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HOW DOES THE COVID-19 PANDEMIC IMPACT THE PERFORMANCE OF CHOSEN LOGISTICS PARAMETERS?

Veljko M. Mijušković^{1*}, Ana Todorović Spasenić²

¹*Faculty of Economics Belgrade University, Belgrade, Serbia;* ²*Prvi partizan ad, Užice, Serbia*

Abstract: The ongoing Covid-19 pandemic affects all segments of economic activity globally, including the logistics industries worldwide. The subject of this research is the analysis of the pandemic impact strength on this sector of the economy at the global level through the analysis of parameters that determine the logistics prosperity of countries. The aim of the research is to point out the negative impact of the pandemic onto logistics parameters, such as slowing down customs formalities, less investment in improving the quality of infrastructure and reducing international transport and delivery delays, which has been recorded in almost all supply chain performance. Logistics companies that provide storage facilities and transport organization services are directly affected by the Covid-19 pandemic. The results of the research show that the fastest recovery in this domain has been recorded in Asian countries, where the pandemic was brought under control at the end of 2020, while the slowest recovery has been recorded within the domain of the USA logistics industry. Results also show that the Balkan countries are, in cooperation with European countries, working intensively to introduce and improve the “green corridors” to stimulate the smooth flow of international trade and thus reduce the negative impact of the pandemic within the logistics industries.

Keywords: Covid-19 pandemic, logistics industry, logistics performance, logistics parameters, green corridors.

1. INTRODUCTION

The Covid-19 pandemic had a negative impact on economic growth and the volume of foreign trade of all countries in the world. Given that the development of the logistics industry took place in parallel with the economic growth of countries, the decline in economic activity at the global level, caused by the pandemic, led to a decline in foreign trade and a decline in global freight transport, and thus the engagement of logistics providers (Choi, 2020; Singh et al., 2021; Chowdhury et al., 2021; Illahi & Mir, 2021; Nikolopoulos et al., 2021). Countries

* Corresponding author: veljko.mijuskovic@ekof.bg.ac.rs

have faced a major economic crisis, and the largest percentage of investments is aimed at improving the health system, in order to more effectively protect the population. The decline in international deliveries, the drastic reduction in investment in transport infrastructure and the improvement of logistics competence, border delays that negatively affect the timeliness of deliveries and the slower implementation of customs procedures have contributed to the deteriorating logistics prosperity of countries around the world (Barua, 2020; Carreno et al., 2020; Vidua & Prabheesh, 2020; Goel et al., 2021). The World Bank has pointed to the deterioration of all parameters of the Logistics Prosperity Index (LPI) for all countries of the world for 2020, but positive results for some predictors at the start of 2021, especially for Asia, give promising forecasts in terms of speed and efficiency of global recovery of logistics industry after the end of the crisis caused by the Covid-19 pandemic.

2. THE IMPACT OF THE COVID-19 PANDEMIC ON THE VOLUME OF INTERNATIONAL TRADE

The Covid-19 pandemic caused a major disruption in world trade, which had a direct impact on global production and consumption. At the start of the pandemic, UNCTAD (2020) predicted a significant decline in global trade, to a level lower than the volume of global trade during the great economic crisis of 2007-2010. years (Figure 1). The projections came true. International trade was significantly affected, especially in the second quarter of 2020, when there was a decline of about 14.3% compared to the same period in 2019 (WTO, 2020). There was an improvement in the situation during the summer of 2020, with the easing of the virus, which resulted in a final decline in international trade by 9.2% compared to 2019, and it is predicted that recovery from the effects of the Covid-19 pandemic will take several more years (Barlow et al., 2021).

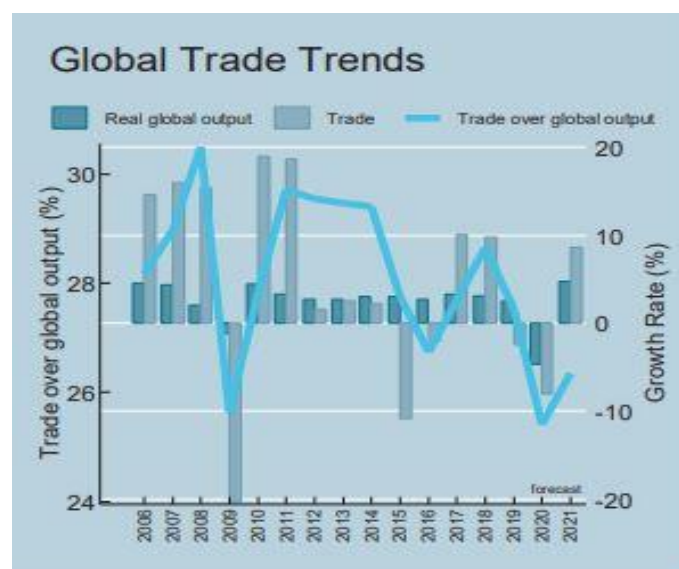


Figure 1. Forecasting the volume of international trade affected by the Covid-19 pandemic (UNCTAD, 2020)

There was a decline in the volume of foreign trade in all parts of the world, first in China, as the cradle of the spread of the pandemic, after which the crisis spread rapidly at the global level. In 2020, Asian countries were the most successful in bringing the Covid-19 pandemic under control, which had a positive effect on GDP, trade volume and the gradual

recovery of industries from the effects of the pandemic. The end of 2020 was marked by the leading position of Asian countries in the field of trade recovery (UNCTAD, 2021), while other parts of the world are facing great losses because they fail to control the spread of the virus (Figure 2).

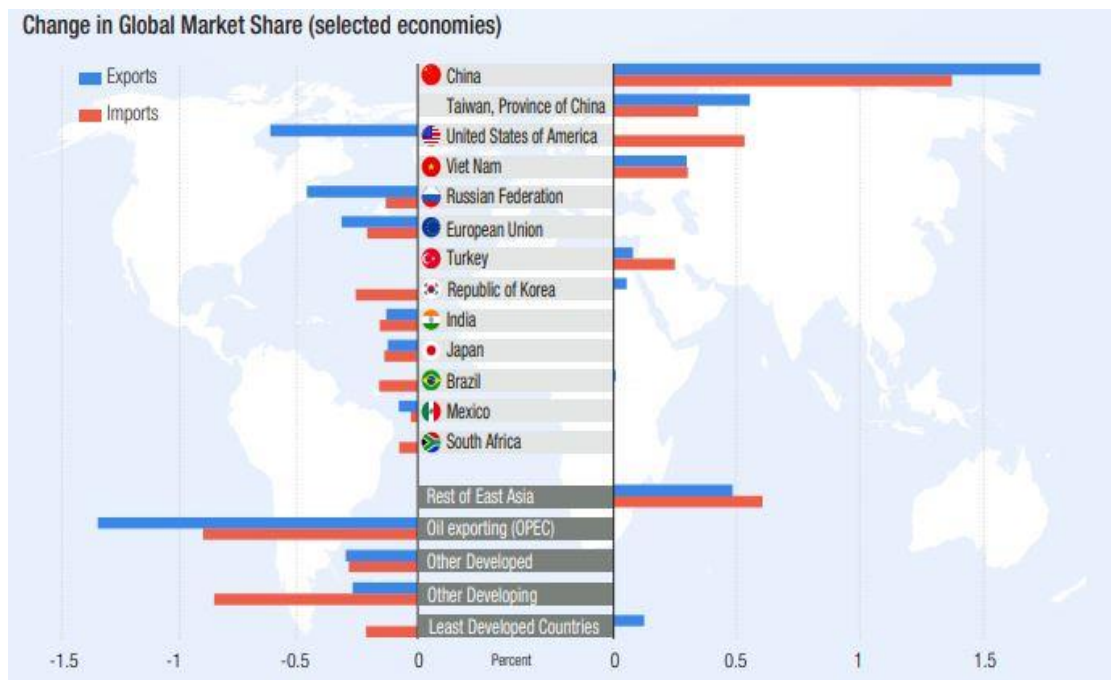


Figure 2. Imports and exports globally during the Covid-19 pandemic - period 2019-2021.
(UNCTAD, 2021)

