:

- a strong market position and an advantage over competition;
- higher profit or return on investment;
- additional income from licensing or transfer of rights to a patent;
- access to a technology through the cross-licensing;
- access to the new markets;
- lowering the risk of breaching rights;
- improving the possibilities to receive subsidies or monetary assets from development funds with an acceptable interest rate;

- a powerful mean to instigate actions against the copycats and counterfeiting;
- a positive image in the public regarding the activities of an enterprise (Inventing the Future - WIPO, 2008).

In application of patents as the strategic instruments, it should be emphasised that a patent system has four significant functions:

- to facilitate a technology transfer and direct foreign investments;
- to encourage a research and development at the universities and research centres;
- to serve as a catalyst of new technologies and new businesses;
- to strengthen the economy, especially Small and Medium Enterprises in terms of collecting the goods, intellectual property and their usage.

These functions are applicable regardless of differences in culture, religion, political system and a degree of economic development, as long as the entrepreneurs are backed by a set of well-planned, coherent and proactive government policies (Idris, 2003).

One of the most important conditions for direct foreign investments is an effective government policy, supporting the economy in patent introduction, development, protection and use. Some of the most efficient policies are providing the financial and tax incentives in order to encourage the following: research and development, enhancement and improvement of the old technologies, and traditional knowledge as well. A patent system stimulates the economic development, by encouraging the patent-based business transactions. Commercialisation of the inventions implies not only product manufacturing but also licensing the rights on manufacturing, usage and sales of those products, with payment of the agreed royalty to the inventor.

Regarding to (Marković *et al.*, 2013) successful national policies of economic development and youth engagement include, besides the involvement of public authorities, the activism of young people in a process through which they have to do something positive for themselves. To overcome this situation, it is necessary to create prerequisites for development and the most complete achievement of young people in the sphere of economics and high tec technology.

Inventions can be protected in other countries as well, generally by means of the Patent Cooperation Treaty (PCT) which stipulates the submittal of one international patent application which has the same legal effect as the submittal of a national application in each of the specified countries. It is therefore provided that an applicant may submit one application and request protection in several PCT signatory countries where intends to protect the invention. A resolute step towards overcoming the territoriality principle in patent law, was

taken by conclusion of the European Patent Convention (EPC) in Munich in 1973.

Unfortunately, the SFRY had not joined the EPC due to ideological reasons, therefore we have lost a precious time, given that during all those years we could not have used the advantages of the European patent as one of the instruments of regional legal, economic and technological cooperation within the European Union. Signing the Agreement on Cooperation and Patent Protection Extension in 2004 was an attempt to catch up with the ever-growing challenges of the contemporary world's innovation technologies, considering that the European Patent Office represents the headquarters of the world's technical knowledge for the European Union. Only since 2010, Serbia has become a member of the European Patent Organization – EPO (Simin, 2012).

4. LEGAL NATURE OF A PATENT

First step in the process of invention commercialisation is a legal protection – patent protection. The patents are granted based on technical criteria, and not based on commercial or market ones, however, the exclusive rights acknowledged by a patent relate to a commercial use of an invention. The key of transforming an invention into a commercial, profit-making product, is conditioned by an exchange of patent information regarding the technical state, new technologies and a legal status of invention.

Our patent law is based on a modern comprehension that a patent is an instrument of free market competition, i.e. that knowledge represents a commodity, which has a market value and its owner. If a patent is observed as a function of technology transfer instrument, it is clear that patents transform technical knowledge into a commodity, which can become an object of market exchange. Technological progress of the USA is built on a Roosevelt's maxim: „The key of development is technology, while the key of technology are patents” (Žarković, 2002).

A legal protection of inventions in Serbia is conducted by an administrative procedure lead by the Intellectual Property Office, pursuant to provisions of the Law on Patents. Procedure of granting a patent is initiated by submitting an application directly to the Intellectual Property Office, as well as based on the applications which are being submitted to the World Intellectual Property Organisation (WIPO) and European Patent Office (EPO), by applying two international treaties, that is, the Patent Cooperation Treaty – PCT and the Agreement on European Patent Application Extension. By using the PCT applications, the enterprises gain a possibility to choose a state or the states where they want to apply, thus economising on the administrative fee costs in countries where they do not have an interest to register a patent (Simin, 2012).

Patent application data may be used as an indicator of innovative activities in the enterprises and among the inventors in a certain country. Patent application protects a new solution of a certain technical problem, depending on the patentability level.

In 2005 there has been a sharp increase in number of patent applications by non-resident applicants, primarily due to coming into effect of the Agreement on Cooperation and Patent Protection Extension, signed between the government of FRY and the European Patent Office (EPO), published in (Official Gazette of Serbia and Montenegro – International Agreements, number 14/2004).

4.1. Patent applications

Number of non-resident applications submitted in one country is a measure of its attractiveness for a technology transfer and placement of new products on its market. A patent application structure where the non-resident ones dominate, may serve as a technological development indicator, with an obvious increase of technological dependence in relation to developed countries of the West.

During 2019, 177 patent protection applications were submitted to the Office. Out of total number of submitted patent applications, 170 were submitted directly to the Office, whereas 7 applications entered the national phase through the Patent Cooperation Treaty (PCT) system. If we analyse the structure of applied patents over the 2010-2019 period, it is noticeable that a number of applied patents by resident applicants has been constantly decreasing.

Table 1. Patent applications in Serbia 2010 - 2019

	Patent Applications 2010-2019									
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Applications of Domestic Applicants	290	180	191	201	201	178	191	173	162	168
Applications of Foreign Applicants Filed Directly in the Office	23	28	20	7	6	9	16	8	5	2
PCT Applications in the National Phase	16	21	13	13	5	4	6	1	7	7
Total	329	229	224	221	212	191	213	182	174	177

Source: Intellectual Property Gazette, Supplement, p.25

Research has shown that in 2005, when the Request for the Entry of Extended European Patent came into force, a number of non-resident applications is significantly higher, compared to the number of resident patent applications.

During 2019, the Office received 61 requests for registering the extended European patent in the Patent Register, and 1466 requests for registering the European patent in the Patent Register.

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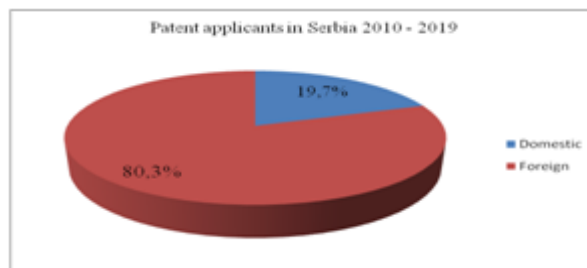
Table 2. *Request for the Entry of the Extended European Patent and European Patent in the register of patents filed from 2010 to 2019*

Requests for the Entry of the Extended European Patent and European Patent in the Register of Patents filed from 2010 to 2019										
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Request for the Entry of the Extended European Patent	250	361	348	307	268	225	189	144	101	61
Request for the Entry of the European Patent	/	/	15	66	240	472	803	1030	1325	1466
Total	250	361	363	373	508	697	992	1174	1426	1527

Source: Intellectual Property Gazette, Supplement, p.27

Also, a strong, uniform and efficient patent protection encourages the process of international technological cooperation, which is especially important for developing countries, where the transfer of modern technology is more useful than direct foreign investments in the form of capital. During the period from 2010 to 2019, share of resident applicants in a total number of applied patents was 19,7%, compared to 80,3% of non-resident ones.

Figure 1. *Structure of Patent applicants in Serbia 2010 - 2019*



Source: Author's calculation based on data of public registers

System of patent applications thus enables a monitoring of technological development, the so called “technology watch”, and competition. Monitoring, analysing and reviewing the patent and trademark status is required prior to beginning of every research and development work, in order not to waste time and financial resources on protecting the already existing goods. Also, this search may serve as a motivation, providing inspiration and intellectual impulse to the inventors.

It is obvious that encouraging a patent system in developing countries is more beneficial to the non-resident enterprises investing in our country, while the positive effects for resident applicants are far less visible.

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Favorable interdependence between the image of the country of origin and the product appears in the case when a certain dimension of the country of origin is seen as an essential product characteristic (Simin *et al.*, 2016). It is obvious that encouraging a patent system in developing countries is more beneficial to the non-resident enterprises investing in our country, while the positive effects for resident applicants are far less visible.

4.2. Registered rights - patents

A patent activity in our country is based on traditional industrial sectors, focusing on items for personal and household use, in contrast with the practice in developed countries where 60 % to 90% of all patents is being applied and registered in promising technical areas such as: organic chemistry, medical

equipment, information technologies, biotechnology, nanotechnology etc (Simin, 2012).

Table 3. Registered Patents 2010 – 2019

Registered Patents 2010-2019										
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Patents of Domestic Owners Granted in the National Procedure	98	60	79	78	62	62	50	35	36	53
Patents of Foreign Owners Granted in the national Procedure	329	119	88	58	43	24	18	12	8	6
Entered Extended European Patents	525	313	360	308	283	225	158	176	109	73
Entered European Patents	/	/	9	49	215	423	589	1041	1376	1586
Total	952	492	536	493	603	734	815	1264	1529	1718

Source: Intellectual Property Gazette, Supplement, p.28

In 2019, 1718 patents were registered, with 59 of them granted according to a national procedure, 73 were entered into Register based on the Cooperation and Extension Agreement with the European Patent Office, while 1586 on the basis of the the Law on Ratification of the European Patents Convention

A fact that only the non-resident granted patents have a growth trend, does not help in overcoming a technology gap in the long term, but a technology transfer should help in strengthening the local innovation activities.

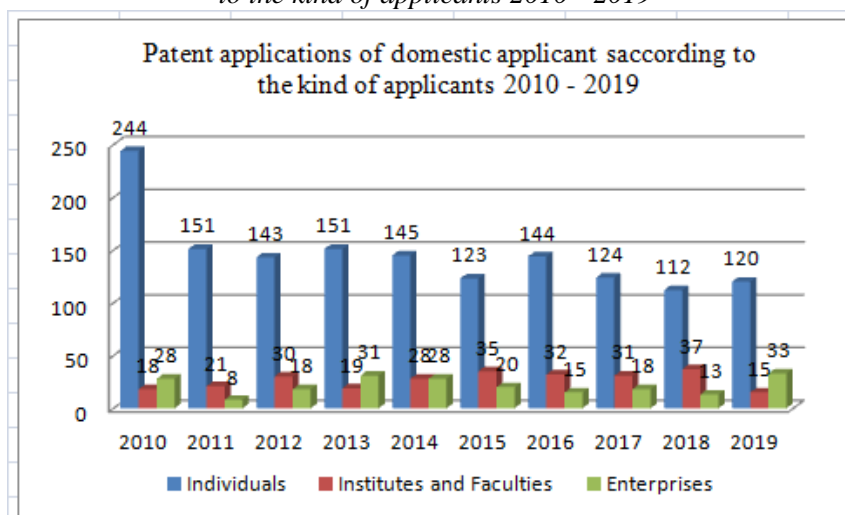
In 2019, in the Republic of Serbia there were 6773 granted patents (out of that number, 709 were granted according to a national procedure, while 1435 based on the Cooperation and Extension Agreement with the European Patent Office, and 4629 pursuant to the Law on Ratification of the European Patents Convention (Intellectual Property Gazette, 2019).

Lack of the scientific and technological development policy in our country, and consequently the insufficient interest of the enterprises for a technological development based on their own innovation activities, results in an extremely low number of applied and granted resident patents (tables 1, 2 and 3). Also, during the last decades of the 20th century till today, development of our economy had been mainly based on the import of foreign equipment and technology, which ended in neglecting a development of our own scientific and technological achievements.

One of the major economic and social problems in Serbia is high unemployment. Since the process of ownership transformation is at the end, but still incomplete, the process of layoffs will continue in the future. This is based on increased employment that has a basis in launching new products, which in turn can not be started without substantial capital investment. Large investments in competitive production can create more sustainable economic growth that would be the leader in job creation (Marković *et al.*, 2013).

A research regarding the structure of patent applications submitted by resident and non-resident applicants has been conducted by categories - individuals, enterprises and institutes.

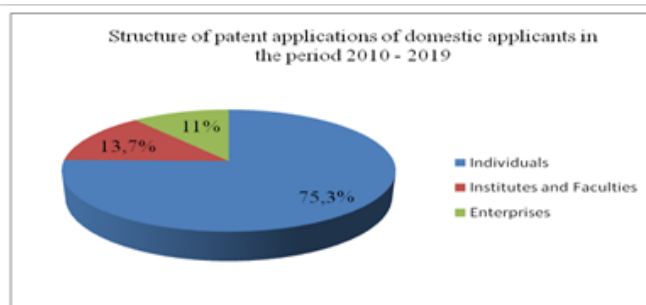
Figure 2. *Structure of patent applications of domestic applicant according to the kind of applicants 2010 - 2019*



Source: Author's calculation based on data of public registers

In a period from 2010 till 2019 (Table 3.), a percentage of patent applications submitted by individuals had increased (on average by 75,3%), and a percentage of applications submitted by enterprises had decreased (on average by 11%) as well as by institutes and faculties (by 13,7% on average). This unfavourable structure of resident patent applications where the enterprises participate merely with 13,7%, confirmed that patents have not yet become a development generator, neither for the intellectual property nor scientific and technological growth in Serbia.

Figure 3. *Structure of patent applications of domestic applicants 2010 - 2019*



Source: Author's calculation based on data of public register

Such an unfavourable structure of our resident applicants only proves the unacceptable current state of our technological creativity, considering that the fastest way to get into a technological dependency is to stop investing into a domestic science. This as well confirms the fact that inventions in our country are still more of a personal act of an individual rather than a strategic, continuous and state-supported activity.

Country can be a powerful symbol, especially at the national level, based on its direct connection with the products, materials and possibilities. Unfavorable interdependence is expressed when the essential characteristics of the product are perceived as dimensions of a negative image of the country of origin (Simin *et al.*, 2016).

According to the Report on Global Competitiveness of the World Economic Forum - WEF (2018), Serbia has advanced by 5 places and is ranked 65th on the world competitiveness ranking list of a total of 140 countries. The achieved value of the Global Competitiveness Index (GCI) of 60.9 is the best result since 2010. Nevertheless, the achieved result remains quite low because Serbia is more competitive than only about half of the countries (54%) and is still one of the most uncompetitive countries on the European continent (Simin-Jovićević & Živkucin, 2019)

As for the rest of the world, the applicant structure is such that most applications are submitted by the enterprises, followed by individuals and the least applications are submitted by institutes and universities. Speaking of the applied and granted patents, it is clear that enterprises constitute the pillars for introduction of new technics, and they invest substantial funds for such purposes. Introduction and implementation of the non-price forms of competition, such as patents, is imperative for the contemporary business operations.

5. IMPLEMENTATION OF PATENTS IN INTERNATIONAL SETTINGS

Innovation capability and a possibility of developing new and inventive products, processes and services are quite diverse and depend on the company's size, business operation area, industry sector and business environment affiliation. That is how Arundel and Kabla have shown that „more value is attributed to the patents of enterprises conducting business in the so called specific industries, as well as that the average patent rate in the industry goes from 15% in metal and steel industry up to 74% in the pharmaceutical industry”. (Arundel & Kabla, 1998).

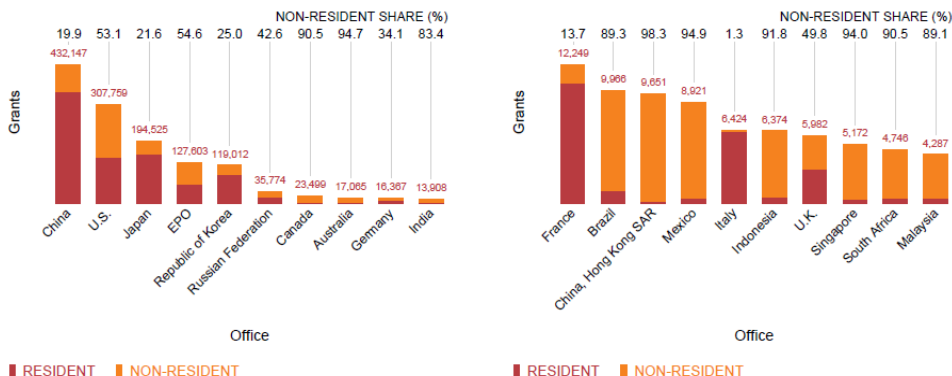
However, in large number of other sectors, enterprise innovations are based on incremental improvement of the existing products, design innovations, change in a delivery method, and managerial and marketing organisation. In many of these sectors, the innovations in enterprises have more of an informal nature, without the participation of costs regarding the research and development, laboratories and employees. In such circumstances, the other intellectual property rights such as the petty patents, industrial design and other trademarks, may have a bigger role compared to the patents in securing a comparative advantage. Considering that (Simin *et al.*, 2016) in Serbia the protection and use of appellations of geographical origin is mainly related to agricultural and food products, these could take the leading position compared to all other types of intellectual property rights.

5.1. Patents and measuring of international competitiveness

Focusing knowledge as a source of productivity and competitiveness puts the intellectual property system to a prime spot in the economy of knowledge. Statistics of patent applications and granted patents reveal a significant rise in patenting in the last two decades, which indicates a pro-patent policy, that started in the USA during 1980s with a promulgation of a so called „Bayh – Dole Act”. Number of granted patents in the USA, by the United States Patent and Trademark Office (USPTO), has been rising by 6% annually since the mid-1980s. The rise in number of patent applications is especially significant for the industries such as information and communication technologies (ICT), biotechnology, nanotechnology, chemistry, etc. Therefore, the rise in number of applied and granted patents on an international level reflects the increased importance that most of the enterprises, including many high-tech enterprises, attribute to the patents (Merges *et al.*, 2009).

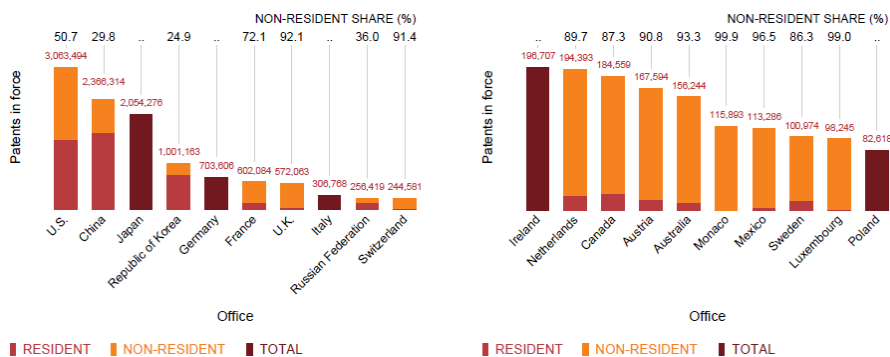
Figure 4 illustrates that among twenty leading countries in the world by the number of granted patents in 2018, China issued the largest number of patents (432,147) in that year, followed by the U.S. (307.759), Japan (194.525), the EPO (127.603) and the Republic of Korea (119.012). Among the top 10 offices, the EPO granted 20.8% more patents in 2018 than in 2017.

Figure 4. Patent grants for the top 20 offices, 2018



Source: World Intellectual Property Indicators, WIPO, Geneva, 2019, p.31
 In 2018, an estimated 1.42 million patents were granted worldwide, up 1.8% on 2017.

Figure 5. Patent in force in the top 20 Offices, 2018



Source: World Intellectual Property Indicators, WIPO, Geneva, 2019, p.19

Patent rights generally last for up to 20 years from the date an application was filed. An estimated 14 million patents were in force across 125 jurisdictions in 2018, representing an increase of 6.7% on 2017. Figure 5. illustrates that in 2018, the largest number of patents in force was recorded in the U.S. (3.1 million), China (2.4 million) and Japan (2.1 million) each had around 2 million patents and the Republic of Korea had 1 million (Table 5.). Germany with 703,606 patents in force ranked in fifth position. Half of all patents in force in the U.S. originated from non-resident applicants, while resident applicants accounted for around 70% of all patents in force in China. Non-resident applicants accounted for more than half of all patents in force in each of the top 20 offices, except for China, the Republic of Korea and the Russian Federation

The inventors and enterprises aiming to protect their innovation, are usually facing a decision whether to submit the first patent application only at the home Intellectual Property Office, in their own country or to do so internationally. The inventor makes this decision depending on the estimate of invention's market potential for conquering new markets or creating new market demands.

The owners who think that their patents are valuable and capable of equally competing on the international market, most often seek a patent protection through the US Patent and Trademark Office – USPTO, mostly due to the size, dynamics and ever growing innovation capacity of the American economy. The USPTO is the largest receiver of resident and non-resident patent applications (World Patent Report - WIPO, 2008).

The best indicator of technological competitiveness is a number of American patents granted to the non-resident enterprises. Only the best inventors from certain countries submit the patent applications to the USPTO, and each granted patent passes through the same examination procedure, i.e. the same filter, therefore it is possible to perform an international comparison.

Examples of the countries as China, Japan, USA, Republic of Korea, Germany etc., having the most granted resident and non-resident patents in the world, show how a well-conceived intellectual property policy, in synergy with an business development incentive policy, may represent a strong impetus for the economic growth and development based on knowledge.

As an illustration thereof, data may be used showing that in a period from 1994 to 2006, the following patents had been granted to Japanese Keiretsu conglomerates through the USPTO,: Canon 11.015 (5,7%), NEC 9.584 (5,0%), Toshiba 7.474 (3,9%), Sony 7.394 (3,9%), Mitsubishi 6.991 (3,6%), Hitachi 6.918 (3,6%), Matsushita 6.704 (3,5%), Fuji Ltd. 6.522 (3,4%), Fuji Photo Film Co. 3.754 (2,0%), Sharp 3.366 (1,8%), etc (Kingston&Scally,2006). This leads to a conclusion that most of the American patents, during this 10-year period, was granted to the Japanese big conglomerate companies.

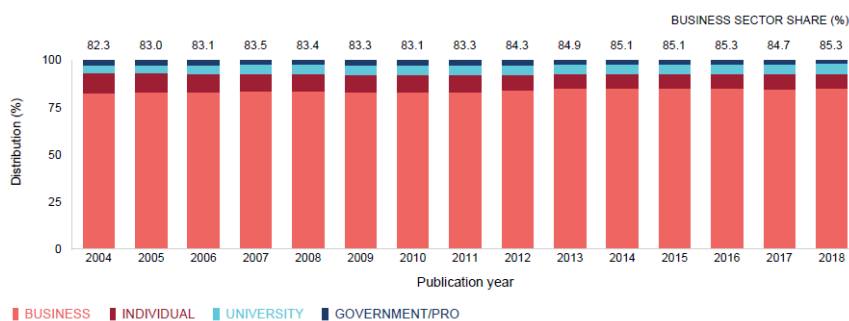
The Japanese Keiretsu model is at the same time the main reason for the Small and Medium Enterprises sector's low level of innovation motivation, regardless of their size. So, small companies often participate in the innovation projects, but mostly by instructions of a larger partner which is a real source of leadership and dynamism. Capability of small enterprises in Japan to cooperate with the large ones within the Keiretsu network is by itself an important organisational innovation, but that does not refute the assertion that Japanese economy is dominated, both quantitatively and in terms of dynamism and innovations, by very large companies (Fukujama,1997).

Similar situation is in Germany as well, where the most part of patent activities relates to large, multinational corporations such as Siemens and Bayer, while the share of small entity granted patents is only 11.880 (13,2%). This percentage depends more on the presence of multinational corporations (MNC) rather than the country economic possibilities, moreover, larger presence of the multinational corporations (MNC), significantly affects the reduction of small entities' share in the number of granted patents by some countries (Kingston & Scally, 2006).

Over a period of 40 years, the Patent Cooperation Treaty (PCT) has steadily grown and is now the largest international intellectual property filing system for the World Intellectual Property Organization (WIPO) and the preferred filing route for applicants seeking patent protection in foreign jurisdictions.

Distribution of granted patents by categories, that is, individuals, enterprises and non-profit organisations (universities and science-research centres) per groups of PCT countries is shown in Table 6. In order to make a comparison as precise and useful as possible, in the conducted research the PCT countries are divided into groups: business, individual, university and government/pro. Government/pro represents public research organization and hospital.

Figure 6. *Distribution of PCT applications by Applicant type, 2004 - 2018*



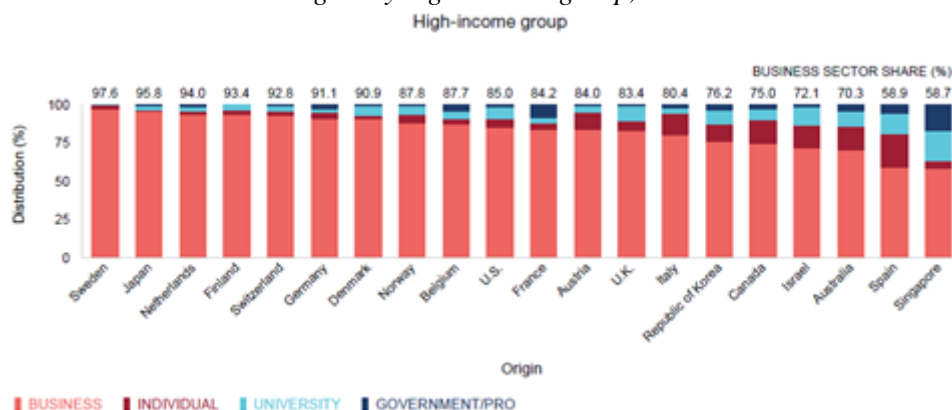
Source: Patent Cooperation Treaty Yearly Review 2019, World Intellectual Property Organization (WIPO), Geneva, Switzerland, p.32

Figure 6. shows that in the cited 15-year period, the smallest share of granted patents have the „non-profit organisations (universities, science-research centres)” and „individuals” compared to the categories „Business - enterprises”. In 2018, the business sector accounted for (85,3%) from all published PCT applications, followed with the „individuals” (7,4%), the university sector (5,4%), and the government and public research organization (PRO) sector (1,9%) sector includes private non-profit organizations and hospitals. A dominant share of granted patents in a category „ Business” (85,3%), confirms that the

enterprises are the leaders in introduction, protection and implementation of the patent system (Patent Cooperation Treaty, 2019).

Since the PCT entered into force in 1978, the number of its member states has increased sharply from 13 to 152 in 2018. About 80% of the world’s countries have joined the System, and 90% of high-income countries. In 2018, countries from the high-income (35.5%) and upper middle-income (26.3%) categories accounted for the largest proportions of total member states.

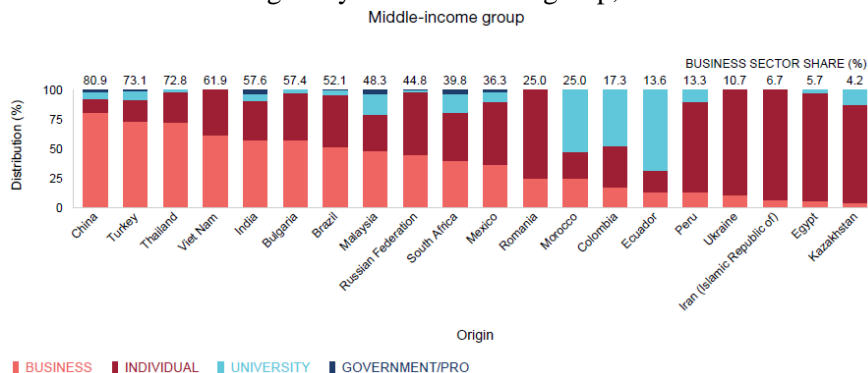
Figure 7. *Distribution of PCT applications by applicant type for the top 10 origins by high-income group, 2018*



Source: Patent Cooperation Treaty Yearly Review 2019, World Intellectual Property Organization (WIPO), Geneva, Switzerland, p.33

Figure 7. and Figure 8. shows that more than 95% of PCT applications originating in Sweden and Japan were filed by „Business” - enterprises.

Figure 8. *Distribution of PCT applications by applicant type for the top 10 origins by middle-income group, 2018*



Source: Patent Cooperation Treaty Yearly Review 2019, World Intellectual Property Organization (WIPO), Geneva, Switzerland, p.33

The „ Business” sector share was particularly high for Sweden (97,6%) and Japan (95,8%). On the top 20 origins from the middle-income category, the „ Business” sector accounted for the majority of published application in seven countries and „individuals” applicant filed the most in eight countries. In the Islamic republic of Iran (93,3%) and Egypt (91,4%) individual applicants accounted for the vast majority of public applications.

Applicants from Asia, Europe and North America have each filed slightly more than 1.2 million PCT applications since 1978. The U.S.(31.1%), Japan (17.3%) and Germany (10.4%), combined, account for the bulk of total filing activity. China has seen its share of PCT filings rise steeply over the past 40 years, up to 21.1% in 2018 (Patent Cooperation Treaty, 2019)

An insight into the countries where an enterprise has submitted a patent application, provides a significant information on technological activity and enterprise marketing strategy, considering that one of the main reasons for submitting application is to grasp the commercialisation possibilities of a new product, that is, new technology in that country.

These percentages speak exactly about the share of technology-intensive enterprises with valuable patents, which have the greatest chance to succeed on the market. This high level of patent protection of the Enterprises in developed countries is the best indicator of the growth in implementation of intellectual property as an integral part of a business strategy in the Enterprises sector.

CONCLUSION

In order to have its own economic value, the intellectual property must be legally protected in a efficient way. In Serbia, there is a legal and institutional framework for an efficient implementation of the intellectual property rights, which represent a significant strategic resource, still not fully used.

A successful implementation of the intellectual property rights system, and especially the patent system in the world, indicates a diversity of models and approaches by the countries and shows how a well-conceived intellectual property policy, in synergy with an business development incentive policy, may provide a strong impetus for the economic growth and development based on knowledge. A positive practice of one country is not necessarily, and by default, applicable to the others, but it is clear that in the countries which possess and apply the intellectual property development strategy, new possibilities are being opened for the growth and development within a new and innovative economy.

Uniform and efficient patent protection encourages the process of international technological cooperation, which is especially important for developing countries, where the transfer of modern technology is more useful than direct foreign investments in the form of capital. A research into trends and current state of the patent implementation by the enterprises in Serbia, shows a number of limitations which impede the fully realisation of the enterprises' innovation potentials.

Over the last decades of the 20th century till today, Serbian economy mostly relied on the import of foreign technology and equipment, which resulted in neglecting a development of domestic technical and technological achievements. During the period from 2010 to 2019, share of resident applicants in a total number of applied patents was (19,7%), compared to (80,3%) non-resident ones. A patent application structure where the non-resident ones dominate, may serve as a technological development indicator, with an obvious increase of technological dependence in relation to developed countries of the West. Due to the low level of investments in research and development, a more dynamic development of domestic technological capacities is lacking, resulting in Serbian enterprises' reliance on the implementation of foreign technologies, whether we speak about licenses, foreign direct investments, joint ventures etc.

A consequence of such a lack of well-conceived innovation policy was an unfavourable structure of the resident applied patents, from the innovation sources point of view, in a period from 1945 till today. During the period from 2010 to 2019, the most patent applications were submitted by individuals (75,3), then the institute and universities (13,7%) and lastly the enterprises (11%). Such an unfavourable structure of resident patent applications confirms that patents do

not constitute a generator of development, neither of intellectual property nor the technological and economic progress in Serbia.

In contrast with this trend in our country, the most applications per applicant category in the world is submitted by the business sector -enterprises (85,3%), followed by the individuals (7,4%), then the institutes and universities (5,4%) and lastly the government and public research organization (PRO) sector (1,9%). From the perspective of applied and granted patents in the world, it is clear that the leaders in introduction of new technics are the enterprises, which are investing the significant funds in such activities. Therefore, the introduction and application of non-price competition forms, such as the patents, is a modern business imperative.

At the same time, it should be emphasised that if the presence of multinational corporations in a country is lower, the small and medium enterprises become the only and main generator of activities regarding the intellectual property rights implementation and economic development. That is why in Serbia, which is still not sufficiently attractive for direct foreign investments due to relative economic backwardness and political instability, the enterprises sector should take over the role of growth and development generator, through the larger application of intellectual property rights. A well-balanced national, regional and local development is only one of the results of the intellectual property rights policy implementation, in the form of encouraging research and development, opposite to the knowledge import.

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Advantages and limitations of using SPSS in teaching statistics

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Abstract: During past few years, multimedia learning has become very important and interesting topic in the field of teaching methodology. Many research works in different scientific fields, including statistics, have proven that multimedia makes learning process much easier. Statistical packages are software designed for the explicit purpose of performing statistical analyses. For our Statistics course we chose the SPSS program as one of the most represented in the teaching and tested it in class in order to see how they would affect teaching process. The research was conducted on two groups of 50 students, divided on subgroups of 25 (traditional and multimedia group), at two faculties: the Faculty of Finance and Economy and the Faculty of Civil Construction Management of the Union “Nikola Tesla” University, Belgrade, Serbia. The tests of adopted knowledge conducted during this research showed that students from multimedia group had much higher average scores.

Key words: multimedia, software, SPSS, teaching, learning

JEL: C88, I21

1. INTRODUCTION

Nowadays, usage of different kinds of multimedia is largely included in the education because it allows the wider spectrum of possibilities in teaching and learning. Multimedia is very useful in the process of explaining statistical ideas, abstract terms, theorems, problems, etc.

Experience in work with students showed that they are highly interested in modern methods in learning, which include all kinds of multimedia, such as educational software and internet.

The use of multimedia in teaching different subjects at Union “Nikola Tesla” University, Belgrade in Serbia has become a long-standing practice.

Different kind of softwares were used in the following subjects:

- Mathematics – Adobe Flash i Geogebra (Milovanović, 2005, 2014, 2015; Milovanović *et al.*, 2011, 2012, 2013, 2015, 2016, 2017, 2018, 2019).

- Statistics – SPSS (Milovanović *et al.*, 2018, 2019).
- E-business – Moodle (Perisić *et al.*, 2014, 2015, 2017, 2018).

The aim of this article is to recognize the importance of multimedia in the teaching process.

The teaching and learning of statistics has pervaded all levels of education, including post-secondary, college-level and graduate-level curricula (Garfield & Ahlgren, 1988). For college- and graduate- level students, statistics has become a requisite course for a wide range of fields. The learning of statistics cultivates students' quantitative and logical thinking, and additionally provides skills necessary for future employment choices. College statistics courses are expected to train students for proficiency in statistical skills. However, students face challenges in these courses. Studies showed that many students did not obtain an adequate understanding of basic statistics concepts in class and were unable to solve applied problems (Garfield, 1995; Garfield & Ahlgren, 1988). Educators have employed multiple technological solutions in teaching, such as visual aids, simulations or animations, with hope of enhancing college student statistics learning (Chance *et al.*, 2007).

Different kinds of statistical software programs have been developed exclusively for helping students learn statistics. Several packages have been used by statisticians for many years, including *SPSS* (<http://www.spss.com>), *S-plus* (<http://www.insightful.com>), *R* (<http://www.r-project.org>), *SAS* (<http://www.sas.com>), and *Minitab* (<http://www.minitab.com>).

We used software SPSS and tested it in class in order to see how they would affect teaching process.

1.1. IBM SPSS software

The IBM SPSS software platform offers advanced statistical analysis, a vast library of machine learning algorithms, text analysis, open source extensibility, integration with big data and seamless deployment into applications.

Its ease of use, flexibility and scalability make SPSS accessible to users of all skill levels. What's more, it's suitable for projects of all sizes and levels of complexity, and can help you and your organization find new opportunities, improve efficiency and minimize risk.

Within the SPSS software family of products, SPSS Statistics supports a top-down, hypothesis testing approach to your data while SPSS Modeler exposes patterns and models hidden in data through a bottom-up, hypothesis generation approach.

1.2. Advantages and limitations of using SPSS

ADVANTAGES:

The advantages of using SPSS as a software package compared to other are:

- SPSS has a very nice interface and keeps their interface consistent, even after 20 years of use.
- Analyzing data is very quick and easy there is no programming required.
- Some coding and saving codes for further analysis saves time.
- Many complex statistical tests are available as a built in feature.
- Interpretation of results is relatively easy.
- Easily and quickly displays data tables can be expanded.

LIMITATIONS:

The limitations of using SPSS as a software package compared to other are:

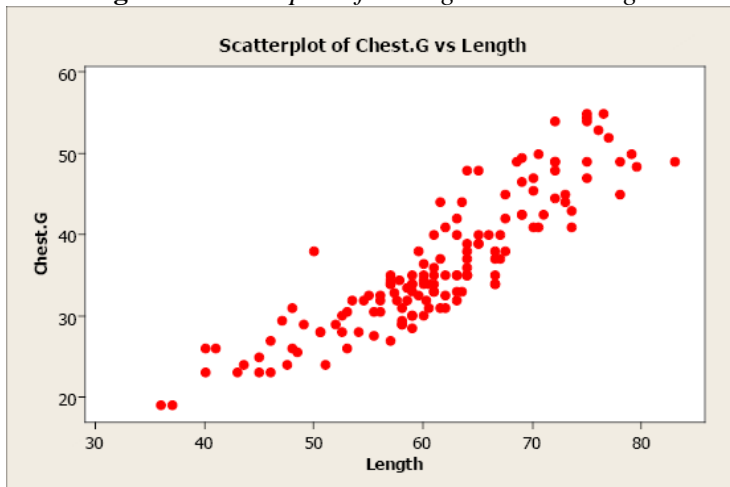
- SPSS can be expensive to purchase for students.
- Usually involves added training to completely exploit all the available features.
- For those requiring advanced procedures not on SPSS, programmable coding, like in R Statistics, may be more limited and not as robust and use of R or other programs might be needed.
- Default graphics are far from publication quality. Generally, it's better to use other programs for graphics.
- Information about effect size and confidence intervals is missing for many techniques.

2. COURSE OF STATISTICS WITH SPSS PROGRAM

2.1. Correlation and Simple Linear Regression

A correlation exists between two variables when one of them is related to the other in some way. A scatterplot is the best place to start. A scatterplot (or scatter diagram) is a graph of the paired (x, y) sample data with a horizontal x-axis and a vertical y-axis. Each individual (x, y) pair is plotted as a single point.

Figure 1. Scatterplot of chest girth versus length



A scatterplot can identify several different types of relationships between two variables.

- A relationship has **no correlation** when the points on a scatterplot do not show any pattern.
- A relationship is **non-linear** when the points on a scatterplot follow a pattern but not a straight line.
- A relationship is **linear** when the points on a scatterplot follow a somewhat straight line pattern. This is the relationship that we will examine.

Linear relationships can be either positive or negative. Positive relationships have points that incline upwards to the right. As x values increase, y values increase. As x values decrease, y values decrease. The linear correlation coefficient is also referred to as Pearson's product moment correlation coefficient in honor of Karl Pearson, who originally developed it. This statistic numerically describes how strong the straight-line or linear relationship is between the two variables and the direction, positive or negative.

The properties of "r":

- It is always between -1 and +1.
- It is a unitless measure so "r" would be the same value whether you measured the two variables in pounds and inches or in grams and centimeters.
- Positive values of "r" are associated with positive relationships.
- Negative values of "r" are associated with negative relationships.

When you investigate the relationship between two variables, always begin with a scatterplot. This graph allows you to look for patterns (both linear and non-

linear). The next step is to quantitatively describe the strength and direction of the linear relationship using “r”. Once you have established that a linear relationship exists, you can take the next step in model building.

Example 1 – case study:

Suppose we are interested in whether there is a quantitative connection between the success of students in the exam in statistics and mathematics (by the number of points from 0 to 100) at Union “Nikola Tesla” University. The first stage in such an analysis comes down to taking a random sample of n elements. The data were entered into the SPSS program as given in the following figures.

After the measurement, n pairs of data are reached. (In our case, we measured the number of points in 25 students.)

Figure 2. Database in SPSS

	Statistika	Matematika
1	56	50
2	90	80
3	85	70
4	25	10
5	100	95
6	85	80
7	50	40
8	65	65
9	95	90
10	80	100
11	80	85
12	15	0
13	0	10
14	65	60
15	75	70
16	75	75
17	80	75
18	85	80
19	20	30
20	60	50
21	65	65
22	75	70
23	80	85
24	55	50
25	55	85

Based on the given data, we constructed an appropriate scatter plot (Figure 1).