Import and export activities of all parts of the world directly affect the development of the logistics industry on a global level, and current trends, caused by the pandemic, have left consequences in the management of logistics and supply chains of all internationally oriented companies. There has been a slowdown in economic growth in all countries of the world (Barua, 2020; Carreno et al., 2020), which has had a direct impact on the slowdown in the growth and development of the global logistics industry (IFC, 2020; Gonzalez, 2020; Goel et al., 2021; Sing et al., 2021).

3. SLOWING OUT OF GLOBAL LOGISTICS PROSPERITY AS A RESULT OF THE COVID-19 PANDEMIC

The International Transport Forum (2020), researching the volume of freight transport at the global level during the period 2010-2019, noted the existence of a correlation between global economic growth and the growth of all types of freight transport. Road freight transport recorded the highest growth in the observed period, especially in Russia (+ 32%) and Europe (+ 20%), followed by an increase in the volume of maritime container transport (the highest growth was recorded by OECD countries + 50%). The growth trend was halted in early 2020 when the Covid-19 virus began to spread rapidly from China to all parts of the world, affecting all spheres of life, including economic growth and development of all countries, and thus the logistics industry and all predictors of its development (ESCAP, 2020; Rivera, 2020).

The first quarter of 2020 was marked by a slowdown in China's economic growth, which spread to other Asian countries. During the period January-February 2020, the volume of China's freight transport decreased by 19.8% compared to the same period in 2019, which is partly due to the large impact of the Covid-19 pandemic on reducing the business activity of small and medium enterprises by as much as 46 % compared to the same period last year (Liu et al., 2020). The volume of foreign trade of Asian countries with the rest of the world has drastically decreased, and with the spread of the pandemic, the volume of trade among all countries in the world has gradually decreased (Liu et al., 2020; Rivera, 2020; Larsen, 2021). Time and resources are focused on the health care of the population, with measures to help the population and the economy to survive in times of crisis. All spheres of the economy have been affected by the Covid-19 pandemic, which has directly affected the logistics industry, which has the status of an important support to every sector of the economy (ESCAP, 2020; Loske, 2020; Liu et al., 2020; Rivera, 2020; Nikolopoulos, 2020; Goel et al., 2021; Notteboom, 2021; Oyenuga, 2021):

- reduction of the volume of all types of freight transport (road, water, train and air),
- negative impact on the timeliness of deliveries due to border delays and driver testing procedures,
- slowing down the implementation of the customs clearance procedure,
- supply chain disruptions and blockages affect the liquidity of logistics companies.
- reduction of supply chain management outsourcing due to savings in crisis conditions reduces the engagement of logistics providers,
- investments in the improvement of transport infrastructure are no longer a priority, which creates additional problems for the logistics industry.

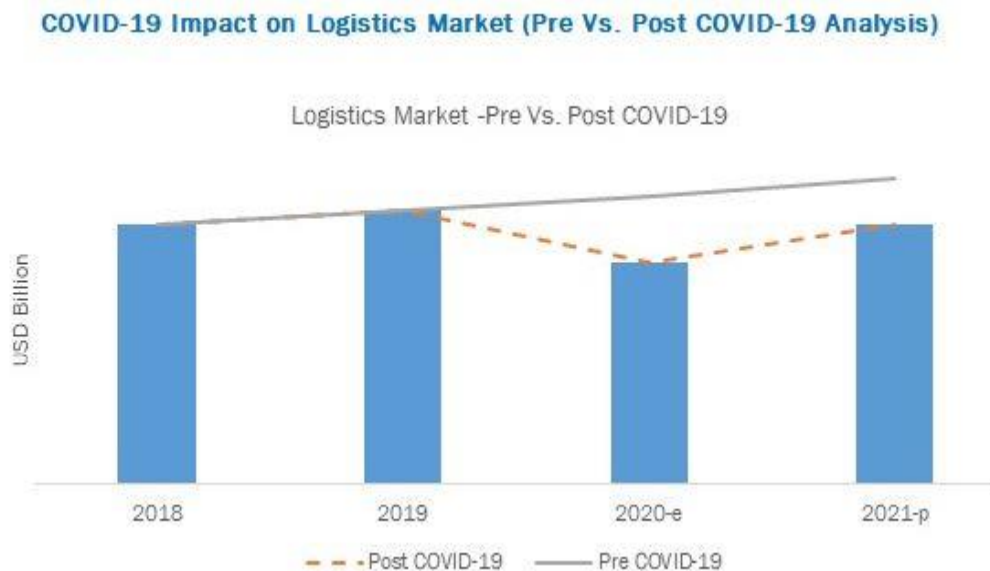


Figure 3. The impact of the Covid-19 pandemic on the value of the global logistics market (Markets & Markets, 2021)

The Covid-19 pandemic affected all predictors of the development of the global logistics industry, resulting in a decline in the value of the global logistics market (Figure 3). A slight recovery is projected for the period mid-to-late 2021, and the basis for a positive prognosis is the fact that Asian countries have already brought the virus under control by the end of 2020,

while positive effects of vaccination are expected for the rest of the world. The forecast of growth in the value of the global logistics market for the period 2020-2021. is influenced by the dynamic development of e-commerce (OECD, 2020; Ding & Chao, 2021) whose most important support comes from the domain of the logistics industry, as well as the currently important role of this industrial sector for the distribution of vaccines around the world (Shretta et al., 2021; WHO, 2021), also has an impact. The global logistics industry suffered losses in 2020, but they are much smaller than the losses suffered by other sectors: tourism, catering, all modes of passenger transport ... Optimistic forecasts for the period ahead are the best proof of the role and importance of the logistics industry globally. It has the status of an important support and backbone of all other economic sectors, which implies that the full recovery from the consequences of the pandemic, in addition to the economic policy measures of the countries, will be conditioned by the dynamics of recovery of other economic sectors.