Figure 3. Scatterplot of chest girth versus length (step 1)

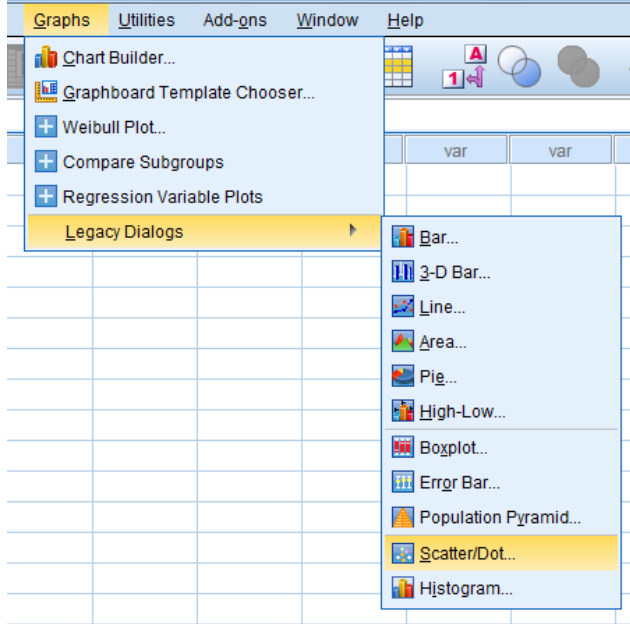


Figure 4. Scatterplot of chest girth versus length (step 2)

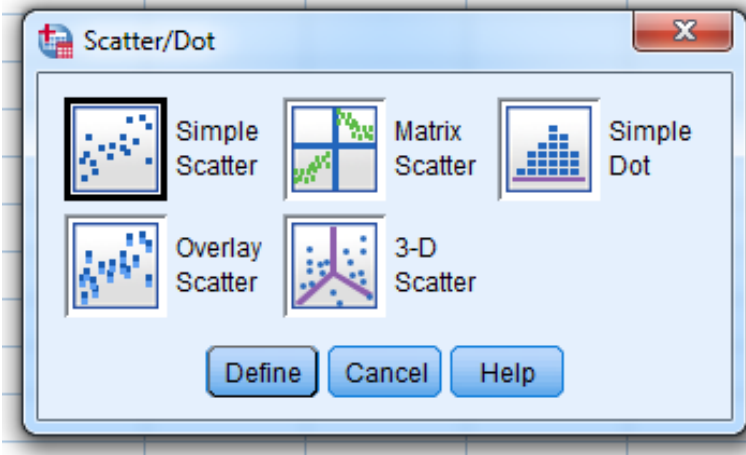
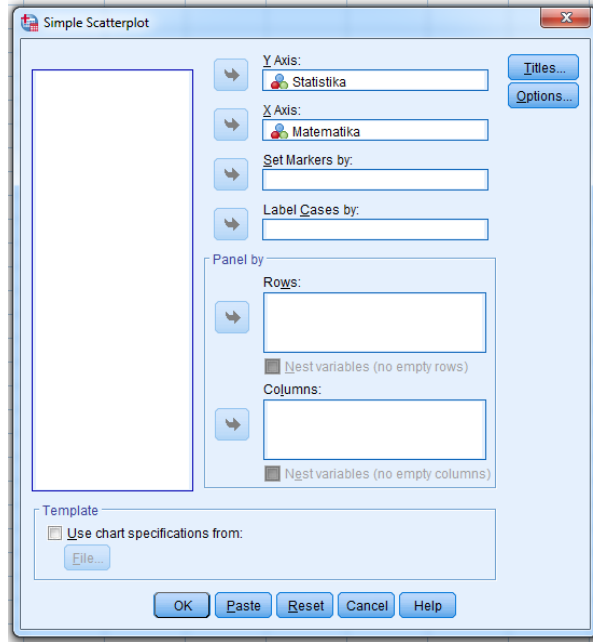


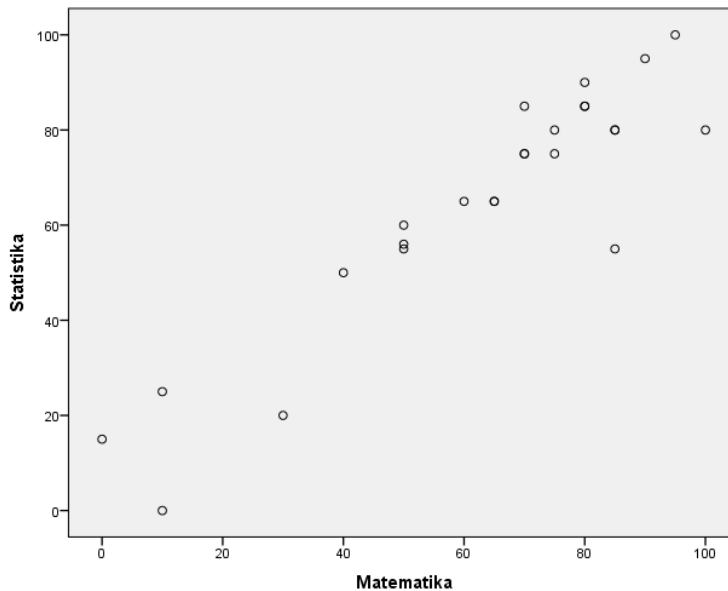
Figure 5. Scatterplot of chest girth versus length (step 3)



The result is shown in the following figure:

Figure 6. Scatterplot of chest girth versus length (output)

→ Graph



Interpretation of scatter plot diagrams

The previous figure shows a strong positive correlation between the two observed variables in the sample as a whole. Students with a higher number of points on the exam in Mathematics (variable Matematika – Figure 6) achieve better results on the exam in Statistics (variable Statistika – Figure 6).

As the linear relationship of the variables is teachable from the figure, Pearson's correlation between the two variables should be calculated.

There are a large number of different types of correlation coefficients and the choice depends on the level of measurement of the variables (applied measurement scales).

The two most important correlation coefficients are: Pearson's product linear correlation coefficient (r) applicable to variables expressed on an interval or scale ratio and Spearman's rank order correlation coefficient (r rho) applicable to ranked data (data are available at the level of the ordinal measurement scale).

Since it was determined that the relationship of the variables is approximately linear and that the results are evenly distributed, we can continue to calculate the Pearson correlation (Figures 7, 8, 9).

Figure 7. Pearson correlation in SPSS (step 1)

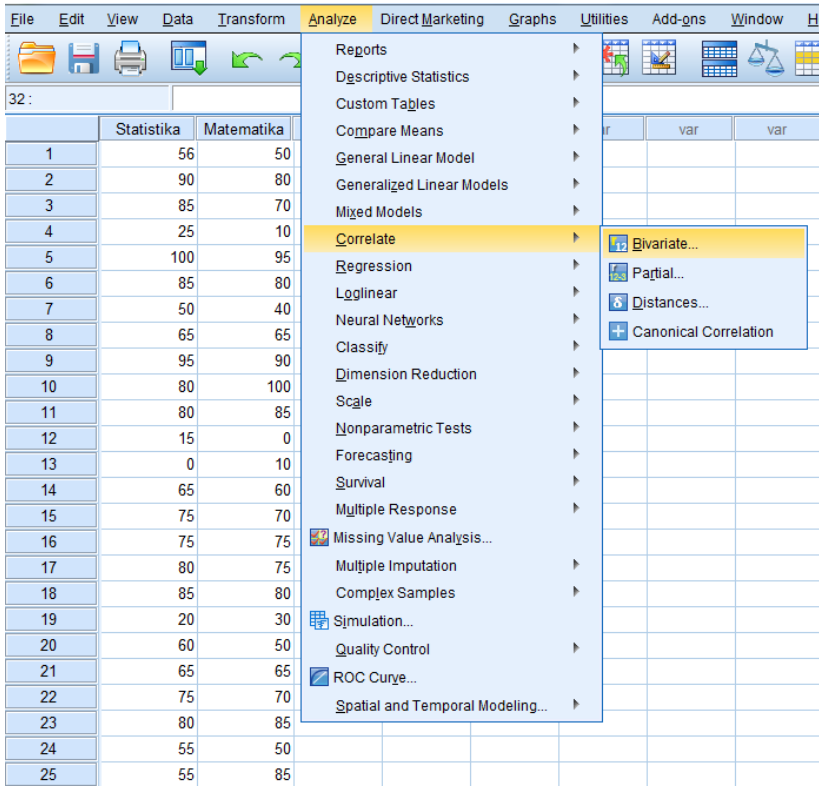


Figure 8. Pearson correlation in SPSS (step 2)

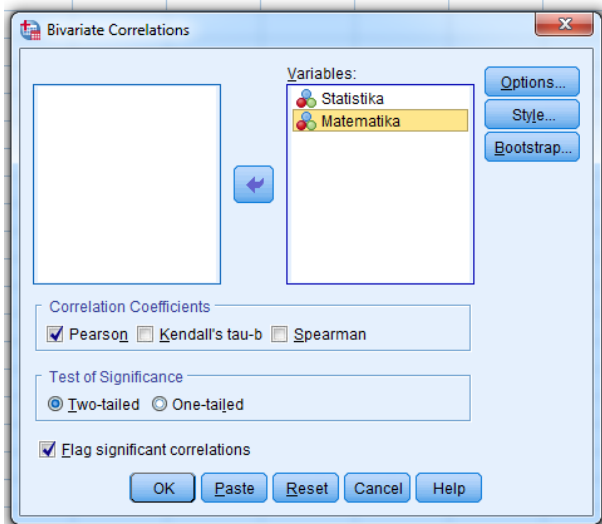


Figure 9. *Pearson correlation in SPSS (output)*

➔ **Correlations**

		Statistika	Matematika
Statistika	Pearson Correlation	1	.921**
	Sig. (2-tailed)		.000
	N	25	25
Matematika	Pearson Correlation	.921**	1
	Sig. (2-tailed)	.000	
	N	25	25

** . Correlation is significant at the 0.01 level (2-tailed).

In determining the strength of a linear relationship, different authors give different interpretations. One of the guidelines for determining the strength of correlation is the following:

small $r = 0.1$ to 0.29

mean $r = 0.30$ to 0.49

large $r = 0.5$ to 1.0 .

These guidelines apply regardless of whether the coefficient r is preceded by a negative sign. The negative sign indicates the direction of the connection, not its strength. The strength of the correlation is equal when the coefficients are $r = 0.5$ and $r = -0.5$, respectively. The only difference is its direction. In the given example, there is a strong correlation (above 0.5) between the two variables, which suggests that the linear relationship between the results of students in the Statistics exam and the results of students in the Mathematics exam is strong, but it cannot be concluded that there is a difference between the analyzed variables cause-and-effect relationship.

The next thing to look at is the calculated significance level (labeled Sig. 2 tailed). This data shows us with how much confidence we should observe the obtained results. In this case, $p < 0.01$, so we conclude that the calculated correlation is significant.

3. RESEARCH METHODOLOGY

3.1. Aim and questions of the research

Thanks to the experiences of some previous researches and results, some of the questions during this research were:

Are there any differences between results of the first group of students, who had traditional lectures (control group – *traditional group*) and the second group, who had multimedia lectures (experimental group – *multimedia group*)?

3.2. Participants of the Research

The research was conducted 100 students of two faculties: the Faculty of Finance and Economy (50 students) and the Faculty of Civil Construction Management (50 students) of Union “Nikola Tesla” University, Belgrade, Serbia. Students were divided on subgroups of 25 (traditional and multimedia group). The first group had traditional lectures and the second one had multimedia lectures (traditional lectures plus using SPSS software). Groups were formed randomly, so the previous knowledge was practically the same, which was confirmed by test. Average score of this pre-test was practically equal in these groups (I: 73.35, II: 72.25 out of 100) at the Faculty of Finance and Economy (I: 70.15, II: 71.25 out of 100) and at the and the Faculty of Civil Construction Management.

3.3. Methods, Techniques and Apparatus

Students who had a multimedia course (multimedia group) in Statistics studied with the SPSS program. The material includes examples that we have dealt with the mentioned software tool. Students could solve problems in a much faster and more efficient way. Students were enabled to make conclusions about dependent variables by changing independent variables (their relationship, correlations, etc.). Students can modify these parameters and initial conditions to explore and make their own conclusions.

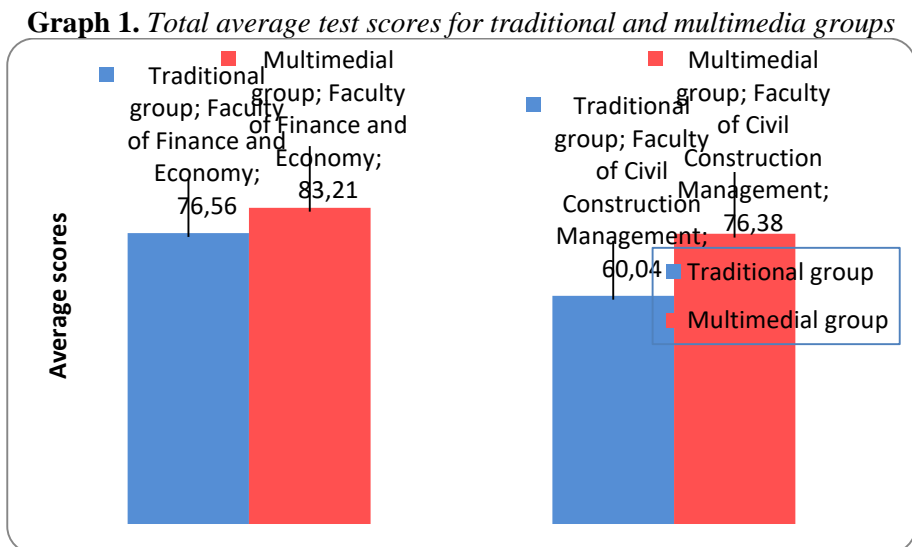
We now have the power to have students analyze real and often messy data, giving students a better idea of what statisticians do by having them go through the process of collecting, analyzing and making conclusions to investigate their own questions. Assessment can focus on giving students data sets and having them complete a full analysis on their own, which may include “cleaning” the data first (e.g., Holcomb 2004). Such exercises empower students as users of statistics and allow them to better understand and experience the practice of statistics (Ben-Zvi 2004).

After the courses were finished all students were tested. They had test (on paper, scoring was within the interval from 0 to 100 (25 points per task).

Results were analyzed with *Student’s t-test* for independent samples using *SPSS* (version 10.0) software. Result was considered significant if the probability p was less than 0.05.

4. RESULTS

Average score in the multimedia group was 83.21 with standard deviation 15.08, and in traditional group average score was 76.56 with standard deviation 14.51 at the Faculty of Finance and Economy, multimedia group was 76.38 with standard deviation 19.13, and in traditional group average score was 60.04 with standard deviation 16.2 at the Faculty of Civil Construction Management (Graph 1). Statistical comparison with *t-test for two independent samples* showed that multimedia group had remarkably higher score in comparison with the traditional group, with statistical significance of $p < 0.05$.



5. DISCUSSION AND CONCLUSIONS

The development of multimedia has progressed exponentially in the last 10 years, and therefore it can be expected that software packages will progress more and more.

Using multimedia enables visualization of statistical concepts and processes (Biehler 1993), demonstration of complex abstract ideas and provision of multiple examples in seconds. Students are better able to explore and “see” statistical ideas, and teachers are better able to present them to students. Such tools give students and teachers much more flexibility to ask “what if” questions.

Many research works in different scientific fields, including statistics have proven multimedia makes learning process much easier.

Integrating multimedia in the classroom and using software, animations, etc. has great potential to enhance teaching and learning, turning that potential into a reality can be a complex and multifaceted task. Some of the key factors for

successfully integrating technology in the classroom are well-defined educational visions, curriculum design, and teacher preparation and support (Kleiman 2004).

It is very important to try to find ways to access and utilize appropriate technology to help students learn statistics. The GAISE College Report (Franklin et al., 2000; Franklin & Garfield, 2006) lists some issues to consider when selecting technological tools to use in helping students learn statistics:

- Ease of data entry, ability to import data in multiple formats
- Interactive capabilities
- Dynamic linking between data, graphical, and numerical analyses
- Ease of use for particular audiences
- Availability to students, portability.

The information provided by the students concerning the impact of the statistical software package should be treated carefully, because:

- software cannot be isolated from curricular materials
- student characteristics could clarify why some benefit and others do not
- the questionnaire used here needs to be refined and open-ended items that probe for how and why explanations should be added.

Tentative conclusions are that the software has a positive effect on understanding and doing statistics. It seems to support the component mental activities of statistical thinking. The results concerning the idea that the software enhances intrinsic motivation were not encouraging. Working with their own data helps the students, but their self-confidence was not enhanced and their attitude toward quantitative research was not influenced in a positive way. It is rather promising that approximately 30% of the students express a favorable change in attitude toward statistics and in metacognitive skills. Cognitions associated with the data matrix are stimulated by the software package. The data matrix ranks first for understanding statistics and G. Schuyten & H. Dekeyser 216 for doing statistics.

We believe that no one tool can do it all and that there are many good tools available to use, many of which are free. Therefore, rather than thinking about one software tool for students to use, we encourage teachers to think about what sets of tools will help student best learn statistics in each unit of the course. What is used to graphically explore data in one unit may not be the best to illustrate sampling in another.

During our research teachers emphasized that *using multimedia* have made students work easier and have proved to be motivating for them. A great number of them insisted that multimedia (software, internet, etc.) enabled easier understanding, learning and implementation of knowledge. Students' remark,

and consequently one of this research's conclusions, was that *multimedia* is an important aspect of teaching and learning process.

From all the above, we can conclude that the analysis of data in the SPSS program is of great importance for obtaining adequate research results, but also for presenting the results in a precise way. Data analysis can be extremely important in many scientific fields that require the presentation of results obtained by applying some of the statistical methods.

It significantly increases the productivity of an analytical process, because its application significantly reduces the scope of work and facilitates the passage through all stages of the analysis process using a single software solution. It can be concluded that it works with a large amount of data and could not be imagined without this or some similar software.

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Cultural heritage tourism - Dacian fortresses in the Orăștie area, Romania

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Abstract: The history and culture of an area provide it and its inhabitants with an identity, especially in the current European context when globalization is one of the supported policies. It is important to preserve the cultural historical heritage and enhance its value through various activities and events. An increasing number of people appreciate heritage tourism, and the antiquity and uniqueness of some anthropogenic resources make it stay in tourists' preferences. In Romania, the Dacian period arouses increased interest, as it is linked to the roots of the Romanian people. The fortresses in the Orăștie area are an abode of history and culture for all tourists.

Keywords: cultural tourism, heritage tourism, cultural historical heritage
JEL: L83

1. INTRODUCTION

“Cultural tourism is one of the tourism forms attracting a great number of tourists, and that can support a tourist destination (Sava & Stanujkić, 2018; 2019). Cultural tourism is a general term referring to leisure travel motivated by one or more aspects of the culture of a particular area (Harris & Howard, 1996).

The International Council on Monuments and Sites (2002) considers that “Cultural and cultural-cognitive tourism is that form of tourism, which focuses on the cultural environment and that, in its turn, may include the cultural and historic sights of a destination or the cultural-historic heritage, the values and lifestyle of the local population, arts, crafts, traditions and customs of the local population”.

The World Tourism Organization (WTO Report 2012) considers cultural tourism as “trips whose main or secondary purpose is visiting sites and events whose cultural and historic values have made them part of the cultural heritage of a community”.

The main themes of cultural tourism and the forms of tourist activity it generates were well highlighted by Claude Origet du Cluzeau in her work entitled “Le tourisme culturel”.

Table 1. *Cultural tourism – themes and forms*

Theme	Form of tourist activity
Religious	Pilgrimage, charismatic meetings
Discovering cities, regions, countries	Circuit, holiday travel
Historic	Circuit, visiting the site
Memorial	Circuit and trip
Ethnical	Circuit, holiday travel
Artistic	Circuit, internship
Crafts / Industry	Theme circuit, trip in industrial sites
Parks and gardens	Circuit, holiday travel, trip
Festivals, cultural events	Holiday travel
Gastronomic	Holiday travel, circuit, gastronomic internship
Shopping	Holiday travel in a city
Linguistic	Holiday travel with the school of the family
Culture pedagogy	Classes outside school

In the urban environment, cultural tourism can be considered a mass phenomenon, as a result of the permanent demand for different cultural activities (Sava, 2017).

Heritage tourism, a type of cultural tourism, can be developed by preserving the existing anthropogenic tourist resources and sustainably enhancing their value.

Table 2. *Heritage tourism resources*

Heritage tourism resources	Initial purpose
Roman castra	military
Fortifications	military
Citadels	Ancient or medieval settlement
Castles	Fortified dwellings
Palaces	Residence of a sovereign
Fortresses	military (North America)
archaeological discoveries (tools, pots, coins, weapons)	Community life and military
Monuments (triumphal arches, obelisks, columns)	Eulogy, remembrance

Archaeological sites	Archeological digs
Museums	Preservation, exhibition and study of objects, documents
Memorial houses	Preservation, exhibition and study of objects, documents belonging to personalities who have influenced history
Practices, traditions	practices of the life of a community
Legends, ballads	recognition of the special character of a historical event, of a hero
gastronomy	nourishment

Various events are envisaged with a view to boost heritage tourism:

- Festivals;
- Archaeological camps;
- “Living history” events - interactive presentations trying to transport tourists back in time through clothing, activities, gastronomy;
- Temporary exhibitions;
- Thematic contests.

All these events can take place periodically or occasionally, depending on the interest and the existing resources. For tourists, it is important that the tourist resources are as old as possible, authentic, unique, in a good state of preservation, which keep the imprint of the past and, if possible, tell a story.

People practicing heritage tourism have at least an average level of culture and want to know more about past events, to find their roots, to try the feeling of pride and admiration.

2. ROMANIA - HERITAGE TOURISM RESOURCES

“Romania is a European country located in the central-south-east of the continent, stretching over an area of 238.391 km² and neighbouring Hungary, Serbia, Bulgaria, Republic of Moldova and Ukraine. On its territory the relief forms are evenly represented, that is the mountains take up 31% of the territory, the hills and orchards 36%, and the plains 33%. The Carpathian Mountains look like a bow in the middle of the country, bounded to the interior and the exterior by hills and plateaus, while the plains go to the exterior.

The climate is temperate-continental with Mediterranean influences and four distinct seasons. The access ways are diverse: road, rail, air, river and sea (Sava, 2015)”. Romania’s history is quite turbulent, being influenced by its geographical position and by the entire history of Europe.

There is a large number of testimonies of the past throughout the country, some of them being nationally and internationally recognized. Their value, uniqueness and variety recommend them as important anthropogenic tourist resources for heritage tourism.

In Romania, there is a law referring to the identification and protection of cultural heritage sites, namely Law no. 5/2000 on the National Territory Planning Plan - Section III - protected areas. Thus, in Article 1, paragraph 2, protected areas are defined as “natural or built-up areas, geographically and/or topographically delimited, which comprise natural and/or cultural heritage sites, and are declared as such in order to achieve the specific goals for the preservation of heritage sites”.

Table 3. Cultural heritage sites - national interest

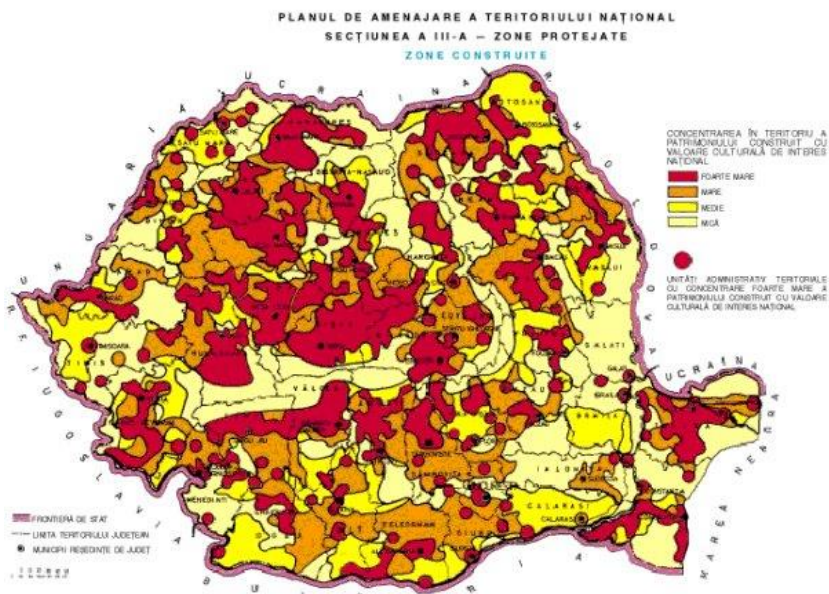
Groups of cultural heritage sites	Subgroups of cultural heritage sites	No. of cultural heritage sites
Monuments and architectural ensembles	<ul style="list-style-type: none"> - Fortresses; - Ensembles of ruined princely courts; - Fortified churches - fortresses; - Castles, mansions, palaces; - Tower houses; - Urban civilian buildings; - Urban ensembles; - Wooden churches; - Open air ethnographic museums; - Cave churches; - Churches and monasteries; - Industrial architecture; fitting communication paths; - Folk architecture monuments (village dwellings); - Rural traditional ensembles; 	<ul style="list-style-type: none"> - 35; - 5; - 22; - 28; - 11; - 70; - 20; - 81; - 7; - 6; - 197; - 13; - 15; - 7
Monuments and archaeological sites	<ul style="list-style-type: none"> - Paleolithic compounds; - Neolithic and Eneolithic settlements; - Settlements and necropolises from the Bronze Age; - Fortifications and settlements from the early Iron Age (Hallstatt Culture); - Dacian fortifications; - Necropolises and sacred areas – 	<ul style="list-style-type: none"> - 6; - 11; - 6; - 9; - 35; - 8; - 33; - - 10;

	<ul style="list-style-type: none"> Iron Age; - Castra and civilian settlements; Roman-Byzantine fortifications; - Ancient towns; - Buildings; - Medieval monuments identified based on archaeological research; - Archaeological reserves with sites on long-term dwelling levels – settlements and necropolises 	<ul style="list-style-type: none"> - 6; - 15; - 6
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Source: Law no. 5/2000 on the National Spatial Planning Plan - Section III - protected areas - Annex III - processed data

Throughout the country, there are 662 cultural heritage sites protected by the law. (Figure 1)

Figure 1. Distribution of the built heritage



Source: Law no. 5/2000 on the National Spatial Planning Plan - Section III - protected areas - Annex IV

From the second group of heritage sites, all subgroups are tourist resources for heritage tourism, and from the first group we have fortresses, castles, mansions and palaces. Urban historic centres with a built heritage of national interest are of larger or smaller sizes and are, in their turn, included in the protected areas.

Table 4. Protected urban historic centres

County with protected urban historic centres	Number of protected urban historic centres		
	large	medium	small
Alba	3	6	30
Arad	1	3	9
Argeş	3	-	21
Bacău	2	3	19
Bihor	1	1	14
Bistriţa Năsăud	1	1	10
Botoşani	2	-	13
Braşov	2	5	21
Brăila	1	-	1
Buzău	2	-	4
Caraş-Severin	2	5	12
Călăraşi	1	-	1
Cluj	3	2	30
Constanţa	3	5	14
Covasna	1	2	5
Dâmboviţa	1	2	21
Dolj	2	-	9
Galaţi	1	-	-
Giurgiu	1	1	3
Gorj	1	1	26
Harghita	2	4	15
Hunedoara	4	3	26
Ialomiţa	-	-	1
Iaşi	2	2	13
Ifov	-	-	2
Maramureş	2	5	28
Mehedinţi	1	2	10
Mureş	4	2	26
Neamţ	2	1	22
Olt	2	1	9
Prahova	2	7	13
Satu Mare	2	-	4
Sălaj	1	3	19
Sibiu	2	6	42
Suceava	4	4	35
Teleorman	3	1	11
Timiş	2	1	3
Tulcea	1	4	20
Vaslui	3	-	13
Vâlcea	1	6	8
Vrancea	22	3	13
Capital city- Bucharest	1	-	-

Source: Law no. 5/2000 on the National Spatial Planning Plan - Section III - protected areas - Annex III - processed data

Dacian fortifications protected by law are in large numbers (35 fortifications) and spread all over the current territory of Romania (Table 5).

Table 5. Protected Dacian fortifications

County where the Dacian fortification is	Number of Dacian fortifications
Alba	3
Bacău	2
Braşov	1
Buzău	1
Caraş-Severin	1
Constanţa	2
Covasna	2
Dolj	2
Giurgiu	1
Gorj	1
Harghita	1
Hunedoara	8
Iaşi	1
Neamţ	2
Sibiu	1
Teleorman	2
Tulcea	1
Vaslui	2
Vâlcea	1

Source: Law no. 5/2000 on the National Spatial Planning Plan - Section III - protected areas - Annex III - processed data

The largest agglomeration of such fortifications is in Hunedoara County, where the capital of the Dacians used to be. Therefore, it can be said that there are numerous resources, from different historical periods to meet the needs of potential tourists whose main motivation is history. In addition to these resources, there are history and military museums with collections of specific artifacts. Romania's cultural and historical tourist resources are numerous, diverse, from different periods of time, are located throughout its territory, and have features that are able to attract both Romanian and foreign tourists.

3. DACIAN FORTRESSES IN THE ORĂŞTIE MOUNTAINS AND HERITAGE TOURISM

The Şureanu Mountains are located in the Southern Carpathians, and are formed by two subdivisions, one in the eastern part - the Sebeş Mountains, and one in the western part - the Orăştie Mountains. The Orăştie Mountains are bordered by the Mureş Valley corridor in the north, by the Sebeş Valley in the east, by the Jieţ Valley in the south, including its tributaries, and by the depression corridor of the Strei in the west.

These are not very high mountains; they are medium height mountains with a maximum height of 2130 meters at Vârful lui Pătru. Instead, the area they spread on is quite large - 1585 km². Most of these mountains are composed of mesometamorphic and epimetamorphic crystalline schists (predominantly), but there are also sedimentary rocks and Jurassic limestones, especially in the southwest. Between the Şureanu and Cârpa peaks, there is a rather small glacial area, which has a specific microclimate and three glacial lakes: Iezerul Şureanu, Iezerul Cârpa and Iezeraşul Cârpa.

The hydrographic network is rich, mentioning the surface rivers Sebeşul, Râul Mare, Râul Mic, Cugirul, Pianu, Orăştie, Strei, Şipot, Şura Mare and Ciclovina and the springs Şipot, Şura Mare, Cioclovina, Izvorul de sub Piatră, Cuculeu. In this mountain area, there is plenty of groundwater, some even reaching one kilometer in length. The climate shows variations between the lowest and highest areas, so during the summer months there are average values of 19⁰C at the foot of the mountains and 8⁰C at altitudes over 2000 meters. During the winter months, the average temperatures are between -2⁰C in the lower area and -7⁰C in the high mountain area.

The vegetation of the Şureanu Mountains presents a great variety of species arranged in floors, namely alpine, subalpine, coniferous and deciduous forests, as well as meadow vegetation. The fauna is consistent with the vegetation and is well represented, including birds (horned lark, snow bunting, water pipit, wheatear, alpine accentor, common rock thrush, common raven and golden eagle), common European vipers, viviparous lizards, various species of butterflies, mammals (wolves, bears, wild boars, foxes, deer, squirrels, martens, lynxes and wildcats). In the cold mountain waters, there are common frogs, salamanders, triturus, brown trout, grayling, Mediterranean barbel, Romanian loach, European bullhead.

These mountains were the cradle of the Dacian civilization and later of the formation of the Romanian people. Dacia, the territory inhabited by the Geto-Dacians in ancient times, knew its glory during King Burebista's reign (82 BC-44 BC), when it stretched from the Black Sea coast and the Bug - to the east, the Bohemian Quadrangle, the Pannonian Danube and Moravia - to the west, the Maramureşului Mountains - to the north, and the Haemus Mountain (the Balkans chain) - to the south (fig. 2). He managed to unite the most important tribes in this area.

Figure 2. *Map of Dacia during Burebista's reign*



Source: <http://www.istorie-pe-scurt.ro/harta-dacia-burebista/>

Over the years, several armed conflicts took place in the area, the most important being those from the period when Dacia was ruled by Decebalus (69-106 AD) and finally conquered by the Roman Empire. The first capital of the Dacian kingdom was at Argedava (today, Popești village from Giurgiu County). Burebista moved it to Sarmizegetusa, a much easier place to defend, due to the relief.

The political-administrative center of Dacia was surrounded by a series of fortresses and strongpoints (strongholds, fortresses, isolated defense or watchtowers) unique in Europe. At present, the fortifications around the capital Sarmizegetusa Regia are preserved, the ones that had, first of all, the role of defending it. All these are found in the group of protected Dacian fortifications, which have been part of the UNESCO heritage since 1999.

Table 6. *Dacian fortresses in the Orăștie Mountains*

Name of fortress	Location	Current state
Sarmizegetusa Regia	Grădiștea de Munte village, Orăștioara de Sus commune, Hunedoara County	ruins
Costești -Cetățuie	Costești village, Orăștioara de Sus commune, Hunedoara County	ruins
Costești- Blidaru	Costești village, Orăștioara de Sus commune, Hunedoara County	ruins
Luncani-Piatra Roșie	Close to Alunu village,	ruins

	Boşorod commune, Hunedoara County	
Bănița	Bănița village, Bănița commune, Hunedoara County	ruins
Căpâlna	Căpâlna village, Săsciori commune, Alba County	ruins

The Bănița and Căpâlna fortresses were built as outposts of the defensive system of the Dacian capital, being located much further away, but they joined the fortresses in the Orăștie Mountains due to the initiative of archaeologist Daicoviciu Constantin around the 1950s. The name "Dacian fortresses in the Orăștie Mountains" has been accepted by the general public since 1999 for all six fortresses, even if it is not geographically correct. The six fortresses are located in the Șureanu Mountains (Fig. 3).

Figure 3. Locations of the fortresses in the Șureanu Mountains



Source: <https://cetateasarmizegetusa.ro/localizare/cai-de-acces/>

Table 7. Features of Dacian fortresses

Name	Features
Sarmizegetusa Regia	<ul style="list-style-type: none"> - located on the south-western foot of Godeanu peak at an altitude of 1656 m; - built on five terraces, on a total area of 30000m²; - the enclosure walls are made of cut-stone; - the thickness of the walls varies between 1.40m and 3.30m; - the height of the enclosure walls was between 6 and 8 m; - The height of the exterior walls rose up to 14m; - It has an entirely Hellenistic

	<p>planimetric model being a quadrilateral formed by massive stone blocks (muris dacicus);</p> <ul style="list-style-type: none"> - It has monumental stairs with massive steps; - It has impressive stone tiles; - The circular sanctuary with a central altar-room made of wood and stone; - rectangular sanctuaries of alignment type with limestone tambours; - andesite sanctuaries; - solar disc;
Costești –Cetățuie	<ul style="list-style-type: none"> - located on Dealul Cetățuia at an altitude of 561m; - the enclosure walls made of cut-stone; - It has a partial Hellenistic model for the exposed parts; - the stone wall has an angular path; - The thickness of the walls between 1.40m and 3.30m; - It has monumental stairs with massive steps; - Four rectangular sanctuaries of alignment type (with four and six alignments) with limestone tambours; - the presence of two water tanks;
Costești- Blidaru	<ul style="list-style-type: none"> - located on Dealul Blidaru at an altitude of 703m, on an area of 6000m²; - the strongest fortified complex - a fortress in the shape of a trapezoid united with a pentagon; - it had six towers; - the enclosure walls with cut-stone; - It has a completely planimetric model; - The thickness of the walls is between 1.40m and 3.30m; - entrance gate "in harassment", "with hindrance"; - it has monumental stairs with massive steps; - rectangular sanctuary of alignment type with limestone tambours; - two water tanks;
Luncani-Piatra Roșie	<ul style="list-style-type: none"> - It is located on Dealul Piatra Roșie at an altitude of 831m;

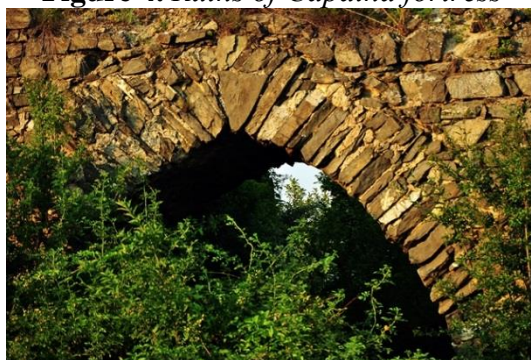
	<ul style="list-style-type: none"> - It has an entirely Hellenistic planimetric model; - It used to have 5 towers; - The enclosure walls are made of cut-stone; - The width is between 1.7 and 4 m; - The height is 4-5m and up to 12m at towers; - It has monumental stairs with massive steps; - It has limestone slabs; - rectangular sanctuary of alignment type with limestone tambours;
Bănița	<ul style="list-style-type: none"> - It is located on Dealul Bolii at an altitude of 904m; - The enclosure walls are made of cut-stone; - The thickness of the enclosure walls is between 1.4 and 2 m; - It has a partial Hellenistic model for the exposed parts, with a short front and a series of other front walls arranged at variable distances from the steep slope; - It has monumental stairs with massive steps; - The most difficult to get to;
Căpâlna	<ul style="list-style-type: none"> - It is located on Dealul Cetății at an altitude of 610m; - The enclosure walls are made of cut-stone; - Partial Hellenistic model for the exposed places; - Monumental stairs with massive steps; - a five-meter-wide defense ditch; - A rectangular sanctuary of alignment type with limestone tambours;

Source: Processed data based on: <https://patrimoniul.ro/monumente-istorice/lista-patrimoniului-mondial-unesco/17-monumente-istorice/unesco/92-cetatile-dacice-din-muntii-orastiei>; <http://www.romaniadevis.ro/dacia/zona-geto-daca/cetatile-dacice/item/cetatile-dacice-din-muntii-orastiei-in-patrimoniul-unesco>

All these fortresses have impressive walls known as the Dacian Wall (Murus Dacicus), which “first appeared in the Orăștie Mountains in the 1st century BC upon the extension of Burebista's power over the Greek fortresses from the

Black Sea.... The Hellenistic Wall is composed of two paraments (in specialized language) made of shaped rectangular stone blocks. From place to place the stone blocks alternated with others arranged transversely (also called header bricks). Between the two rows of blocks, soil (most likely a soft earth) and gravel (the so-called emplecton) was compacted, and no mortar was used. In order to achieve better adherence and to avoid the risk of collapse, ditches were dug in the stone in a "swallow's tail", in which wooden beams were placed that connected the two outer faces. The Dacian Wall (Murus Dacicus) is identical with one small difference: it does not have the header bricks that fixed the wall better...At the Dacian fortifications in the Orăștie Mountains, the Hellenistic Wall is combined with other traditional defense systems: the ground wave and palisades”
(http://www.encyclopedia-dacica.ro/?option=com_content&view=article&id=773%26Itemid=452).
The ruins of these Dacian fortresses reveal interesting aspects of the lives of the ancient Dacians, the ancestors’ good organization and preoccupations.

Figure 4. *Ruins of Căpâlna fortress*



Source: <https://viziteazaalbaulua.ro/sasciori-resturi-medievale/>

We should take notice of some insignia and objects discovered during the archaeological research of the fortresses, namely:

- Dacian Draco;
- Dacian iron “Cats” (spikes with iron teeth);
- Dacian tools;
- Dacian pottery;
- Dacian weapons (sabers, swords, spears, shields);
- Bronze objects (pots for mixing and serving wine, the candlestick and the ritual mask from the Piatra Roșie Fortress, as well as the Krater-type pot from Costești-Cetățuia);
- Jewelry;
- Kosons.

Their battle flag was Draco or Dracon, and represented a wolf head with open mouth, made of either silver or bronze, and which continued with a body of

dragon made of textile. The legend says that it would have been made after a wolf, Suier, which was rescued and domesticated by Decebalus, sacrificed for him. In fact, the wolf was considered the mystic animal of the Dacians (Sava *et al.*, 2019).