4. THE IMPACT OF THE COVID-19 PANDEMIC ON THE PREDICTORS OF THE WORLD BANK LPI INDEX

Every other year, the World Bank publishes a ranking list of countries with the most developed logistics industries. For this purpose, the Logistics Prosperity Index (LPI) was developed, which is determined by the following predictors of the level of development of the logistics industry: customs, logistics infrastructure, logistics competence, international shipments, efficiency of shipment tracking/tracing and timeliness of deliveries. The World Bank published the last ranking list in 2018, after which, in the period 2019-2021, all countries on the list underwent serious changes in the domain of each of the predictors of the LPI index, under the influence of the Covid-19 pandemic. In the continuation of the work, the focus will be on the impact of the Covid-19 pandemic on each of the predictors of the LPI index for the parts of the world with the most developed logistics industry: Europe, the USA and Asia.

4.1. THE IMPACT OF THE COVID-19 PANDEMIC ON THE PARAMETERS OF LOGISTIC PROSPERITY OF EUROPEAN COUNTRIES

European countries have faced the consequences of the Covid-19 pandemic in the domain of all economic sectors, which has directly affected the logistics industry in support of them. The European Commission, in cooperation with all EU member states, has taken measures to mitigate the impact of the pandemic on the transport sector in order to ensure the rapid and continuous flow of goods (EC, 2020). Similar variants of support, depending on the budget, were provided by a large number of non-EU countries in Europe (such as Serbia). The focus was on providing unhindered transport and logistical support to the import/export of basic goods such as food and medical supplies. The expansion of e-commerce, especially during lockouts across Europe, has contributed to the survival of many logistics providers and is the main reason for the smaller volume of crises in Europe's logistics sector compared to the one facing other sectors of the economy.

Germany, the Netherlands, Sweden, Belgium, the United Kingdom and Austria, the best ranked countries in terms of the value of the LPI index for 2018 (WB, 2018), during the period 2020-2021. changed the list of priorities to economic and financial policies, reoriented themselves to the protection of the population and basic activities, which directly reflected on the stagnation of the improvement of any predictor of the LPI index. Stagnation in the field of

improving the predictor of logistical prosperity was recorded in all European countries, which, with the drastic influence of external factors over which countries have no influence (especially the Covid-19 pandemic), affected the lack of ranking of countries in this domain in 2020.

Period 2020-2021. marked the following trends in the domain of the impact of the Covid-19 pandemic on the predictors of logistical prosperity of European countries:

Customs: All European countries have defined customs regulations and procedures in the context of the Covid-19 pandemic. These regulations and procedures were encouraged by the slowdown in customs clearance procedures that were expressed during the period February-April 2020, at the very start of the pandemic (Deloitte, 2020). The European Commission has adopted a list of measures to, given the circumstances, maximize the stalemate in the customs clearance procedure, especially in the area of compliance with epidemiological measures (EC, 2020). The period December 2019-April 2020 was marked by a slow procedure of import customs clearance of shipments from Asian countries, especially shipments from Asian e-traders, in order to get acquainted with the way the virus spreads and define steps to combat it (OECD, 2020; Ding & Chao, 2021). During this period, due to the fear of spreading the virus, the companies Lufthansa, British Airways, Air France, American Airlines and Turkish Airlines stopped transporting shipments from China (BBC, 2020). In Serbia, during the period March-April 2020, there was a lot of truck pressure on large border crossings because it was only through them that it was possible to enter the country. This has resulted in a slowdown in import and export customs procedures, and has also contributed to the tightening of legislation in the field of exports of medicines and food. Getting used to the pandemic and defining regulations and procedures in the field of improving goods transit and customs clearance in the conditions of a pandemic have contributed to accelerating these flows. Detentions throughout Europe were caused by the fact that drivers had to undergo the necessary sanitary examinations to prevent further spread of the virus. The crisis caused by the pandemic slowed down the economic growth of European countries, had an impact on the reduction of imports and exports during period January-May 2020, which directly reflected on the reduction of import /export customs clearance of goods (Figure 4).

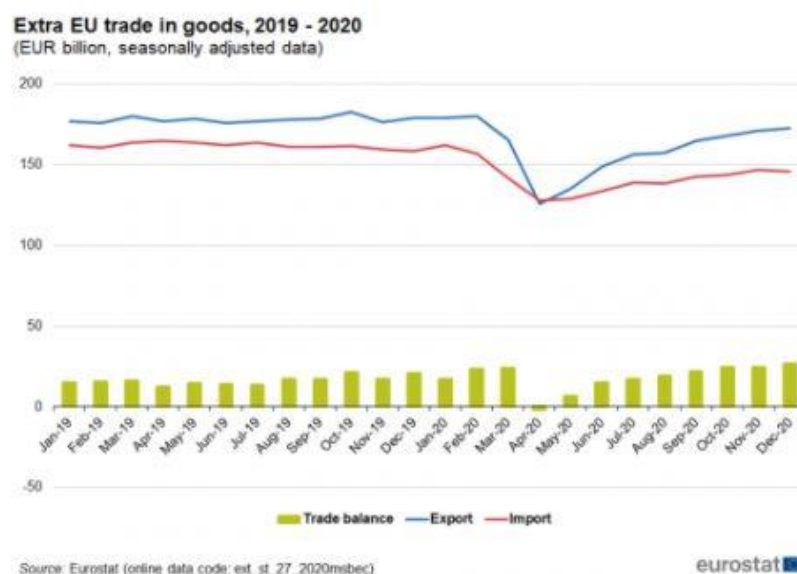


Figure 4. Trends in the volume of international trade in Europe during the Covid-19 pandemic (EUROSTAT, 2020)

- **Logistics infrastructure:** During the period 2019-2021, the volume of investments in the improvement of the logistics infrastructure of European countries has been significantly reduced, because the focus has shifted to preventing the disruption of the stability of the health sector, including all activities that support it. In the second quarter of 2020, the largest part of GDP in European countries was spent on investments in health care and the improvement of the transport of medical equipment (Figure 5). The period end of 2020-2021 was marked by an increase in investment in the field of improving logistical support in the field of vaccine distribution at the global level. The European Bank (2021) published data that around 1.5 billion euros were invested in the strengthening of the economy and health in the European Union during 2020.

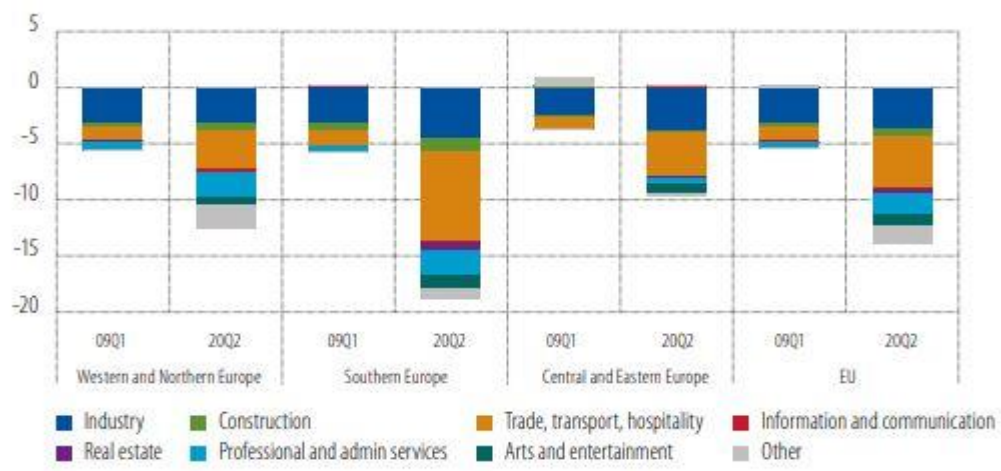


Figure 5. Investment in Europe - % of GDP Q2 2020 vs. the same period of 2019 (Eurostat, 2020)

- **International shipments:** Figure 4 shows a decrease in the volume of international shipments because they are determined by the volume of imports and exports. The decline was pronounced during the period January-April 2020, after which there was a gradual increase. Frequent lockouts in Europe have not slowed down international shipments significantly, and the expansion of e-commerce has further stimulated them. Over the years, European countries have been known for a large number of average online purchases per year, and the same number increased even more during the pandemic (Figure 6).