The Dacian iron “Cats” were iron spikes fastened with leather straps to shoes, obtained by hot processing (beating) an iron band. This iron band had bent ends so that it could be fastened (each had a fastening system), as well as holes along the band necessary to insert sharp iron spikes in a pyramid shape (similar to rivets). Their length was between 8 and 12 cm, and the fastening sides were 2-4 cm. Dacian tools were very diverse and served several fields of activity, so drawknives (used for woodworking), nail pullers, volcanic tuff grinders (for grinding grain), iron compass (large of 35cm and small of 16, 5cm), tool for removing nails, spike removal wrenches, saw, medical kit, bronze mold (for jewelry-especially for pendants), chisels, sickle, etc. were discovered.

The Dacian pottery around the fortresses in the Orăștie Mountains is either handmade or made on the potter’s wheel. It is not very diverse in shape, and towards the Sarmisegetusa Fortress it shows finer Mediterranean influences. In addition to the usual pots (the carrenated bowl, with short pedestal or foot ring, the bowl with incurved rim and short pedestal, and the bowl with flaring rim and foot ring, the pitcher with bellied body and the handle joined under the rim, and the krater with bell-shaped body, situla type pots), there are also very large pots for storing supplies (the piriform pot and the large jar with widened or profiled rim and foot ring). The main decorative motif of ceramic objects was the incision. Ceramic pipes for water supply were also discovered.

The Dacians were very skilled craftsmen in the processing of gold, silver and bronze, as shown by the objects discovered around the Dacian fortresses, such as fibulas, necklaces, bracelets, sponces, ornamental chains, brooches, buckles and harnesses.

The golden Dacian Kosons weigh about 8 grams, appeared during King Koson’s reign, and had a figurative representation inspired by that of the Roman denarii. However, they are inscribed in Greek letters. The Dacian period brings to the attention of potential tourists the life, organization, culture and military technique of Romanian ancestors. The history of these places is very interesting not only for specialists, but also for all lovers of knowledge, originality, adventure and beauty. Included in the UNESCO world heritage, these Romanian fortresses can constitute an important tourist resource, even if their state is precarious. In this sense, various steps have been taken to preserve them.

Recently, Law no. 23/2020 on the legal regime of the Dacian Fortresses in the Orăștie Mountains, which are part of the UNESCO World Heritage List was

adopted. This law seeks to ensure the protection of Dacian fortresses by limiting works in their area, including archeological works, ensuring from various sources the necessary funds for the consolidation and maintenance, guarding the perimeters and their administration by Hunedoara County Council (Dacian fortresses Costești-Blidaru, Costești-Cețățuie, Lunca-Piatra Roșie and Bănița) and Alba County Council (the Dacian fortress from Căpâlna).

Table 8. *Tourist routes leading to the Dacian fortresses*

Route	Mark	Duration (hours)
Ohaba Ponor – Șura Mare Gorges – Ponorici Cave – Cioclovina Cave – Piatra Roșie fortress	Red band+ red triangle	7-8
Costești – Valea Grădiștei – Dealul Grădiștei – Sarmizegetusa Regia fortress – Vf. Muncel – Vf. Godeanu	Red cross	10-11
Costești – Blidaru fortress – Leurdana – Târșă – Poiana Omului – Vf. Rudii – Culmea Meleia – Vf. Tâmpu – Șaua Steaua Mare – Vf. Godeanu	Blue band	14-15
Grădiștea de Munte - Prihodiște - Poiana Omului - Piatra Roșie fortress - Valea Roșia - Cioclovina – Cioclovina Cave	Red triangle	7-8
South of Căpâlna – bridge over the Sebeș river - parallel with the Gărgălău stream – Căpâlna fortress	Red cross	1

Source: Data from Salvamont Hunedoara, and from:

<https://sites.google.com/site/romanianatura75/home/carpatii-meridionali-harti-marcaje-pesteri/sureanu/descrierea-a-sase-trasee-turistice-din-zona-cetatilor-dacice-din-muntii-sureanu>

Bănița Fortress is inaccessible to tourists, as there is no delimited and marked route. Only mountaneers can climb from Bănița village. By road, Costești-Cețățuie can be reached from Călan through Ohaba Streiului, Chirid and Ocolişul Mare, the distance being 25 km, or from Orăștie 18 km. From Costești through Grădiștea de Munte you can reach Sarmizegetusa Regia on DJ 705A by driving 20 km. In Costești, a parking lot is arranged towards Cețățuie Fortress, and the access to the ruins is free and without visiting hours, as it is, in fact, for five of the six Dacian fortresses. For Sarmizegetusa Regia there is a parking lot about 2km away from the ruins, at the beginning of the paved road. The access to the ruins is made according to established visiting hours and for a fee.

Table 9. *Sarmizegetusa Regia visiting hours*

Period	Visiting hours
1 May – 30 September	09:00 – 20:00
1 March – 30 April; 1 October – 30 November	09:00 – 18:00
1 December – 28/29 February	10:00 – 15:00 (weather permitting)

Source: <https://cetateasarmizegetusa.ro>

The last entry is always 30 minutes before closing time. The rates are differentiated, thus adults pay 20 lei, and pupils, students and pensioners pay only 5 lei. When using an audio guide (Romanian, English, French, German, Hungarian), visitors pay another 20 lei / device / 90 minutes. Photographing and filming for commercial purposes is allowed following an approval and paying the amount of 300 lei / 60 minutes. For Romanian organized groups (minimum 15 people), guidance is provided in Romanian, 100 lei / 60 minutes. There is no visiting fee for the following categories of persons:

- children up to 7 years old;
- official delegations;
- employees and pensioners of the museum network;
- employees of the Ministry of Culture;
- children up to 18 years of age with special needs or disabilities and the accompanying person;
- children up to 18 years of age to whom social protective measures are applied;
- adults with severe or accentuated disabilities and the person accompanying them;
- pupils and students Romanian citizens from abroad, scholarship holders of the Romanian state;
- Euro 26 cardholders on the 26th of every month;
- war veterans, invalids and war widows;
- all persons on the occasion of the "Open Gates Day".

There are two routes for visiting the former Dacian capital:

- Route 1: - west gate - east gate access way - sacred area - pentagonal tower and return;
- Route 2 - west gate - access road on the right to the monetary workshop - south gate - east gate and return.

Figure 5. Visiting routes at Sarmisegetuzei Regia



Source: <https://cetateasarmizegetusa.ro/localizare/harti/>

Several professional materials were elaborated for a better knowledge and promotion of the Dacian Fortresses in the Orăștie Mountains.

Table 10. Promotional materials for the Dacian Fortresses

Name of fortress	Code	Promotional material
Sarmizegetusa Regia	LMI HD-I-s-A-03190	- photo album; - virtual tour; - video footage;
Costești Cetățuia	LMI HD-I-s-A-03178	- photo album; - virtual tour; - video footage;
Costești Blidaru	LMI HD-I-s-A-03181	- photo album
Luncani-Piatra Roșie	LMI HD-I-s-A-03200	- photo album
Bănița	LMI HD-I-s-A-03156	- photo album
Căpâlna	LMI AB-I-s-A-00020	- photo album

Some artifacts discovered in this area have been reconstructed in 3D format (anvil, decorative iron spike, anvil, iron cake, ie magnifying glass). Various annual events are organized in order to support the cultural heritage tourism nearby the Dacian Fortresses in the Orăștie Mountains.

Table 11. *Annual events in the Sarmisegetusa Regia area*

Name of event	Date
Dacian spring	1 March-30 April
A different kind of school: Knowing more, being better	18-22 April
International Day for Monuments and Sites (aka World Heritage Day)	18 April
Doors Open Day	August
UNESCO World Heritage Day in România	16 Noiembrie
Sarmizegetusa Regia Volunteers	all year long
Presentation stand within the annual festival from Simeria, the plateau from Măgura Uroiului “Dac Fest”	July (17-19 July 2020)

Between 2014-2019, the number of registered tourists, who visited the Sarmizegetusa Regia site, according to the data provided by Hunedoara County Council, Public Service for the Administration of Historical Monuments - Sarmizegetusa Regia, was of 303630 persons.

Table 12. *Evolution of the number of tourists*

Year	2015	2016	2017	2018	2019
No. of tourists	30000	60900	70829	64651	77250

Source: Public Service for the Administration of Heritage Monuments – Sarmizegetusa Regia

In the last five years, the number of those who visited this archeological site increased annually. The increase was even significant due to the promotion and increase of of Romanians and foreigners interest in history. The exception to this upward trend was in 2018 because a series of unforeseen events was recorded, namely a strong storm after which trees fell over the access road, then days followed when other affected trees were cut down in a controlled manner. During summer, there were massive landslides, which in turn blocked the access road for quite a long time. Access to the area was difficult, as tourists could only reach the site by walking a distance of 5.5 km. The accommodation possibilities are quite numerous, being, mostly guest houses, in the localities around the Dacian fortresses, such as Costești, Orăștioara de Jos and Orăștioara de Sus, Boșorod, Tău Bistra, Ludeștii de Jos, Ocolîșu Mic, Cranberry, Orastie. (Crișan, 2008).

Table 13. *Accommodation facilities nearby the Dacian Fortresses in the Orăștiei Mountains*

Location	Accommodation facility	Contact
Orăștioara de Sus	Sarmizegetusa Pension Blidaru Pension Pension Popasul Dacilor Pension Roua 2005 Pension Monica Pension Cotiso Pension La Istrate Pension	Tel.+40722631555 Tel. +40254246642 www.popasuldacilor.ro Tel.+40744473723 www.pensiunea-monica.ro Tel. +40722919886 Tel. +40728073702
Orăștioara de Jos	Daniela Pension	www.pensiunea-daniela.ro
Petroșani –Deva E79, 8,6km	La Nicolae Motel	www.lanicolae.ro
Bănița DN66	Drăgan Pension	Tel.+40749646030
Căpâlna	Turist Complex Vraja Vacanței Podul Cetății Pension	https://www.vrajavacantei.ro/ Tel.+40786944588

A gratifying fact for Sarmizegetusa Regia is related to the signing of a contract, in June 2020, for the implementation of the project "Capital of Dacia - living museum of European cultural heritage", which was submitted through the RO-Culture program, call "Restoration and revitalization of historical monuments", program financed by EEA Grants (Norwegian funds) 2014 - 2021. The objective of the project is to preserve, restore and revitalize this historical monument, to capitalize on it culturally and economically. It is hoped that once this project is completed, there will be an increase of at least 30% of visitor arrivals, as well as a return to public attention of a series of interactive activities, including the revival of traditional crafts (Dacian blacksmithing, by setting up a mobile workshop). The duration of the project is 48 months, and its value is 3 million euros (2 million from Norwegian funds and 1 million from the budget of Hunedoara County Council).

CONCLUSIONS

Cultural heritage tourism is of increasing interest among tourists eager to know interesting things. Visiting historical sites is becoming more and more attractive, whether they are the main motivation of the trip or just an optional one during a stay. Heritage tourist circuits can include historical sites belonging to the same period of time from relatively close localities or countries, or from sites that present the evolution in time of a nation, the history of a family.

In Romania, there are a series of anthropogenic tourist resources with historical value that can support the development of heritage tourism. The ruins of the Dacian fortresses have been preserved from ancient times, and the most representative ones, known as the Dacian fortresses in the Orăștiei Mountains,

have been included in the UNESCO heritage, thus recognizing their uniqueness and importance. The six Dacian fortresses constitute the defensive system of the capital of Dacia, of Sarmizegetusa Regia fortress (Pețan, 2018).

There is a possibility to visit the ruins of the fortresses protected by law, but, as I have showed in this study, a number of measures and fitting-out and protection works are still needed. For the national and international heritage tourism, these sites are a special resource that needs to be further promoted.

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Higher education and sustainability in the countries of the Asian region and Serbia

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Abstract: In current human lives, sustainability is the only possible way! Striving to establish its balance nature is always more powerful than mankind. Humanity must expand knowledge to find the right path of development. Knowledge expansion raises environmental awareness but the education of each individual must begin from the earliest age. Over time, knowledge increases until the moment when a person strives to higher education. The paper points on the importance of higher education institutions intending to understand how mankind is an inseparable part of nature. A more educated person can better understand the importance of protecting the natural environment. In the paper, authors present the good practice of higher education in Asian countries, whose aim is reaching sustainable development goals. Higher education in Serbia is also presented in the paper, as well as the way of Serbian path of sustainable education.

Keywords: human lives, sustainability, knowledge, higher education, ASEAN countries, Serbia

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1. INTRODUCTION

The notion of sustainable development has often been linked to environmental projects, which are on the other hand, related to environmental protection, biodiversity conservation, recycling and similar. All mentioned belongs to the domain of sustainable development (SD), but it is necessary to understand SD as an attempt to act at the global level, by harmonizing the three pillars of sustainability: economic, environmental and social. The initiative, as a concept, originated from the United Nations in 1987, according to the document "Common Future", in which the Norwegian politician and doctor Gro Harlem Bruntland stated some of the general recommendations for sustainable development. In these recommendations, it is necessary to harmonize the economy and ecology with the social conditions of life (Our Common Future, 1987). Economic indicators and environmental goals are opposite values because the goal of the economy is high income and as much „volume“ as it possible, while environmental goals are precisely the reduction of negative

human activities and the reduction of environmental pollution to a minimum. Ideal for ecology is the non-existence of any civilizational "modernity", primary production, a shutdown of factories, cessation of extraction of non-renewable elements and their processing. However, it is certainly disastrous for the economy to "stop production". Sustainable development should be understood as socio-economic and cultural progress, which reduces human negative activities - in accordance with the capacities of the environment. The future of the coming generations must not be negative, as their rights to all achievements (whether natural or social) which the present generations are entitled. Based on that fact, two principles are important: rationality and solidarity. Sustainable development can also be called human development, which provides solutions to the modern crisis of humanity and enables its further survival. Sustainability in the social sense comes to the fore, which tries to reduce the gap between rich and poor regions in the world and to enable the proper distribution of business results and world wealth (Pejanovic, 2011). Sustainable development is considered as the balance established in the consumption of resources and the ability of the natural system to conserve those resources for the future (<https://sdgs.un.org/goals>).

In the current situation, sustainable development can be interpreted by the definition of unsustainable development, which emphasizes that "unsustainability is development after which environmental damage punishes the economic growth" (Boer, 1995). "If development means increasing well-being, then sustainability means not reducing that well-being over time" (Davies, 2009). „Sustainable development presupposes and advocates responsibility in the behaviour of future generations, regardless of the fact that future generations do not have the right to vote and today they cannot be creators of current politics” (Meadowcroft, 2007). In the way for today's generations to enable the future of those who come, it is necessary to raise their environmental awareness (Ilic *et al.*, 2020). Education, especially the system of higher education, represents the avant-garde of vision and wisdom, and its basic values indicate the potential leadership role in modern society and in raising the ecological sanctuary of humanity. The authors try to point the interdependence of the system of higher education and sustainable development. In the function of sustainability, higher education should play a major role and must be a major support. This interdependence could be illustrated by an example that comes from many countries. Namely, the experience of powerful integration of education and sustainable development indicates the importance of the so-called "human capital" which should be found in sustainable development in the long term. Human capital is a social component and derives from education in order to serve the economic and environmental category of sustainability. Human capital implies human behaviour, as well as the sharing and knowledge transfer (Ilic *et al.*, 2020). The paper provides an overview of some of the countries in the Asia-Pacific region that are making efforts to introduce sustainable innovations in higher education. Countries from East and South Asia to the

Pacific Islands are included, with contributions from Japan, India, the Philippines, China and Taiwan. Looking at the higher education system of the mentioned countries, it can be seen contributes to scientific discussions on sustainability and strategic changes in the educational sphere. In the context of the paper, the effort of these countries to adopt an inclusive view of the term "sustainability" is expressed, and it is understood as a learning process but also as a term with variable and disputed meanings (Wals & Jickling, 2002). The authors strive to include and present an integrated view of the nature and purpose of higher education institutions in the countries of the Asia-Pacific region, emphasizing the importance of "education for sustainable development" (ESD) and the harmonized vision of strategic changes in education systems. The paper gives an overview of environmental management and corporate operations of higher education institutions, as well as their basic academic activity. The paper emphasizes the importance of establishing a "green gathering" on the campuses to promote cross-sectoral partnerships, acquiring new teaching and research initiatives, as well as strategic efforts of certain countries to effectively integrate sustainability and higher education. The countries of the Asia-Pacific region realized in time that if they are alone (as individual countries) they can achieve „little“ to strengthen themselves on the path of sustainability. Creating a network of connected higher education institutions, these countries have managed to put their higher education in the service of sustainable development and understand its importance. The authors try to learn lessons, discover critical factors for success and understand the changes that have taken place in the countries of the Asia-Pacific region, but also in Serbia (concerning the higher education). Serbia was also (once) part of a great state, Yugoslavia, and the authors nostalgically try to point the importance of unity for the entire Balkan region. The authors believe that it would have been much better if the former countries, members of Yugoslavia, today separate states, stayed together and tried to pave the way for sustainable development. In that way, they would be able to harmonize the economy and ecology with the social component of sustainability much easier. The authors want to point the good practice of higher education and sustainable development in the Asia-Pacific region, to inspire and inform the society in Serbia for the application of that practice in their own higher education.

2. AUTHORS OF THE ASIAN REGION - RELEVANT LITERATURE

A closer look at specific societies - such as the societies of the countries in the Asia-Pacific region, can provide a better insight into the development of sustainability and sustainable innovation in higher education. The pioneering answers came in the form of scientific papers by authors from this region, who explained good practice and illuminated future development paths, touching on critical issues of sustainability. The scientific research of the Pacific region is based on problems such as the specificity of the location, funding sources,

structural barriers and engagement of stakeholders both within the state (between line ministries or state support) and cooperation between states. According to Nomura and Abe, it is examined the main initiatives for sustainable development in Japanese higher education with a special focus on government support, in other words, on the harmonization of national approaches to sustainability with higher education institutions (Nomura & Abe, 2009). Higher education institutions in Asia and the Pacific strived for sustainability with the cooperation of the governments of these countries. The efforts were reflected in the emergence of certain international educational "networks" in the education field. For example, the Institute for Advanced Studies of the United Nations University, based in Japan, has developed two international networks for education for sustainable development (ESD) by promoting sustainability in postgraduate education (ProSPER.Net network) and through a network of regional centres for professional development, in which many higher education institutions were involved. Also, the UNEP Regional Office for Asia and the Pacific (UNEP) with eight higher education institutions in this region has launched the UNEP Asia-Pacific Regional University Consortium (RUC) with the aim of interdisciplinary cooperation in education and research. There have also been several sub regional efforts. For example, ASEAN member countries committed to ESD based on the ASEAN Environmental Education Action Plan from 2008 to 2012, which was created by the Global Desire for ESD (UN DESD). Pacific island nations have strengthened their sustainability, as well as ESD, with the Pacific Regional Environmental Program (SPREP) and the Pacific Islands Forum (PIF) (Nomura & Abe, 2018).

According to Corcoran and Wels, the emphasis was put on policy and practice, derived from the universities of the island countries of the South Pacific Ocean (Corcoran & Wels, 2004). These countries have approached sustainability by respecting the geographical and cultural context, as well as solving the challenges of protecting recognizable indigenous traditions, i.e. varieties. According to Elias, it is analyzed India's national policy by examining the success of efforts to integrate sustainability with curricula in education but also the importance of developing local projects as well as community-based projects, which also aimed to implement sustainability into curricula (Elias, 2006). Niu and colleagues highlighted key Chinese initiatives to implement sustainability goals in curricula in so-called green campuses, believing that green campuses are necessary for ESD (Niu *et al.*, 2010). In the Philippines, according to Galang, it was analyzed an innovative green school project, accreditation processes for a sustainable approach, but with sectoral potential and key economic challenges (Ryan *et al.*, 2010). According to Mochizuki and Fadeeva, it was examined the role of policy in funding green initiatives in higher education institutions in Taiwan, illustrating Taiwan's green campus sustainability program, improving the exchange of sustainability information, and developing sustainability-based curricula (Mochizuki & Fadeeva, 2008).