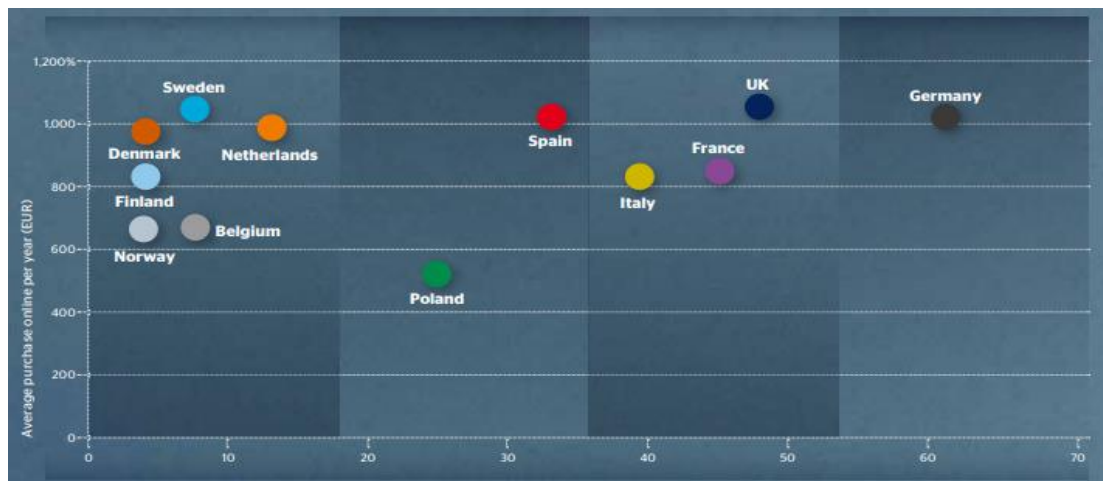


Figure 6. Number of e-commerce consumers and average online spend per year – Europe (Postnord, 2020)

- **Logistics competence:** During 2020, logistics providers invested in the improvement of logistics competencies, but to a much lesser extent than in previous years. In times of economic crisis, caused by a pandemic, the focus is on the struggle for survival and elimination of all unnecessary costs, and investing in logistics competencies can be considered as such a category of costs in a global crisis. During 2020, logistics providers invested in the improvement of logistics competencies, but to a much lesser extent than in previous years. In times of economic crisis, caused by a pandemic, the focus is on the struggle for survival and elimination of all unnecessary costs, and investing in logistics competencies can be considered as such a category of costs in a global crisis. At the same time, it is important to note that the existing logistics competencies of all logistics providers significantly crystallized during the Covid-19 pandemic, especially in the area of deciding how to quickly and efficiently, with minimal costs, implement any supply chain operation (Cantoni et al., 2021).
- **Efficiency of shipment tracking/tracing:** The efficiency of shipment monitoring, from the technical-technological aspect, has not been impaired. The volume of investments in innovations in this domain has been reduced, but by 2019, innovations have generated numerous benefits. Monitoring efficiency has not been impaired, but compliance with normal delivery deadlines has been compromised.
- **Timeliness of deliveries:** The timeliness of deliveries globally is jeopardized by border congestion, sanitary procedures for drivers, delays and customs clearance procedures. European countries have become accustomed to this domain, delays are much smaller in the period from 2020 to 2021, but they are still not negligible. The timeliness of deliveries globally is jeopardized by border congestion, sanitary procedures for drivers, delays and customs clearance procedures. European countries have become accustomed to this domain, delays are much smaller in the period from 2020 to 2021, but they are still not negligible. The countries of the European Union, together with the countries of the Balkans, including Serbia, are working on establishing and defining regulations for the functioning of the so-called "green corridors" whose goal is to reduce shipment delays (EC, 2020), while at the same time solving a number of other problems in the implementation of customs procedures and the efficiency of shipment monitoring.

4.2. US LOGISTIC PROSPERITY INDEX DURING THE COVID-19 PANDEMIC

For years, the USA has been highly ranked by the World Bank in the field of logistical prosperity and all the predictors that determine it. In the period 2012-2018. The USA, according to the value of aggregate LPI, ranked high 10th globally, and the following predictors of logistical prosperity were rated best: timeliness of deliveries, efficiency of tracking shipments, quality of infrastructure and logistical competence (WB, 2018).

In addition to the Covid-19 pandemic, the United States also faced political turmoil, which affected the country's economic growth. The largest decline in the volume of US foreign trade activity was recorded in the first five months of 2020, especially trade between China and the USA (Figure 7). The decline in the volume of foreign trade activity directly reflected on the stagnation of the logistics industry, and the trends in the field of logistics prosperity and its determinants are identical to the trends that prevailed in Europe:

- complicated sanitary procedures have led to congestion at borders and the disruption of customs clearance procedures,
- reduced volume of investments in improving the quality of logistics infrastructure,
- reduced volume of international shipments, especially sea container shipments (Figure 8), but the expansion of online trade has led to large losses in the field of the logistics industrial sector (Figure 9),
- high rank in the field of consignment tracking efficiency (especially technical-technological innovations in this domain) and logistical competence has stagnated, ie. remained at the level of previous years,
- the timeliness of deliveries, a predictor of logistical prosperity by which the USA was recognizable, was disrupted as a result of the Covid-19 pandemic. Stagnation at the borders and the slowdown in the customs clearance procedure, along with political protests before and after the elections, have led to delays in deliveries, but since the start of 2021, this issue has been significantly resolved.

U.S. Net Exports of Goods

A. U.S net exports of goods (exports minus imports), January 2007-June 2020

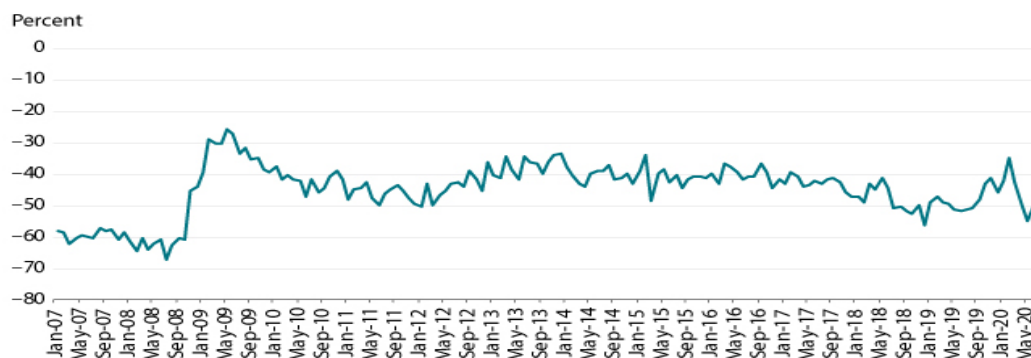


Figure 7. Decline in the volume of USA exports during period January-May 2020. (Leibovici & Santacreu, 2020)

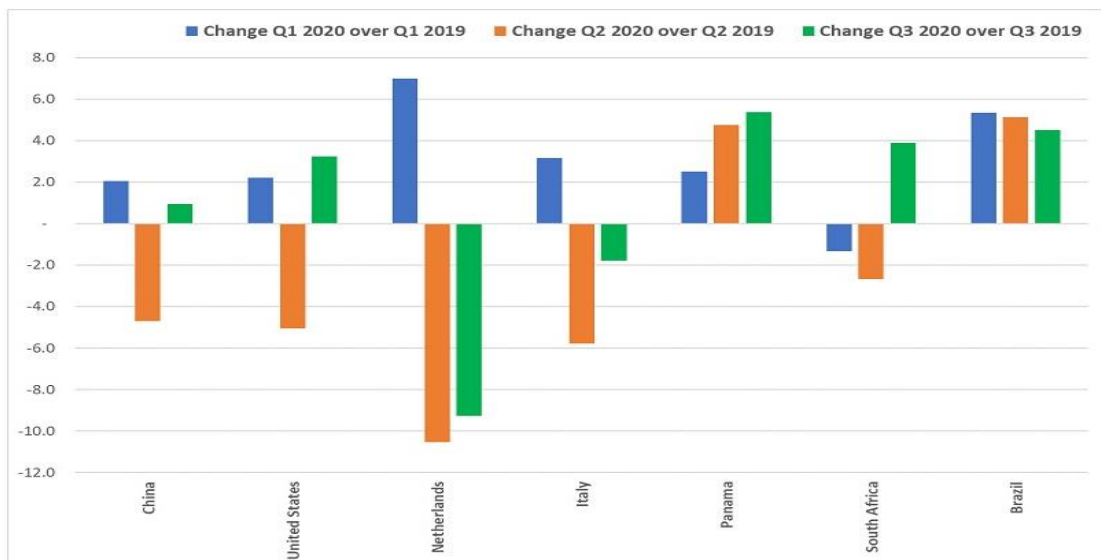


Figure 8. Sea container transport globally experienced the largest decline in Q2 2020 (UNCTAD. 2020)

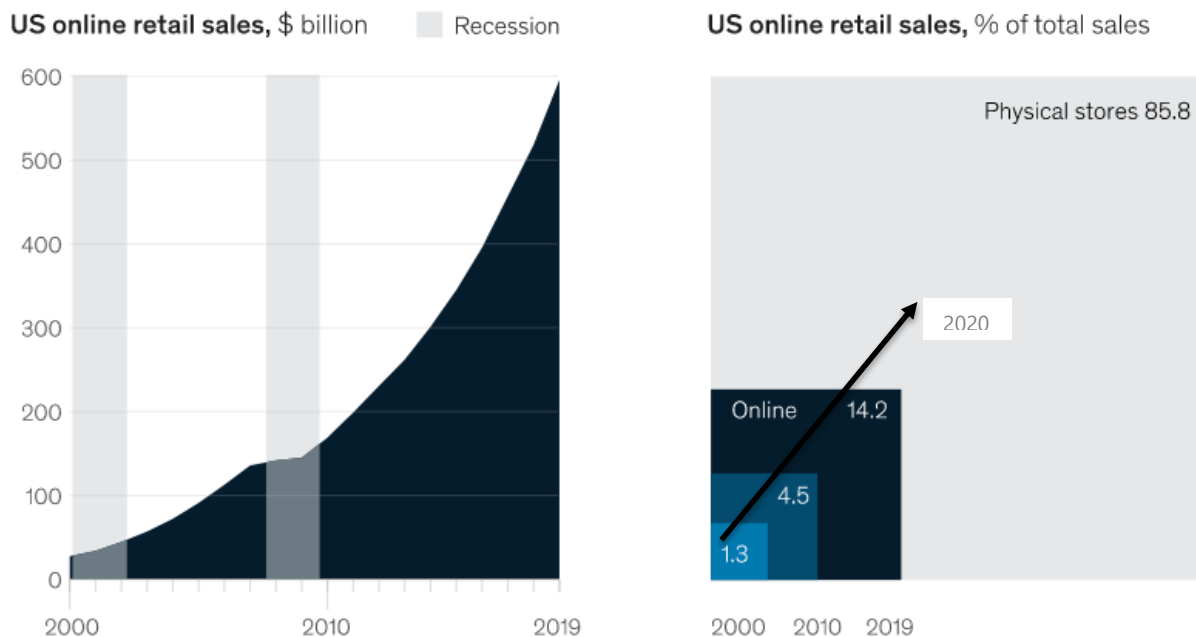


Figure 9. Expansion of online retail in USA during period 2000-2020 – 32,4% of total sales (McKinsey, 2020)

With the consequences of the Covid-19 pandemic in the field of logistics industry, the US was hit hardest in the first two quarters of 2020. At the end of 2020, a set of measures for the recovery of the entire economy from the consequences of the pandemic was adopted, which will directly lead to the economic growth of the country and the development of the logistics industry. The US logistics industry is an important support to the global distribution of medical equipment and vaccines.

4.3. LOGISTIC PROSPERITY OF ASIAN COUNTRIES DURING THE COVID-19 PANDEMIC

The Chinese economy was the first to be hit by the consequences of the Covid-19 pandemic. The period January-March marked a drastic decline in the volume of imports and exports of China (Figure 10) which directly affected all industrial sectors, and thus the logistics industry of the best ranked Asian countries in the field of logistics prosperity: Singapore, China and India. The main problems faced by Asian logistics providers are: delivery delays, delays in procurement, expected transit stops and labor shortages. Each of the aforementioned problems created problems in the supply chains of multinational companies, which directly affected their business results (Kumar, 2020).