The papers of the mentioned authors enabled the comparison several number of strategic challenges for higher education and attempts to respond to them. In these papers, the role of government and its importance in creating policies that promote sustainable development is most important. In Japan, India, and Taiwan, government agencies funding has been crucial to implementing sustainability in higher education institutions. However, the authors also point the fact that there are significant differences between the desire for political action and reality, to achieving the goals of sustainable development and education for sustainable development. The 2009 Global Progress Report on DESD (Decade of Education for Sustainable Development), indicated that the biggest problem of sustainability progress stemmed from reduced or insufficient cross-sectoral communication within the countries (UNESCO, 2009a). Japan and Taiwan have improved synthesis and cooperation among educational institutions by involving government cross-sectoral departments to promote sustainable development in education (Decade of education for sustainable development, 2005-2014).

One of the key challenges during the first decade of the 21st century in the countries of the Asia-Pacific region was based on the need to develop sustainability based on the specific local characteristics of the region and the academic strengths of higher education institutions rather than generic approaches. Corcoran and Wels, emphasizing the dimension of government, pointed the important role of cultural parameters and social priorities to the sustainability of higher education, while the authors Mochizuki and Fadeeva stressed the need for higher education answers in practical solutions to local problems practice that would be achieved through higher education. According to Elias, it was pointed how sustainability was linked to long-standing intellectual and political movements in India, while the authors Nomura and Abe pointed to the use of special expertise of local sustainability to find answers to global competition pressures (present among universities). According to Galang, point is on the preliminary conclusions from the green school projects, believing that higher education institutions had to find their ways for sustainable development. Authors Corcoran and Wels believed that the whole process of approaching sustainability should be linked to the local environment and institutional priorities, highlighting the sustainable strategies of universities in the South Pacific. Therefore, from all mentioned, it can be concluded that in the countries of the Asia-Pacific region, sustainability in education was approached through practice and among state cooperation, in other words, cooperation between universities within and outside the state.

3. SUSTAINABILITY IN THE ASIA-PACIFIC REGION AND HIGHER EDUCATION

The Asia-Pacific region is the largest "UNESCO" region with over three billion people, representing more than 60% of the world's population. Socio-political systems in the region differ in governance and politics, as well as in history, which can be classified as colonial and "semi-colonial". The countries of the Asia-Pacific region include different economic spectrum - from rich Japan to less rich Bangladesh. However, it is inevitable to point the fact that in this part of the world, the fastest development of the economy was recorded, as well as the expansion of the population at the end of the 20th century. The companies have undergone profound changes in their industrial patterns and priorities. Just before the regional economic crisis (since 1997), the UNESCO Regional Office for Asia and the Pacific (UNESCO-PROAP, 1996) pointed that the world has never seen such growth as fast as it did in this region. The extreme complexity of human and natural ecology is evident all over the region (UNESCO, 2009a). Noticed for its cultural and ethnic diversity, the Asia-Pacific region represents a living cultural heritage. The region's spiritual wealth goes (hand in hand) with rich ecosystems and natural resources - two-thirds of the world's coral reefs and some of the "deepest seas, driest deserts and cleanest forests" belong to these regions (Tilbury & Janousek, 2007). Precisely because of its richness, the challenges of sustainability were clear and required urgent solutions. The main problems of the region even today are reflected in the high pollution of megacities, the social impact of labour migration (resulting from rapid economic transition), the threat of rising sea levels from the Indian subcontinent to the Pacific islands and difficulties in sustainable economic development. under increasing international market pressures.

Despite the challenges, the Asia-Pacific region has initiated the practice of sustainability in various spheres, especially in the educational sphere of society (UNESCO, 2009b). To reconcile cultural, environmental and political diversity with the pressures of regional economic and resource development, it was inevitable to introduce integrative thinking. Some of the analysts have previously addressed issues of policy and practice, but the situation required careful analysis and recognition of the multiple interests of many social aspects of today (Lindsay, 1993). Demand for higher education has increased across the Asia-Pacific region, along with rising birth rates, leading to the urgent implementation of sustainable strategies. The Asia-Pacific region is particularly interesting as a test or test region for assessing the response of higher education to sustainability challenges. Higher education initiatives for sustainability across the region are in many respects aligned with global trends. A large number of higher education institutions throughout the Asia-Pacific world have contributed to sustainability in Green campuses, especially in the field of greenhouse gas management, waste management and the like. The Green Campus was a

networked university system aimed at improving the educational environment for sustainability, with the basic motto "reduce, reuse, recycle" (Park, 2008). More than 20 Korean universities have joined the Green Campus Association. The University of Sains Malaysia mission in 2006 expressed a strong commitment to poverty reduction, while creatively fostering sustainability using the metaphor of "university in the garden" (Sanusi & Khelgat-Doost, 2008). Various initiatives have been established to bring together academic disciplines and institutions in research activities tailored to sustainability. In 2005, the University of Tokyo established an integrated scientific research system to promote multidisciplinary with a focus on sustainability. A Japanese network with a global perspective, but with a special focus on Asia, has launched an interdisciplinary international journal Sustainability as a Science (Nomura & Abe, 2010). Certain global initiatives formed to increase synergies between research and educational activities and encouraging inter-university cooperation were in Education for Sustainable Development (ESD). As an example, it is the establishment of the UNESCO Chair at Okayama University in 2007, with the intending to research education for sustainable development. The research was initiated by the Regional Centers of the United Nations University (UNU), supporting education for sustainable development.

Universities in the South Pacific, based on the values of regionalism as the best methodology for advancing overall sustainable development, examined economic growth aligned with governance and security. Strategic changes were also promoted through partnerships between higher education institutions. The United Nations Environment Program for Asia and the Pacific (UNEP) established the Asia-Pacific Regional University Consortium (RUC), which launched the Environmental and Sustainable Leadership Program in 2004. The program was launched through Tongji University in Shanghai, and 12 institutions participated in its creation (Tilbury & Janousek, 2007). Since 2006, the RUC consortium has offered a multinational, interdisciplinary postgraduate master's program in environmental management and sustainable development (Niu *et al.*, 2010). In 2008, the Institute for Advanced Studies (IAS) launched ProSPER.Net, the promotion of sustainability in postgraduate education and research network, which brought together leading institutions across Asia and the Pacific (Tabucanon, 2008). Higher education institutions formed the structure of the University Consortium and contributed to linking the theory and practice of sustainability (Stephens *et al.*, 2008). In Japan and Malaysia, the activities of the university consortium were encouraged by interdisciplinary work among higher education institutions (Bawden, 2004). The participation of non-governmental organizations have encouraged in practice, sustainability in higher education institutions.

4. PRIVATE HIGHER EDUCATION IN THE FUNCTION OF SUSTAINABILITY - ASIAN REGION

According to data in 2009, much of East and Southeast Asian countries paved the way for private higher education, which was a growing segment of post-secondary i.e. higher education. For example, in Indonesia, Japan, the Republic of Korea, and the Philippines, private universities enrolled most students, in some cases up to 80%. In the period from 2014 (for 5 years), private colleges and universities in Malaysia increased their number from 100 to 690. Between 1998 and 2001, 46 new private higher education institutions were established in Mongolia; by 2004, Mongolia had a total of 129 private and 47 public colleges and universities. In 2009, Indonesia had 83 public and 3,019 private higher education institutions. Similarly, there has also been an expansion of private higher education institutions in China, and private higher education has become a significant part of the overall education system. In fact, about 43 million students attended private higher education institutions. Some research indicates significant differences in the proportions of public and private higher education in certain Asian countries from 2000 to 2007. Although the number of higher education institutions was increasing, the balance of enrollment between public and private institutions differed significantly. In Vietnam, private university students accounted for 10.4% of the total enrollment in 2007; in China, private higher education accounted for 19.9% of the total enrollment in 2008. In both cases, these figures represent a significant increase in the private higher education system given that these countries had a socialist social order, in which higher education was entirely public or state (Zeng & Wang, 2007). According to 2006 data, more than 50% of higher education in India was provided by private higher education institutions, mostly self-financing (Kaul, 2006). Data from 2018 show that over 40 per cent of students in Asia are enrolled in private institutions. Indonesia and the Philippines are in the top ten countries in the world in terms of student enrollment in private institutions. Table 1 shows the number of public and private higher education institutions in ASEAN countries in two periods, from 2010 to 2012 and from 2015 to 2017. It can be concluded that in almost all countries (except Myanmar) the number of private higher education institutions has increased significantly compared to public and state faculties.

Table 1. *Number of public and private higher education institutions in the countries of Southeast Asia in the period 2010/2017*

Countries	Number of public higher education institutions		Number of private higher education institutions	
	2010-12	2015-17	2010-12	2015-17
Brunei	4	6	-	6
Cambodia	38	54	46	72
Indonesia	83	81	2,818	2,431

Laos	22	85	31	83
Malaysia	20	20	500	599
Myanmar	171	169	-	35
Philippines	220	231	1,636	1,712
Singapore	5	9	47	30
Thailand	98	66	73	455
Vietnam	187	64	29	305

Source: British Council/H233, 2018. The shape of global higher education: understanding the ASEAN region

For many years, the Asian region has been paving the way of distance learning education, controlling and reducing costs in higher education, thus contributing to sustainable development policy. Data from 2011 show that more than 70 universities across the region taught exclusively through distance learning. One of the oldest universities in Asia, the Open University of the Republic of Korea, has launched numerous innovations in distance learning by offering high-quality instruction when it comes to this way of learning. The countries as the largest beneficiaries of distance education in 2011, were China and India. The Beijing-based Central Radio and Television University directly served about 2.6 million active and, indirectly, another 3.5 million students through a network of open provincial universities. It used radio, television and the Internet for this way of distance learning, while lecturers were organized in learning centers across the country. India also had close to nine open state universities in 2011 and about 60 non-university programs (run by conventional universities) that together enrolled about 3.3 million students, of whom nearly a million were active, both at undergraduate and postgraduate (Asian Development Bank, 2011). Over the years, quality standards have been introduced, which have contributed to even greater development of this type of study. In Thailand, according to data from 2018, ministries (in the field of education) have introduced numerous criteria to regulate the offer of distance learning programs. The criteria are detailed in terms of quality and management program, staff, resources, student support, monitoring student participation on learning platforms, as well as verifying student identities during final tests and exams. It is necessary to provide adequate resources and in that sense point out that there are three different ways of providing distance education services, namely: the possibility of using print media, broadcasting educational content and e-learning. Programs must have a standard schedule of higher education as well as the requirements of standard criteria (British Council/H233, 2018). It is necessary to point the fact that in the modern practice of higher education in Asia and Europe, student exchange projects are increasingly included in terms of the possibility of obtaining full scholarships for students from other countries. An example of this is the SHARE project, which was initiated in 2015 and funded by the European Union and whose value is ten million euros. With this project, the ASEAN Association countries (specifically Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar,

the Philippines, Vietnam, Singapore and Thailand) and the European Union invite future students to apply for undergraduate studies abroad in the period from August to December 2020. years. So, the SHARE program offers a one-semester exchange of students from selected universities in the ASEAN region and is fully funded. SHARE represents the EU support to higher education in the ASEAN region intending to establish better regional cooperation, knowledge exchange and internationalization of higher education institutions of the ASEAN Association countries. Realizing its vision of creating an ASEAN area of higher education, ASEAN is collaborating with a consortium led by the British Council and consisting of the DAAD (Deutscher Akademischer Austauschdienst - German Academic Association), EP-Nuffic (Dutch internationalization agency - Dutch International Agency), Campus France, ENQA (European Association for Quality Assurance in Higher Education) and EUA (European University Association - European University Association) (EU & Association of Southeast Asian Nations, 2020). Projects that involve student exchange advocate a social or societal component of sustainable development that refers to the most sensitive but also the most important link in education. By involving students in this program and exchanging knowledge and experiences, a new future strength of a human society is created, which is based on young people and which thus represents a contribution to the concept of sustainable development.

5. SUSTAINABILITY OF HIGHER EDUCATION IN SERBIA

In 2005, Serbia drafted the National Strategy for Sustainable Development, while it was supposed to pave the way to specific strategic priorities and directions. However, due to various social, political and economic obstacles, special priorities of sustainability have been put in the seal. This certainly refers to the fact that the path of sustainable development in Serbia is difficult to achieve, ie it is difficult to achieve harmonization of theory and practice (Ilić, 2020). Insufficient economic resources were an important obstacle to paving the way for sustainable development. According to the report of the European Commission from 2012, education in Serbia is stagnant, ie it is progressing poorly. The mentioned report pointed that there were no satisfactory educational resources under the jurisdiction of the Ministry of Education, Science and Technological Development, and that the previous educational reforms did not yield the expected progress (European Commission Agenda). It was inevitable for this purpose, improving the educational system of Serbia to work on strengthening and financial support, ie on the control of educational programs that would be harmonized with European standards (Ilic & Stojanovic, 2019). There has been little progress in the implementation of the National Qualifications Framework in the field of higher education. To meet the needs of the labour market, it was inevitable to modernize the education system, to reform it by introducing new curricula. It was necessary to educate the appropriate staff or human resources, which would adequately respond to the

economy and society in Serbia (results obtained through Tempus projects called "Careers"). According to these results, the Serbian newly educated force of graduates had a deficit in taking the initiative for certain business tasks, but also a lack of critical thinking and decision-making. These results are partly because students in Serbia generally do not have the opportunity to practically apply the acquired knowledge in companies or work organizations while studying (Pejanovic & Tomas-Simin, 2014). Unlike other countries (both the countries of the European Union and the Asia-Pacific region), Serbia does not have, ie did not have, a system of education that would be oriented towards the needs of the economy. A big problem for Serbia was the high unemployment rate and the inability of young graduates to start working and improve their further acquired knowledge through practice. In the Serbian education system, there is not enough satisfaction to create or train staff who would later find it easier to find employment in both domestic and foreign companies. In Serbia, educational profiles are not in accordance with the economy, and they are implemented even more slowly in it. According to the education strategy from 2012, it was planned that by 2020, secondary education would receive the status of compulsory education, ie that the level of highly educated staff would increase to 38.5%, from 6.5% according to statistical calculations in 2012. In the same strategy, high goals were set, ie for scientists in Serbia to reach European standards, for teachers to be motivated as much as possible to give the best results, and for the needs of the economy to be harmonized with the educational profiles of future students and vice versa.

However, these goals were set without considering reality and how Serbian society experiences and invests in education itself. The means of material and financial support for education in Serbia have been symbolic since 2012 until today, and there is financial uncertainty, which is why the plan has not been achieved. The most critical points of the Strategy have just been reflected in the discrepancy between the set goals and the impossibility of employing highly educated staff. Insufficient funds were allocated for science, as evidenced by the data from 2012, according to which the amount of 0.36% of GDP was allocated from the budget for science (in 2011, 0.35%). According to the data of the Republic Bureau of Statistics, the share of total budget funds for research and development in the gross domestic product in 2017 was 0.40%. The largest percentage of budget funds for research and development went to the state sector (57.3%), followed by the higher education sector (26.3%). According to socio-economic goals, most of the budget funds allocated for research and development in 2017 were spent for the goal: General improvement of knowledge - Research and development (R&D) financed from general funds of universities (34.6%) (CBS, 2018). The share of total budget funds for R&D in the gross domestic product in 2018 was 0.37%. The largest percentage of budget funds for R&D in 2018 went to the government sector (58.1%), followed by the higher education sector (27.3%) (CBS, 2019). With the strategy of scientific and

technological development, it is planned that the amount of allocated funds will reach the level of 0.60% of GDP by 2020. The Union of Education Workers of Serbia made an analysis and proposal of funds for education and science for 2020, proposing that the largest increase be in the following segments, individually: science and administration of the Ministry of Education, Science and Technological Development, and the Institute for Quality Evaluation (Adzic, 2019). Comparing the planned and actual allocations from the budget for science, it can be concluded that this figure was almost half lower than planned in 2020, ie that it is around 0.3%, out of the planned 0.6%. In the area of improving human resource capacity, the support that researchers received through additional funding in 2012 was significantly less than in 2011. Funds for financing various scientific and professional publications, such as monographs, scientific journals, attending and organizing symposia in Serbia and abroad, have been reduced. The listed items have greatly damaged the reputation of the Serbian educational system in Europe and the world (Government of the Republic of Serbia & Ministry of Education, Science and Technological Development, 2013).

Also, Serbia has a problem with the population outflow, i.e. with the reduction of the population. More than thirty thousand people leave the country every year, seeking economic security in better developed Western European countries. The curve showing the demographic movement of the population in Serbia in the eighties of the twentieth century had a declining trend, first in Vojvodina, while in ten years this decline was reflected in the entire country and continued to decline. Certain calculations indicate an alarming figure according to which, by 2050, the population of Serbia will decrease by more than 2 million. This trend will certainly contribute to the negative effects on education in Serbia (Pejanović, 2014). It can be stated that the state needs to help more institutions dealing with the quality of education, such as the Ministry of Education, Science and Technological Development, the National Council for Higher Education, KONUS and similar organizations. It is necessary to mention that these organizations have different results when it comes to education in Serbia and that it is the result of insufficient finances, but also problems concerning the staff within these organizations. With the reform of the higher education system, which was supposed to be harmonized with the Bologna Declaration, Serbia started in 2003, while the Law on Higher Education was passed in 2005. The law from 2005, defines the manner of the European system of accumulation and points transfer, ie the system of higher education was introduced, which contains three cycles and that ends with the acquisition of a diploma. Finally, in the school year 2007/2008, a new way of studying began in Serbia, when all students study according to the reformed higher education program. The introduction of the Bologna Declaration, according to many (Serbian) authors, had a negative impact on the higher education system of Serbia, because the state was not ready to respond to the new situation in a

proper way. Namely, Serbia had very thorough ways of studying before Bologna, through the so-called Humboldtian acquisition of knowledge, which represented the integration of teaching, learning and researching. The staff graduating from the faculties at that time, were much more educated and ready for business tasks than the staff that studied according to Bologna system. The Bologna Declaration brought a number of problems because this system becomes total extreme, which resulted in easy obtaining of diplomas and a lot of low-quality "highly educated" staff, who mostly politically ascended to leading positions to which they could not answer intellectually. In these circumstances, the result was distrust in the educational system of Serbia, both citizens and countries from abroad (Čomski, 2014). Two years ago, Serbia introduced the so-called dual education, but according to certain authors, this education is obsolete, considering that it was relevant in Germany in the nineteenth century due to the way the German society and economic system functioned at that time. Some teachers believe that this education system has only further widened the gap between the rich and poor layers of Serbian society, while the situation regarding employment in the economy is very unstable. "Serbia does not have a strong economy or a group of the foreign population that would be integrated, and instead of the problem of lack of workers, the main problem in Serbia is unemployment." (<https://www.021.rs/story/Info/Nauka-i-tehnologija/212281/Sistem-obrazovanja-u-Srbiji-savrseno-odgovara-aktuelnoj-vlasti.html>). The result of many years of neglect of the education system in Serbia has finally led to the loss of full membership of the National Body for Accreditation and Quality Assurance of Higher Education of Serbia (NAT) in the European Association for Quality Assurance in Higher Education (ENQA). The previous Commission for Accreditation and Quality Assurance, called KAPK, was given the task by the competent Commission to eliminate irregularities related to meeting European educational standards, and NAT, as a newly formed body, was supposed to eliminate these shortcomings (Ozon Press, 2020). Unfortunately, that did not happen.

CONCLUSION

Based on the facts in the paper, trying to solve the problem of sustainability in higher education, the authors consider that innovative strategy as well as greater financial resources from foreign partners are necessity; it is general conclusion. For achieving a better quality of higher education in all regions (in Serbia) application of new technologies is needed. The application of modern programs and methods as well as information and communication technologies are present in the modern business environment in many developed countries, such as the countries in the Asia-Pacific region. Modernization of higher education implies not only a traditional teaching approach, but also active innovative knowledge and learning approaches through practice and work. An integrative approach is necessary for the strategy of higher education in Serbia where the goals will be related to technological and economic processes and students would be included

in all economic processes and applications. It is a sustainable way to direct higher education towards the economic development of Serbia. Software products, case studies and the connection of various modules in the production processes of a company are increasingly demanded in modern international business. In the period of globalization, there is a growing need for innovation of higher education and practical skills. The application of a higher level of education, which is a lever of economic development, with modern technology, it would be created greater financial effects and greater benefits for companies, and thus a higher GDP for Serbia. In the era of the global virus pandemic, many experts and highly educated personnel, who acquired new knowledge in developed countries and from various parts of the world, have a chance to stay in Serbia with government support and make an even greater contribution to innovating knowledge and education. In that way, conditions (social, economic and ecological) for modernization of all processes would be created, but also a healthier society and well-being of all inhabitants of Serbia.