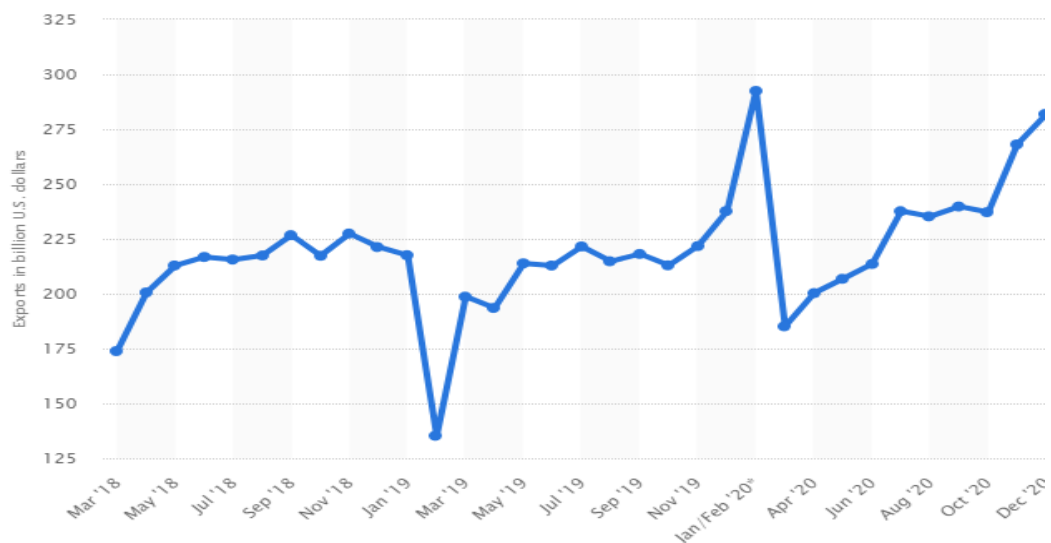


Figure 10. Monthly value of exports from China (Statista, 2021)

China brought the virus under control by strict epidemiological measures as early as mid-2020, which had a direct impact on economic recovery and export growth (Figure 10). Singapore has also seen a solid recovery from the effects of the crisis, while India is facing a major problem of putting the virus under control, resulting in a drop in foreign trade of \$ 15.24 billion. The stable recovery of the logistics industry of China and Singapore was already recorded in Q3 & Q4 of 2020 thanks to e-commerce and related 3PL providers (Figure 11). In March 2021, Chinese exports amounted to around 241.13 billion USD (Statista, 2021). This indicated an over 30 percent increase in exports compared to the same period of the previous year. A more drastic crisis in the domain of India's logistics industry has been avoided due to the increase in demand for warehouses, as a result of the growth in demand for food and other products that meet the daily needs of the population. Thus, Asian countries, thanks to the rapid

bringing of the virus under control, suffered the impact of the Covid-19 pandemic on the predictors of logistical prosperity, but already in Q3 2020, stability was achieved in each of the predictors. Rapid recovery with the consequences of a pandemic will be one of the key sources of competitive advantage of these countries in the global logistics market in the years to come (Figure 12).

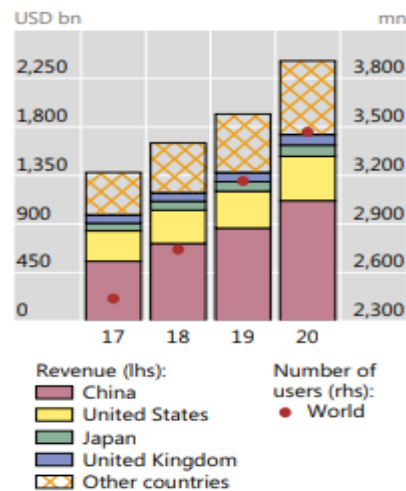


Figure 11. Online orders in retail industry in selected countries (Alfonso et al., 2021)

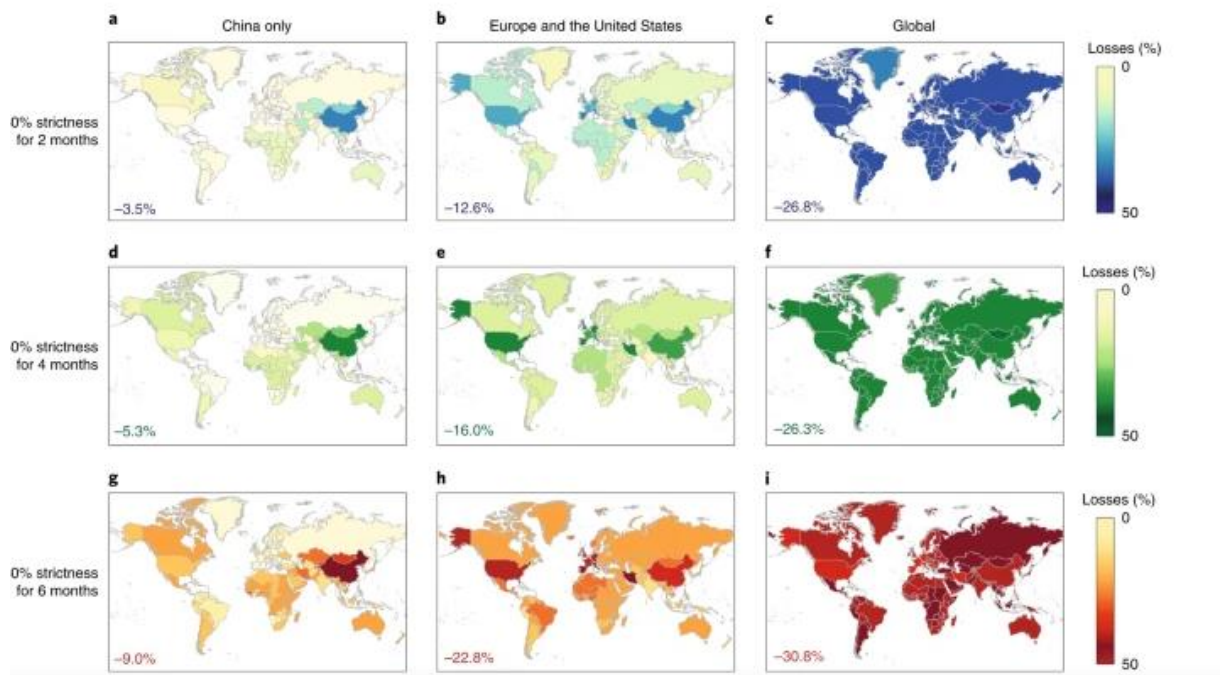


Figure 12. Economic impact of Covid-19 on China, Europe and USA (Guan et al., 2020)

The consulting company Mordor Intelligence (2021) is working on projections for the recovery of certain industrial sectors after the Covid-19 pandemic. Positive results of the logistics industry in Asia in the period end 2020-2021. are the basis for positive forecasts for the period 2021-2026. years. The consultants predict that the values of the logistics market of

the Asia-Pacific region will increase by 6.1% in that period, which is the best presenter of the successful fight of this sector of the economy with the consequences of the pandemic. The losses suffered by this industry are much smaller than other sectors of the economy, primarily thanks to B2C and C2C e-commerce models.

5. GLOBAL LOGISTICS INDUSTRY RECOVERY STRATEGY

The analysis of the impact of the Covid-19 pandemic on the global logistics industry presents the strength of this industrial sector, which is reflected in the speed and efficiency of dealing with the consequences of the pandemic and functioning in its conditions. The global logistics industrial sector suffered the greatest losses during the period January-May 2020, after which, with related economic and financial policies of countries around the world in this domain, it quickly "rose" in support of other sectors of the economy. Leading countries in the field of logistics prosperity worked on defining a strategy for rapid and efficient recovery from the consequences of the pandemic, in order to return the value of the global logistics market and the engagement of logistics providers to the 2018 level. It is a great challenge to solve the following issues in the coming period (IFC, 2020):

- financial support to the authorities in the field of recovery from the consequences of the pandemic, as well as in the field of stimulating the inflow of investments in the improvement of logistics infrastructure,
- improving the speed and efficiency of cargo inspection and cross-border controls in order to fully resolve the crisis of the temporary trade embargo and export restrictions on sensitive cargo such as medical and pharmaceutical materials,
- technical-technological innovations in order to improve coordination in relation to compliance with epidemiological measures - speed and efficiency of logistics activities,
- stimulating the development of e-commerce because the same year ago, even in the conditions of a pandemic, it crystallized as the leading driver of survival and development of the global logistics industry,
- reconfiguration of global value chains, ie. shortening supply chains during the crisis period (especially in the field of supply of strategic raw materials) in order to prevent any delays in the realization of supply chain management objectives.

6. CONCLUSION

The Covid-19 pandemic affected the economic growth of all countries, which directly affected all economic activities, including the logistics industry. The logistics industry did not suffer severe consequences such as tourism and hospitality, on the contrary, it quickly withstood the "blow" of the crisis, primarily thanks to the expansion of e-commerce and support for the distribution of medical equipment and vaccines. The prosperity of the logistics industry globally stagnated during the period 2019-2021. which can be considered a great success given the large losses suffered by other sectors of the economy. Forecasts for the coming years are promising. Measures of state financial support, "green corridors", improving the speed and efficiency of transit inspections and technical-technological innovations in the field of improving the efficiency of shipment tracking are the key predictors to effective recovery from the Covid 19 pandemic and improving logistics prosperity in Europe, USA and Asia.

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INDUSTRY 4.0 AND SUSTAINABILITY

Alexandra Baltazar¹, José Dias Lopes^{2*}

¹ ISEG/ULisboa, Portugal; ² ADVANCE and ISEG/ULisboa, Portugal

Abstract: The fourth Industrial Revolution (IR), also known as Industry 4.0 (I4.0), is one of the subjects that dominates the present. It represents a new paradigm in terms of industrial value creation through a set of technologies, which add value to the entire product life cycle and the supply chain. In 1987, the United Nations Organization defined the concept of sustainable development, which made the topic increasingly relevant also in companies. The organizations act sustainably when their actions consider the three dimensions of Triple Bottom Line: economic, environmental, and social. The scientific production followed these developments which established a heap integrating both dimensions. The main purpose of this study is to evaluate that heap answering the question: Which are the dominant concepts in literature, emergent in the relation between I4.0 and Sustainability? The results show four dominant groups of concepts. Production, mainly of industrial nature; Sustainability and its environmental, human and social, and economic dimension; and technologies; Finally, a heterogeneous group, in which there are highlighting concepts related with the practical application of both dimensions being studied and its interaction (New, Product, Integration, Challenges, Policy, Impacts, and Implementation). Stands out from the results, the wide use of words grouped in an economic dimension (economy, business model, value creation). This situation points to the high transformational character of Industry 4.0, not only in the way businesses are managed and companies generate value, but also in the economy as a whole.

Keywords: Industry 4.0, Sustainability, Manufacturing, Production, Technologies.

1. INTRODUCTION

The production and distribution of goods have been marked, in recent years, by the practical application of two concepts of great impact: Industry 4.0 and Sustainability. This work analyzes the published literature where the two themes are addressed simultaneously to characterize the aspects that have dominated this double application of the concepts of Industry 4.0 and Sustainability.

The fourth Industrial Revolution (IR), or Industry 4.0 (I4.0), is one of the themes that dominate today (Frank, Dalenogare & Ayala, 2019). Although the level of maturity in the

* Corresponding author: diaslopes@iseg.ulisboa.pt

application of I4.0 varies from country to country, in all countries and many organizations, a new technological disruption is developing, which brings challenges and opportunities.

Like previous IRs, I4.0 is considered to represent a new paradigm in the creation of industrial value, namely through technology, artificial intelligence, and digital transformation (Birkel, Veile, Müller, Hartmann & Voigt, 2019).

The current globalization process is faced with the challenge of corresponding to the permanent worldwide growth in demand, production, and consumption of goods while ensuring the sustainable development of human existence (Manavalan & Jayakrishna, 2019). To face this difficulty, the creation of industrial value must integrate the concept of Sustainability (Stock & Seliger, 2016).

Concerns about sustainable development objectives influence the decisions of organizations, largely due to pressure from stakeholders and consumers. It is unacceptable for an organization to focus only on maximizing its economic performance, without incorporating social and environmental responsibility policies. Sustainability, through the Triple Bottom Line (TBL) approach, which suggests a balance between the economic, social and environmental dimensions, has become a priority (McWilliams, Parhankangas, Coupet, Welch & Barnum, 2016; Stock, Obenaus, Kunz & Kohl, 2018).

The main purpose of this study is to conclude on which concepts are dominant in the literature, emerging in the relationship between I4.0 and Sustainability. At the same time, it contributed to the debate on a topic of high interest to society, governments, organizations and the scientific community.

The methodology used will be the content analysis with qualitative and quantitative data, selected to be able to characterize the sample and achieve a categorization, description and interpretation, as comprehensive as possible.

Concerning its structure, this work consists of five more sections, in addition to the introduction. The second section corresponds to the Literature Review, in which the reasoned information about the themes in which it is divided will be shared: “Industry 4.0”; “Sustainability”, “Industry 4.0 and Sustainability”. In the third section, the methodology adopted will be described and justified. The fourth section will present and analyze the results. Finally, the fifth section describes the main conclusions and recommendations of this study.

2. LITERATURE REVIEW

In this section, the two dimensions under consideration will be addressed, according to the content of the references consulted through the subthemes: “Industry 4.0”, “Sustainability” and “Industry 4.0 and Sustainability”.

2.1. INDUSTRY 4.0

The constant evolution of science and technology has contributed decisively to industrialization at a global level (Liao, Deschamps, Loures & Ramos, 2017; Bibby & Dehe, 2018). This aspect has increased the competitiveness and the number and type of customers, making the requirements and specificities concerning the product and its life cycle to be unpredictable. To meet demand, produce the necessary quantities, in a customized way and at the lowest cost, companies make use of technological developments (Bibby & Dehe, 2018).

In this way, the future of manufacturing companies is transformed by the development of an increasingly digital environment, in which the value and supply chains are interconnected

and the systems are intelligent, autonomous, integrated and automated. These technological advances aim to speed up the elimination of unnecessary production costs, increase their capacity and reduce their times, ensuring the quality of products (Bibby & Dehe, 2018; Stock et al., 2018).

The 4th IR arises due to the trend towards the prevalence of these automation technologies in the manufacturing industry. Although the 3th IR already focused on the automation of processes and machines, it was at the 4th IR that they were used throughout the value chain, through the integration of industrial digital ecosystems that enable integrated solutions (Xu et al., 2018; Liao et al., 2017). In this way, the rigid automation processes, developed in the 3th IR, have been overcome in their complexity and flexibility, as the new revolution is implemented (Stock et al., 2018).