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Application of LT – contradiction matrix in innovation development

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Abstract: Although Altschuller's Contradiction Matrix and Bartini-Kuznetsov's LT - Table are designed to make it easier to come up with the ideal final solution of problems, in practice they often come up with optimal rather than ideal solutions. One of the reasons for this phenomenon can be attributed to the subjectivity of the innovator arising from the logical-descriptive theory of solving inventive tasks. The second reason is related to the existence of unidentified laws of nature shown in the LT - table of physical quantities. The integration of these two tools yields an effective LT - Contradiction Matrix as a new inventology tool, which does not have the disadvantages of the individual tools from which it arose. Application of the LT – Contradiction Matrix was successfully demonstrated in the case study of the development of a personal respiratory protective device for the case of the coronavirus.

Keywords: LT-Contradiction Matrix, Inventology, Coronavirus
JEL: O1

1. INTRODUCTION

The ideal final solution (IFS) of any problem is always associated with the maximum utilization of the material and energy resources that reside within the system, in its sub-systems or in the super-system (Rajic, 2019a). Finding the right resource is compounded by the contradictions that underlie every problem. They occur when the level of demand is increased compared to the existing system. In doing so, the requirements may be different, hence the diversity of contradictions. There are basically two types of contradictions: technical contradiction (TC) and physical contradiction (PC) (Rajic *et al.*, 2016).

TC occurs between system parameters. When one parameter improves, then the other one inevitably deteriorates. Since the “or-or” principle is represented in this case, the adopted TC solution is based on the optimization of the state of two different parameters (Rajic *et al.*, 2019a). However, according the Theory of Inventive Problem Solving (TIPS/rus. TRIZ) solution for the TC should be based on the “and-and” principle in order for it to be an IFS. PC occurs only within one element of the system, when it is physically contradictory, i.e.

simultaneously warm and cold, or heavy and light, etc. That is why the principle of "and-and" is represented in PC, and the obtained solution is based on the idealization of the system, which is closer to the concept of IFS (Rajic *et al.*, 2019a). Since each TC contains one or more PCs, the PCs solution simultaneously leads to the solution of the TC and thus the problem as a whole. So, in the search for a solution, one has to go from defining and calculating IFSs, and then through detecting TCs, to solving PCs that are at the core of the problem. By studying patents, Altschuller discovered the basic laws of engineering systems (ESs) development and based on them developed a set of tools such as Contradiction Matrix, Inventory Task Algorithm (rus. ARIZ), TRIZ standards, and more (Rajic, 2019b).

Many TRIZ tools indicate that none of them are individually sufficient to solve all problems effectively. The most famous TRIZ tool is the contradiction matrix. It includes 39 parameters that describe any ES and 40 principles that are recommended for eliminating TCs and PCs. As science and technology evolve and change on a daily basis, then the original TRIZ contradiction matrix must only be seen as a basis that needs to be supplemented independently in accordance with new solutions contained in scientific and professional publications and patent publications. An innovative contradiction matrix, drawn from procedures taken from the leading fields of technology, can help to find IFS for 21st century innovative problems. One possible move in this direction is to rely on the work of Bartini who, in addition to design work in the field of aviation, has dealt with the theoretical innovation logic that is essentially the forerunner of TRIZ (Bartini, 1965). He developed a method called "and-and" because of the principle of the physical connection of mutually exclusive properties, and implied "both this and that." This is exactly what Altschuller calls PC. Bartini analyzed the dimensions in an inventive problem using the mathematical apparatus of disaster theory. For a long time, his work was not known to the general public because of the secrecy of the military work he did. Therefore, it can be argued that Altschuller and Bartini discovered their dialectical systems in technics independently of one another. It was not until the late 20th century that Bartini's ideas emerged in the works on TRIZ (Bushuev & Petrov, 2017; Bushuev, 2015; Bushuev, 2017). The authors propose to use Bartini's unit system together with TRIZ on a new mathematical basis. However, there are certain weaknesses and inconsistencies in these works, which is why both TRIZ and LT systems can be used individually and only to a limited extent. These papers mainly analyze the innovation process itself, as well as the individual ARIZ steps that are related to the LT system (Bushuev, 2004, 2005, 2006a, 2006b; Wei *et al.*, 2009) , but not the contradiction matrix.

The aim of this paper is to explain possible innovative synergies in finding IFS problems by using the original LT contradiction matrix in which the TRIZ contradiction matrix is upgraded with the LT system so that the two systems

complement each other and simultaneously be used to solve TCs and PCs. This creates the preconditions for a more efficient and much wider application of this new tool in finding IFS to problems of different genesis than it has been the case so far.

2. CRITICAL ANALYSIS OF TRIZ - CONTRADICTION MATRIX AND LT - SYSTEM

In case of applying the Contradiction Matrix, by intersecting the parameters that are being improved with those that deteriorate automatically, it is proposed in the cells of the matrix to use several different TRIZ principles out of a total of 40 defined, the application of which would most probably resolve the TC. This way, over 1200 different TCs that exist in ES can be solved (Rajic, 2019a).

The TRIZ principles in the cells of the contradiction matrix are listed in the order that most likely leads to the solution of the problem, and they were obtained by the statistical study of patents that had the same TC at the root of their problem. If, nevertheless, no solution is found, then it is suggested to try to find a solution by playing all 40 TRIZ principles (Rajic, 2016; Rajic *et al.*, 2016). If all the TRIZ principles are completely inapplicable, then the TC should be reformulated so as to achieve some new acceptable concept of a working solution to the problem. These suggestions indirectly confirm the insufficient effectiveness of TRIZ's contradiction matrix.

Due to the above facts, certain authors have been trying to create their modified versions of the contradiction matrix, adapting them to various fields of creativity (economics, business, management, pedagogy, chemical technology, etc.) (Rajic, 2016; Rajic *et al.*, 2016; Rajic, 2017; Rajic, 2019a). Improvements to the classic contradiction matrix were also attempted by adding or subtracting the number of rows or columns of the matrix, changing the name of the 39 technical parameters, adding new cells to the matrix, or filling in the "empty" matrix cells, adjusting the matrix to the user based on some personal experience, using various mathematical models that would lead to the random selection of matrix cells (Mann & Dewwulf, 2003; Coelho, 2009; Cherifi *et al.*, 2015).

Although such attempts were made with the best of intentions, they did not contribute to a significant improvement in the effectiveness of the adversarial matrix. The matrix cannot guarantee the solution of some complex technical problem without its deeper analysis by the innovator. For the users of the matrix, it is therefore recommended to formulate several TCs for a single problem situation, that is, to form a set of recommended principles. One of the main weaknesses of the matrix, but also of TRIZ as a whole, is that it represents a heuristic methodology, based on empirical knowledge and logical-descriptive methodology (Rajic, 2019c, 2019d). This contributes to increasing the share of subjectivity in finding solutions to problems. However, the ideal solution can be

only one, independent of the author trying to define it, and therefore it should be defined with high mathematical precision. The use of space long-time (LT) - a system of physical units can reduce subjectivity in the decision-making process. Likewise, using the LT system, it is possible to accurately describe not only the engineering parameters and principles contained in the problem, but also the economic, environmental, biological, chemical and some other parameters (Bolshakov & Petrov, 2017). Multiplying the two LT units gives the product a new LT unit that provides "both this and that", which is similar to solving a TC in TRIZ's contradiction matrix.

Bartini observed the regular relationships between physical constants and presented them in the form of a kinematic system of physical quantities (Bartini, 1965), and together with Kuznetsov developed a geometric direction in the study of physical dimensions (Bartini & Kuznetsov, 1978). It is intuitively clear that an LT physical size chart could have significant practical value for innovators. However, they did not leave information on its possible practical application, nor did they in any way associate it with TRIZ. If you look at Bartini – Kuznetsov's LT - table, it is observed that the vertical columns of the kinematic system contain a series of whole degrees of length (from L^{-2} to L^6) and the horizontal rows contain a series of integers of degrees of time (from T^{-6} to T^3) (Bushuev, 2008). The intersection of each column and each row gives a dimension of a certain physical size. The dimensions of all physical quantities are represented as a product of the whole degree, $L^m T^n$, where $|m + n| \leq 3$ for three-dimensional space and expresses the physical laws of conservation.

The paper (Rajic, 2020) proved the existence of 18 of 39 TRIZ parameters as basic LT-units, while the remaining 21 parameters and all 40 TRIZ principles represent state expressions. A detailed description of each individual TRIZ parameter is given in the literature (Domb, 1998; Mann & Dewwulf, 2003; Coelho, 2009). Bartini's LT - table can easily find TRIZ parameters classified as basic physical units (1-11, 15-17, 19, 21, 23 and 27). However, other TRIZ parameters, which are classified as condition expressions, cannot be found in the LT - table. They can be reached through mathematical and physical unless you know the value of TRIZ parameters displayed as LT - size, then multiplication or division two known values identify an unknown parameter or TRIZ parameter or TRIZ principle as condition expression. When combining the use of TRIZ's contradiction matrix and LT table, the basic and derived physical units have a convincingly high frequency of occurrence, i.e., extremely large number of repetitions of one LT - unit, while in the expression of state there are more LT - units that have the same frequency of occurrence.

3. COMBINATION OF TRIZ - CONTRADICTION MATRIX AND LT - TABLE

The LT contradiction matrix (Table 1) was constructed by combining TRIZ contradiction matrix and Bartini-Kuznetsov's LT table. Crossing the two TRIZ parameters yields a cell containing the suggested TRIZ principles presented in the order whose use is most likely to resolve the contradiction. If these two parameters are presented as LT-magnitudes, then their multiplication (or division), or addition (subtraction) of their exponents results in a new LT-magnitude corresponding to the first proposed TRIZ principle, or one whose application would be most likely provide a solution to the contradiction. This way the 21 TRIZ parameter and all 40 TRIZ principles representing state expressions can nevertheless be displayed as basic LT units. In the Bartini-Kuznetsov's LT table, on the other hand, some LT units are known and studied in detail, so they are taken as such in the LT contradiction matrix. This way the 64 parameters were obtained in the LT contradiction matrix. Each of these 64 parameters can be seen as a parameter that is either repaired or broken or represents a solution to the contradiction. If the LT product of the parameter being repaired and the one is being corrupted is not among the 64 specified LT parameters (eg. $L^{18}T^{-16}$), then this unit L^mT^n indicates that the contradiction solution is in a genetic trend whose value is 2 ($m + n = 18-16 = 2$) and IFS problems in the form of the required X-resource can be any member of that genetic group. The parameters belonging to the specific genetic group in Table 1 are indicated by a number: -3, -2, -1, 0, 1, 2 and 3.

Table 1. *The Part of LT- Contradiction Matrix*

CHARACTERISTICS		Worsening Feature											
		LT	Gen	...	8	9	10	11	12	13	...		
Improving Feature	1	Pressure change	L^2T^{-5}	-3									
	2	Pressure gradient	L^1T^{-4}										
	3	Change angular acceleration	L^0T^{-3}										
	4	Bulk density gradient	$L^{-1}T^{-2}$										
	5	Preliminary action	L^7T^{-9}	-2					$L^{15}T^{-18}$	$L^{14}T^{-17}$			
	6	Phase transition	L^6T^{-8}						$L^{14}T^{-17}$	$L^{13}T^{-16}$			
	7	Poynting vector	L^3T^{-5}						$L^{11}T^{-14}$	$L^{10}T^{-13}$			
	8	Pressure	L^2T^{-4}						$L^{10}T^{-13}$	L^9T^{-12}			
	9	Current density	L^1T^{-3}						L^9T^{-12}	L^8T^{-11}			
	10	Angular acceleration	L^0T^{-2}						L^8T^{-11}	L^7T^{-10}			
	11	Volume charge density	$L^{-1}T^{-1}$						L^7T^{-10}	L^6T^{-9}			

12	Feedback	L^8T^{-9}	-1		$L^{10}T^{-13}$	L^9T^{-12}	L^8T^{-11}	L^7T^{-10}	$L^{16}T^{-18}$	$L^{15}T^{-17}$		
13	Inert environment	L^7T^{-8}			L^7T^{-12}	L^8T^{-11}	L^7T^{-10}	L^6T^{-9}	$L^{15}T^{-17}$	$L^{14}T^{-16}$		
14	Composite materials	L^6T^{-7}			L^8T^{-11}	L^7T^{-10}	L^6T^{-9}	L^5T^{-8}	$L^{14}T^{-16}$	$L^{13}T^{-15}$		
15	Change of power	L^5T^{-6}	-1		L^7T^{-10}	L^6T^{-9}	L^5T^{-8}	L^4T^{-7}	$L^{13}T^{-15}$	$L^{12}T^{-14}$		
16	Change in force	L^4T^{-5}			L^6T^{-9}	L^5T^{-8}	L^4T^{-7}	L^3T^{-6}	$L^{12}T^{-14}$	$L^{11}T^{-13}$		
17	Surface tension; Acceleration of flow	L^3T^{-4}			L^5T^{-8}	L^4T^{-7}	L^3T^{-6}	L^2T^{-5}	$L^{11}T^{-13}$	$L^{10}T^{-12}$		
18	Electromagnetic field strength; Dynamic viscosity	L^2T^{-3}			L^4T^{-7}	L^3T^{-6}	L^2T^{-5}	L^1T^{-4}	$L^{10}T^{-12}$	L^9T^{-11}		
19	Acceleration; Magnetic displacement	L^1T^{-2}			L^3T^{-6}	L^2T^{-5}	L^1T^{-4}	L^0T^{-3}	L^9T^{-11}	L^8T^{-10}		
20	Frequency	L^0T^{-1}			L^2T^{-5}	L^1T^{-4}	L^0T^{-3}	$L^{-1}T^{-2}$	L^8T^{-10}	L^7T^{-9}		
21	Space curvature	$L^{-1}T^0$			L^1T^{-4}	L^0T^{-3}	$L^{-1}T^{-2}$	$L^{-2}T^{-1}$	L^7T^{-9}	L^6T^{-8}		
22	Permeability	$L^{-2}T^1$			L^0T^{-3}	$L^{-1}T^{-2}$	$L^{-2}T^{-1}$	$L^{-3}T^0$	L^6T^{-8}	L^5T^{-7}		
23	Changing the physico-chemical parameters of the object	$L^{10}T^{10}$		0		$L^{12}T^{-16}$	$L^{11}T^{-13}$	$L^{10}T^{-12}$	L^9T^{-11}	$L^{18}T^{-19}$	$L^{17}T^{-18}$	
24	Copying	L^9T^{-9}				$L^{11}T^{-13}$	$L^{10}T^{-12}$	L^9T^{-11}	L^8T^{-10}	$L^{17}T^{-18}$	$L^{16}T^{-17}$	
25	Intensivity (rate of maneuverability)	L^7T^{-7}			L^9T^{-11}	L^8T^{-10}	L^7T^{-9}	L^6T^{-8}	$L^{15}T^{-16}$	$L^{14}T^{-15}$		
26	Mobility; Loss of energy a mobile object	L^6T^{-6}			L^8T^{-10}	L^7T^{-9}	L^6T^{-8}	L^5T^{-7}	$L^{14}T^{-15}$	$L^{13}T^{-14}$		
27	Power; Stationary object energy loss	L^5T^{-5}			L^7T^{-9}	L^6T^{-8}	L^5T^{-7}	L^4T^{-6}	$L^{13}T^{-14}$	$L^{12}T^{-13}$		
28	Force; Reliability; Loss of mass a mobile object	L^4T^{-4}			L^6T^{-8}	L^5T^{-7}	L^4T^{-6}	L^3T^{-5}	$L^{12}T^{-13}$	$L^{11}T^{-12}$		
29	Loss of mass a stationary object; Flow (rate of mass change)	L^3T^{-3}			L^5T^{-7}	L^4T^{-6}	L^3T^{-5}	L^2T^{-4}	$L^{11}T^{-12}$	$L^{10}T^{-11}$		
30	Potential deference; Loss of information	L^2T^{-2}			L^4T^{-6}	L^3T^{-5}	L^2T^{-4}	L^1T^{-3}	$L^{10}T^{-11}$	L^9T^{-10}		
31	Speed	L^1T^{-1}			L^3T^{-5}	L^2T^{-4}	L^1T^{-3}	L^0T^{-2}	L^9T^{-10}	L^8T^{-9}		

Improving Feature	32	Dimensionless constants; Loss of time of a stationary object	L^0T^0		L^2T^{-4}	L^1T^{-3}	L^0T^{-2}	$L^{-1}T^{-1}$	L^8T^{-9}	L^7T^{-8}	
	33	Conductivity	$L^{-1}T^1$		L^1T^{-3}	L^0T^{-2}	$L^{-1}T^{-1}$	$L^{-2}T^0$	L^7T^{-8}	L^6T^{-7}	
	34	Magnetic permittivity	$L^{-2}T^2$		L^0T^{-2}	$L^{-1}T^{-1}$	$L^{-2}T^0$	$L^{-3}T^1$	L^6T^{-7}	L^5T^{-6}	
	35	Partial or excessive actions	$L^{10}T^{-9}$	1	$L^{12}T^{-13}$	$L^{11}T^{-12}$	$L^{10}T^{-11}$	L^9T^{-10}	$L^{18}T^{-18}$	$L^{17}T^{-17}$	
	36	Antiweight	L^9T^{-8}		$L^{11}T^{-12}$	$L^{10}T^{-11}$	L^9T^{-10}	L^8T^{-9}	$L^{17}T^{-17}$	$L^{16}T^{-16}$	
	37	Flexivity (rate of operability)	L^8T^{-7}		$L^{10}T^{-11}$	L^9T^{-10}	L^8T^{-9}	L^7T^{-8}	$L^{16}T^{-16}$	$L^{15}T^{-15}$	
	38	Maneuverability (displacement of mobility)	L^7T^{-6}		L^9T^{-10}	L^8T^{-9}	L^7T^{-8}	L^6T^{-7}	$L^{15}T^{-15}$	$L^{14}T^{-14}$	
	39	Extencia (Use of energy by moving object)	L^6T^{-5}		L^8T^{-9}	L^7T^{-8}	L^6T^{-7}	L^5T^{-6}	$L^{14}T^{-14}$	$L^{13}T^{-13}$	
	40	Temperature; Energy spent by a stationary object	L^5T^{-4}		L^7T^{-8}	L^6T^{-7}	L^5T^{-6}	L^4T^{-5}	$L^{13}T^{-13}$	$L^{12}T^{-12}$	
	41	Mass of mobile object; The law of conservation of impulses	L^4T^{-3}		L^6T^{-7}	L^5T^{-6}	L^4T^{-5}	L^3T^{-4}	$L^{12}T^{-12}$	$L^{11}T^{-11}$	
	42	Weight of stationary object	L^3T^{-2}		L^5T^{-6}	L^4T^{-5}	L^3T^{-4}	L^2T^{-3}	$L^{11}T^{-11}$	$L^{10}T^{-10}$	
	43	Length of moving object; Kinematic viscosity	L^2T^{-1}		L^4T^{-5}	L^3T^{-4}	L^2T^{-3}	L^1T^{-2}	$L^{10}T^{-10}$	L^9T^{-9}	
	44	Length of stationary object	L^1T^0		L^3T^{-4}	L^2T^{-3}	L^1T^{-2}	L^0T^{-1}	L^9T^{-9}	L^8T^{-8}	
	45	Period; Duration of action by stationary object	L^0T^1		L^2T^{-3}	L^1T^{-2}	L^0T^{-1}	$L^{-1}T^0$	L^8T^{-8}	L^7T^{-7}	
	46	Equipotentiality	$L^{10}T^{-8}$	2	$L^{12}T^{-12}$	$L^{11}T^{-11}$	$L^{10}T^{-10}$	L^9T^{-9}	$L^{18}T^{-17}$	$L^{17}T^{-16}$	
	47	Application of phase transitions	L^9T^{-7}		$L^{11}T^{-11}$	$L^{10}T^{-10}$	L^9T^{-9}	L^8T^{-8}	$L^{17}T^{-16}$	$L^{16}T^{-15}$	
	48	Operability	L^8T^{-6}		$L^{10}T^{-10}$	L^9T^{-9}	L^8T^{-8}	L^7T^{-7}	$L^{16}T^{-15}$	$L^{15}T^{-14}$	
	49	Expancia (area spread of power)	L^7T^{-5}		L^9T^{-9}	L^8T^{-8}	L^7T^{-7}	L^6T^{-6}	$L^{15}T^{-14}$	$L^{14}T^{-13}$	
	50	Linergia	L^6T^{-4}		L^8T^{-8}	L^7T^{-7}	L^6T^{-6}	L^5T^{-5}	$L^{14}T^{-13}$	$L^{13}T^{-12}$	
	51	Angular momentum; Action	L^5T^{-3}		L^7T^{-7}	L^6T^{-6}	L^5T^{-5}	L^4T^{-4}	$L^{13}T^{-12}$	$L^{12}T^{-11}$	

2	52	Magnetic Moment; Moment of mass; Linear transport work	L^4T^{-2}		L^6T^{-6}	L^5T^{-5}	L^4T^{-4}	L^3T^{-3}	$L^{12}T^{-11}$	$L^{11}T^{-10}$		
	53	Area of moving object; Loss of substance	L^3T^{-1}		L^5T^{-5}	L^4T^{-4}	L^3T^{-3}	L^2T^{-2}	$L^{11}T^{-10}$	$L^{10}T^{-9}$		
	54	Area of a stationary object	L^2T^0		L^4T^{-4}	L^3T^{-3}	L^2T^{-2}	L^1T^{-1}	$L^{10}T^{-9}$	L^9T^{-8}		
	55	Distance duration	L^1T^1		L^3T^{-3}	L^2T^{-2}	L^1T^{-1}	L^0T^0	L^9T^{-8}	L^8T^{-7}		
	56	Surface time	L^0T^2		L^2T^{-2}	L^1T^{-1}	L^0T^0	$L^{-1}T^1$	L^8T^{-7}	L^7T^{-6}		
	57	Dynamicity	L^9T^{-6}	3		$L^{11}T^{-10}$	$L^{10}T^{-9}$	L^9T^{-8}	L^8T^{-7}	$L^{17}T^{-15}$	$L^{16}T^{-14}$	
	58	Volupower (3D volumetric spread of power)	L^8T^{-5}			$L^{10}T^{-9}$	L^9T^{-8}	L^8T^{-7}	L^7T^{-6}	$L^{16}T^{-14}$	$L^{15}T^{-13}$	
	59	Areration (area spread of energy)	L^7T^{-4}			L^9T^{-8}	L^8T^{-7}	L^7T^{-6}	L^6T^{-5}	$L^{15}T^{-13}$	$L^{14}T^{-12}$	
	60	Moment of action	L^6T^{-3}			L^8T^{-7}	L^7T^{-6}	L^6T^{-5}	L^5T^{-4}	$L^{14}T^{-12}$	$L^{13}T^{-11}$	
	61	Moment of inertia; Power transfer	L^5T^{-2}			L^7T^{-6}	L^6T^{-5}	L^5T^{-4}	L^4T^{-3}	$L^{13}T^{-11}$	$L^{12}T^{-10}$	
62	Volume of a mobile object	L^4T^{-1}			L^6T^{-5}	L^5T^{-4}	L^4T^{-3}	L^3T^{-2}	$L^{12}T^{-10}$	$L^{11}T^{-9}$		
63	Volume of stationary object	L^3T^0			L^5T^{-4}	L^4T^{-3}	L^3T^{-2}	L^2T^{-1}	$L^{11}T^{-9}$	$L^{10}T^{-8}$		
64	Surface velocity	L^2T^1			L^4T^{-3}	L^3T^{-2}	L^2T^{-1}	L^1T^0	$L^{10}T^{-8}$	L^9T^{-7}		

Blank cells in the LT contradiction matrix do not meet the criterion by which the product L^mT^n must have the value of the sum of exponents $|m + n| \leq 3$ for three-dimensional space.

4. CASE ANALYSIS

The use of existing shawls, scarves or balaclavas provide protection from the cold, but not respiratory protection of the face from the various types of contaminants that can be found in the air. On the other hand, the use of existing personal respiratory protective equipment on the market is inadequate and unintended for normal living and working conditions, such as going to and from work, using public transport, visiting places of mass gathering, etc., the reason for which people do not even use them in such circumstances, even though they are at an enormous risk of contamination. Consequently people become massively ill with a series of virulent respiratory infections, especially in winter.

With industrial development, there is a significant increase in various types of chronic respiratory diseases such as asthma, allergies, eczema and the like-diseases, which can be caused by various airborne contaminants (sulfur oxides,

carbon oxides, heavy metals, polychlorinated biphenyls, coronavirus and other various types of biological agents, etc.). Scarf, shawl, and balaclava as clothing units for cold weather that would also have a protective respiratory function for humans would be an ideal solution to the situation described. The problem is there are no such products on the market. Therefore, the question is what ideal respiratory protection is necessary for citizens? Given that the military protective mask is quite expensive and intended to protect against RBC agents used in war, and impractical to navigate the streets of cities in them, as well as on public transport and in similar places, it is obvious that such an option is not acceptable. There is a similar situation when it comes to various types of masks and half masks developed for members of the special services (police, fire department, etc.). Citizens need a cheap but effective protective mask to wear when traveling around the city. The Epidemiologic Mask (EM) is used for the one-time protection of respiratory organs of medical personnel from contamination by biological agents (BA) transmitted through the air. It is the cheapest personal respiratory protective device on the market. Unlike ordinary EMs, which have 5 - 50 μm air openings on them, nano epidemiological masks (NEMs) have 1-2 ηm openings on the layer with silver or TiO_2 applied. Since the aerosol particles generated by the air contamination are 2.5 μm in size, it is clear that classical EMs are not adequate for further consideration. Therefore, the idea is to make a proposal on the basis of NEM to construct a new protective mask that would be targeted at the widest possible population.

All samples of tested NEM are the product of company "9th September" from Gornji Milanovac, Serbia. They consist of three layers made of non-woven textile or polypropylene and one filter layer, which is impregnated with silver nano-particles, and they are disposable. In the test of NEM samples, the method for testing with NaCl was defined in the standard (Ivankovic *et al.*, 2012; Ivankovic *et al.*, 2018; Rajic & Ivankovic, 2019; Rajic *et al.*, 2014). This method is based on the principle of leakage of NaCl aerosol through a filtering medium, whereby the concentration of this aerosol is measured before and after the test sample by the flame photometry method.

4.1. Testing leaking through the filtrating medium

Leakage values (P) through the filtration half-masks NEM, obtained by experimental tests of each model of said media at the flow rate of the test aerosol of 95 dm^3/min , were grouped according to the series in the test procedure and the basic statistical parameters were given in Table 2. According to the criteria defined in the standard (Rajic and Ivankovic, 2019), it is envisaged that for the leakage test with the NaCl test agent at a flow rate of 95 dm^3/min the test value of each sample NEM should not exceed 20% for the FFP1 class, 6% for the FFP2 class and 1% for the FFP3 class of this type of protective agent.

Table 2. *Statistical parameters of the leakage result series through NEM at the flow rate of the test aerosol NaCl of 95 dm³/min*

Mark	N	\bar{X}	SD	Standard error	Pmin	Pmax
NEM	9	0.91652	0.01008	0.0033614	0.9019	0.9283

In Tab. 2 it can be seen that in relation to the standard defined value of 1%, the leakage values through the filtering material in the test samples of the model NEM are slightly less. Accordingly, the samples NEM belong to the highest FFP3 class. In addition, standard deviations of leakage values within a series of results in both models of these agents are also small (0.01008). According to the above, it can be observed that, in accordance with the NEM criteria, in model high quality filtering materials are incorporated.

4.2. Physiological suitability test

The values of the inhalation resistance (P) NEM, obtained by testing each model of the above mentioned devices at the air flow rate of 95 dm³/min, are grouped according to the series in the test procedure and shown in Table 3.

Table 3. *Statistical parameters of the series of results of resistance during inhalation of NEM at the flow of air of 95 dm³/min*

Mark	N	\bar{X} (Pa)	SD	Standard error	Pmin – Pmax (Pa)
NEM	9	128.89	4.17	1.389	125-135

According to the criterion defined in the standard (Rajic and Ivankovic, 2019), the resistance value of inhalation of each sample NEM at 95 dm³/min must not exceed 210 Pa for the FFP1 class, 240 Pa for the FFP2 class and 300 Pa for the FFP3 class of this type of device. From Tab. 3 it can be seen that in the air flow rate of 95 dm³/min, the resistance values for inhalation are less than the defined 300Pa criterion in all test samples, all NEM samples fully meet the set criteria. Testing of the normal statistical distribution of results obtained by experimental tests at 95 dm³/min airflow showed that the values of the test are not subject to normal statistical distribution in the NEM model.

4.3. Calculating the ideality of the filtering masks

The ideality formula was first proposed by Altschuller, and it implied that the degree of ideality was proportional to the sum of the useful functions of the system and inversely proportional to the sum of the harmful functions of the system and the cost of its functioning (Altschuller *et al.*, 1989).

From the standpoint of ideality (Table 4), it has been found that for NEM the main problem is inhalation resistance at a flow rate of 95 dm³/min. For NEM, it is IFS = 47.8%. Since this is a quantitative calculation, this means that a real budget is enabled. This is important because all the necessary values are approximately familiar: the choice of parameters Pi, their current values, the relative importance of Ki, and the possible interval values (Pmin, Pmax) reflect knowledge of user's needs and saturation coefficients on the market, while Li - available knowledge on market offer of the product (Rajic *et al.*, 2019a; Rajic *et al.*, 2019b). This information is essential for the implementation of consulting or project services. This analysis takes into account mathematical non-linearity. In addition, it also takes into account subjective non-linearity over a parameter interval, ponder, and a market saturation coefficient. It is possible to identify prohibited variants of modification engineering of devices where the improvement of one of the parameters, even if it is very significant, makes at least one IFS parameter equal to zero, which makes this modification useless. It also allows the identification of unreasonable variants of modification leading to the passage of some parameters to a zone that represents a meaningless resource consumption, as this does not increase IFS. Even though NEM meets the most stringent criteria prescribed by the standard for the FFP3 half-mask category, from the standpoint of ideality it is well below the desired level (IFS = 47.8%). Standards are set for the level of quality that can be met. When new materials and technologies are conquered, then these standards are tightened, thereby moving toward ideality.

Table 4. *The achieved degree of ideality in the construction of NEM*

PARAMETERS	Leakage through the filtering medium	Inhalation resistance (Pa) at the flow of 95 dm ³ /min	Comfort (points)	IFS (%)
Pmin-Pmax	0.8403-0.9283	125-145	1-10	
P	0.91652	129	9	
K	0.9	0.9	0.8	
L	0.8	0.9	0.8	
S, %	59.6	16.4	68.6	47.8
R, %	26	53.8	20.2	∑100

Since inhalation resistance is a major factor in reducing comfort when using NEM, then one should think in the direction of how it can be reduced. Obviously, one way to reduce the resistance is to reduce the number of NEM layers. If this is done, then the mass of the NEM will decrease. Table 5 contains parameter no. 42 - Stationary object mass (L^3T^{-2}) which has to be reduced. If this happens, then the permeability of the NEM will deteriorate. Table 5, under number 22, lists Permeability ($L^{-2}T^1$). Multiplying these quantities yields L^1T^{-1} , i.e. speed. The dynamics of aerosol filtration by filtration media is a consequence of changes that occur in the filtration material itself, that is, changes in its structure during its exploitation. These changes occur most often due to the deposition of particles on the fibers of the filter material, when the separated particles are not distributed properly over the fiber surface but form chain clusters, thus increasing the thickness of the barrier (fiber + precipitated particles) and reducing porosity. This process increases the efficiency of the filter medium with a slight increase in resistance. The longer the filtration process, or the higher the particulate concentrations of the aerosol dispersion system, the faster the more homogeneous layer of particles is formed, which, depending on size, results in a greater or lesser increase in the flow resistance of the aerosol. If the aerosol and flow are constant characteristics, ideally, the filtration efficiency and resistance change are directly proportional to the filtration time. According to this setting, the quality characteristics of a particular filter material can be determined by testing the dynamics of aerosol filtration by filter media, i.e. by testing the filtration efficiency at different flows, as well as by simultaneously testing the filtering efficiency and changing the resistance of the filtering material depending on the filtration time at different flows. The filtration rate can be increased if the exhalation valve is installed in the NEM or reduced to 3 or 2 instead of 4 layers. The installation of the exhalation valve reduces the resistance to the exhalation of the air, reduces the wetting of the NEM surface that touches the face due to saliva dripping, facilitates the ejection of CO_2 , heat and moisture generated by breathing.

If the NEM mass decreases, then the protection time will decrease too. This can be represented by using units from the LT contradiction matrix (Table 5). The mass of a stationary object is being fixed (L^3T^{-2}), thereby the protection period or parameter no. 45 (L^0T^1) deteriorates. Multiplying these two units gives the parameter no. 53 (L^3T^{-1}), that is, the surface of a mobile object is reduced or the substance is lost. How can this loss be compensated for? If one of the protective layers is pleated, then its surface is greatly enlarged. Since the mass should be reduced, this means that one layer of NEM should be discarded, and one of the layers should be pleated as a form of compensation. The NEM salt layer could be impregnated with a layer of silver or TiO_2 . Textile-applied TiO_2 nanoparticles may affect its hydrophobicity / hydrophilicity, antibacterial properties, and crease resistance (Bauk *et al.*, 2012; Senic *et al.*, 2011; Senic *et al.*, 2013). In contact with sunlight, they exhibit the decontamination properties of highly toxic

substances. This means that NEM can be constructed as a part of everyday wear in winter conditions (scarf, shawl or balaclava), and in the case of protection against highly toxic substances, bacteria and viruses on a chemical basis it will effectively protect the wearer. TiO₂ nanoparticles have low cost and low toxicity. They have been known for many years in the cosmetics industry as a major active ingredient in sunscreen creams and lotions. There are numerous studies showing that micro- and nano-particles of TiO₂ are not mutagenic and genotoxic to humans.

The respiratory protection mechanism of such a respiratory protective device is based on the principle of purification of contaminated air, which is inhaled through the filtration medium, while isolating a part of the face from contact with the outside air, reducing the concentration of the contaminant from the environment and overcoming the corresponding respiratory resistance. In order to achieve the ideal model of a protective scarf, shawl or balaclava (maximum protection efficiency with minimal inhalation resistance), there is a constantly search for improvement of the characteristics of the materials used to make the filter that is built into it. The use of fibrous filter media in the form of paper is based on its porosity. Such fibrous filter materials consist of a maze of fibers of different diameters equal to or less than three times the diameter of the contaminating particles. It is also necessary to keep the fiber diameter small relative to the distances between the fibers. Good filter materials have low aerosol movement resistance and high filtering capacity without high pressure drop. Such are e.g. HEPA (High Efficiency Particulate Air) filters that can be made of paper or cellulose (disposable), stopping particles up to 0.3 μm in size, or PTFE (Polytetrafluoroethylene) fluoroplastic fibers retaining particles up to 0.06 μm (reusable). With the development of nanotechnology, the characteristics of the filtering materials have been raised to a very high level, so that they have the ability to filter micron and submicron particles, as well as gaseous contaminants. Such a filter material typically contains fibers of several types of material, usually cellulose or glass fibers. Plastic fibers are sometimes added to the filter material at a concentration below 7% to improve acid resistance. Also, small amounts of admixtures are added to the fiberglass to improve the characteristics of the filter material, such as resistance to mold, water, stretching, etc.

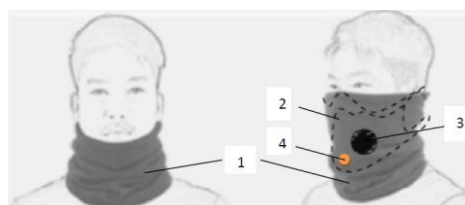
Table 5. *The part of LT-innovation Matrix of Contradictions used for case analysis*

CHARACTERISTICS		Worsening Feature			
		L ^m T ⁿ	Gen (m+n)	22	45
22	Permeability	L ⁻² T ¹	-1	L ⁻⁴ T ²	L ⁻² T ²
31	Velocity	L ¹ T ⁻¹	0	L ⁻¹ T ⁰	

Improving Feature	42	Weight of stationary object	L^3T^{-2}	1	L^1T^{-1}	L^3T^{-1}
	45	Period; Duration of action by stationary object	L^0T^1		$L^{-2}T^2$	L^0T^2
	53	Area of moving object; Loss of substance	L^3T^{-1}	2	L^1T^0	L^3T^0

Thus, TiO_2 or Ag nanoparticles can be deposited on textile, woolen or other substrates which prevent the penetration of the largest particles from the air, but at the same time exhibit antibacterial and antiviral capacity (Rajic and Ivankovic, 2019). VOC (Volatile Organic Compounds) filters are used to prevent the penetration of easily volatile compounds that can be found in the air. They are made from fabric onto which spherical beads of activated carbon are applied. Installing exhalation valve reduces the resistance when using NEM. The pleating of the inner layer increases the active surface of the filtration. The NEM outer layer is impregnated with Ag or TiO_2 nano particles. An internal color-changing indicator is installed on the NEM inner layer in case of saturation with NEM contaminants. Such NEM is placed in a pocket on a scarf (headscarf or balaclava) or fastened with a Velcro strap and, if necessary, placed in a protective position (Figure 2). The proposed NEM design allows washing in case of saturation with contaminants, without reducing the filtering efficiency thereafter. When using scarves, shawls and balaclavas to protect the respiratory organs (small, medium, or large), care must be taken that they are first thing applied to the respiratory organs (mouth and nose) is a suitable protective filter or NEM, depending on size of the face of the user, that is, the range of anthropometric dimensions of the user's head. The metal strap from the filter is then applied to the upper part of the wearer's nose so that the NEM is tightly sealed, and then resumed by wrapping the scarf around the neck and head, just like using a regular scarf.

Figure 2. *Prototype of a scarf with inserted NEM: 1- scarf; 2-NEM; 3- exhalation vault; 4- contamination indicator*



The proposed principled solution completely solves the problem of cheap, long-lasting, effective protection and high physiological suitability of the personal protection agent in case of application of BA and contamination with solid aerosols. Based on the proposed principled solution of different garments with built-in NEM, a prototype of the garment can be made. It must be tested experimentally to verify its effectiveness in laboratory and field conditions, and then the IFS to problems of that newly proposed personal respiratory protective device intended for the population can be measured and calculated. Thus, using the LT - contradiction matrix, a new principled design solution of the personal respiratory protective device intended for the population closer to the concept of ideality in relation to other available means on the market was proposed.

CONCLUSION

Subjectivity when using the TRIZ contradiction matrix and the LT system's excessively high accuracy, have been successfully reduced or completely eliminated by using the LT contradiction matrix as a new tool of inventology. The LT contradiction matrix has 64 parameters that are repaired, malfunctioned, or a solution to the contradiction problem that arises when one wants to improve a feature of an engineering system. Its implementation has synergistically increased the capacity to find IFS to different problems arising from 3210 possible contradictions.

The application of the LT contradiction matrix was successfully demonstrated in the case study of the development of a personal respiratory protective device for the population. As the effects of protection and physiological suitability are key parameters that these agents need to satisfy, leakage tests of NaCl aerosol as a BAG simulator were performed for their reliable assessment. An internal aerosol leakage test found that NEM met the standard criteria for the FFP3 half-mask class. However, the criteria met by the standards are below 50% relative to ideal. This shows that this mask needs improvement. NEM structural improvements were proposed based on the results obtained using the LT contradiction matrix. They should aim to reduce inhalation resistance and increase filtration efficiency. This can be achieved by installing a smaller number of protective layers made of higher quality materials (pleated, impregnated with Ag or TiO₂ nanoparticles and of activated carbon) from which NEM protective layers are made, in order to achieve a lower packing density and increase the filling capacity, ie less leakage of contaminant and less resistance to inhalation of air. The installation of an exhalation valve can further reduce breathing resistance and thus increase the comfort of wearing such a NEM. Incorporating NEMs into cold-proofing products such as scarves, shawls, and balaclavas will achieve a more ideal solution to the problem of effective respiratory protection of the population in winter than existing solutions.

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