Around the world, governments have awakened to this trend and responded in ways that benefit from what the new IR could provide. Thus, from 2011 onwards, France, the United Kingdom, South Korea, China, Japan, Singapore, but mainly Germany, the European Union (EU) and the United States of America, announced major investments and initiatives to accompany and contribute to the development of this new industrial revolution (Liao et al., 2017; Birkel, et al., 2019; Müller & Voigt, 2018).

It was, in 2011, during the Hannover Fair, that the term “Industry 4.0” made its first appearance. The pioneers in developing the theme were researchers Henning Kagermann, Wolf-Dieter Lukas, and Wolfgang Wahlster in search of strategies to maintain Germany's economic competitiveness after the 2008 crisis and secure its position as one of the leading nations in the manufacturing industry. Later, in 2013, the term Industrie 4.0 would be officially presented, through a manifest published by the German National Academy of Science and Engineering, as a strategic initiative of that government (Stock & Seliger, 2016; Xu et al., 2018; Frank et al., 2019; Bibby & Dehe, 2018; Stock et al., 2018; Müller & Voigt, 2018).

Companies, research centers and universities also contributed to the development and production of experimental content and articles on the subject. Although one of the first articles to refer to the concept of “fourth IR” appeared in 1988 (Rostow, cited by Liao et al., 2017), it was in 2013 that academic conferences and publications on the subject began to appear exponentially. These aspects represented synergistic forces for the establishment of the fourth IR, making it one of the most frequently addressed topics in recent years (Liao et al., 2017).

Due to its scope and stage, there is no consensual definition for the term “Industry 4.0” (Birkel et al., 2019). The consulted literature shows that it is a strategic approach that, through the use of recent technological innovations, converges information and communication systems (Manavalan & Jayakrishna, 2019).

This concept represents the new stage of the industry, with repercussions on manufacturing systems by integrating a set of emerging and converging technologies that add value to the entire product life cycle. It implies an evolution of the human role in production systems, in which all activities in the value chain will be developed according to smart and ICT-based approaches (Frank et al., 2019; Birkel, et al., 2019; Kayikci, 2018).

There is a fusion between the virtual and physical world, through the transfer of data between people and objects in the entire value chain (Frank et al., 2019; Birkel, et al., 2019; Kayikci, 2018).

It is based on the adoption of digital technologies that, in real-time, gather and analyze data, producing information to drive the entire manufacturing system. For this reason, I4.0 is also known for the Industrial Internet of Things (IIoT) (Birkel et al., 2019; Müller & Voigt, 2018) and through it, we can see the transformation of traditional factories into smart factories.

Smart factories develop their activity by reconciling production objectives in real-time and total transparency with suppliers and customers, variable and adjustable quantities of

production, multiple variants of the same product through customization, decentralized and autonomous processes (Kayikci, 2018; Frank et al., 2019).

I4.0 enjoys a scope that is reflected in its applicability, not only in the manufacturing industry but also, for example, in mining production, logistics, food supply chain, health, e-commerce, energy management, construction, clothing, etc. (Manavalan & Jayakrishna, 2019).

I4.0 is based on four key elements that facilitate its implementation: technology, processes, organization and knowledge (Kayikci, 2018), and is supported by six principles: virtualization, interoperability, decentralization, real-time capacity, modularization and service orientation (Manavalan & Jayakrishna, 2019; Carvalho, Chaim, Cazarini & Gerolamo, 2018).

The avant-garde technologies that characterize I4.0 are enough and correspond to complex and evolved systems. In literature, the most frequently named and described are Additive manufacturing or 3D printing; Cloud systems; Manufacturing execution systems; Internet of things (IoT); Cyber-physical systems; Big data and Analytics; Sensors and Robotics (Bibby & Dehe, 2018; Braccini & Margherita, 2018; Kayikci, 2018; Stock et al., 2018; Frank et al., 2019; Xu et al., 2018; Müller & Voigt, 2018).

The I4.0 paradigm implies horizontal and vertical integration in the value chain, end-to-end engineering throughout the product life cycle and across the entire supply chain, as well as generating new and disruptive models of business (Xu et al., 2018; Stock & Seliger, 2016).

2.2. SUSTAINABILITY

In 1987, through the Brundtland report, the United Nations (UN) contributed decisively to the definition of the concept of sustainable development, defining it as “development that meets the needs felt in the present, without compromising the capacity of future generations. to satisfy their own needs”(UN, 1987).

From that time on, sustainability started to be a progressively popular theme among corporations, academia and society in general. More recently, in 2015, the UN established the 17 objectives for sustainable development based on five main categories: People; Planet; Prosperity; Peace; and Partnership. These objectives are part of the 2030 Agenda and all countries and stakeholders must try to achieve them in a collaborative form (UN, 2015).

The growth of the world population and socio-economic inequality, the climate change and environmental degradation, the urbanization, the growing scarcity of natural resources, are some of the motivations for the increasing concerns about sustainability on a global scale and in particular for the industry (Braccini & Margherita, 2018).

Corporations are considered to act sustainably when their actions take into account the three pillars of the TBL. The term TBL reflects precisely the multidimensional nature of sustainability and refers to three interdependent dimensions: economic, environmental, and social. The economic success of a company is revealed, namely through its profit and liquidity, ensuring its existence, its ability to create value, and balance costs and revenues. It is therefore concerned with the financial and economic performance of the organization. From an ecological point of view, the company must use renewable resources, reduce waste, recycle and produce since they do not impact the natural ecosystem. The social perspective includes economic actions that respect human capital, employee satisfaction at work and their quality of life, social integration in communities, solidarity, equity, and justice in the distribution of goods and services and equal educational opportunities (Birkel et al., 2019; Braccini and Margherita, 2018).

Although the ideal is a balance in the interaction between these three dimensions, there may be an overlap or conflict between the principles of each one. The TBL requires a holistic

view of its three dimensions, to get out of there the real benefits for society (Müller & Voigt, 2018). Müller & Voigt (2018) refer that when new technologies are implemented, the gains at the economic level can be expanded if ecological and social perspectives are equally promoted.

2.3. INDUSTRY 4.0 AND SUSTAINABILITY

Unlike the previous three IRs, I4.0 is expected to involve not only transformations at the industrial level but also in society itself, through the creation of sustainable industrial value, favoring new business models, connectivity between people, and waste management (Müller & Voigt, 2018; Habib & Chimsom I., 2019).

The intense demand for the industrial system and the simultaneous concern with sustainability is one of the current economic challenges (Manavalan & Jayakrishna, 2019). In addition, environmental, health, and safety concerns have led to an appeal to sustainable practices by organizations that choose to implement I4.0 (Habib & Chimsom I., 2019).

Sustainable manufacturing systems lead to a shift from the linear economy to a circular model, in which resources are efficiently used and waste is reduced through recycling, remanufacturing, and material recovery, representing a path to sustainable development (Franciosi, Iung, Miranda & Riemma, 2018).

The interdependence between the three dimensions of sustainability suggests that these should be taken into account when making strategic and organizational decisions during the implementation of I4.0 and that organizations and countries should take into account the sustainable development objectives of Agenda 2030 (Birkel et al., 2019).

Considering the relationship between I4.0 and sustainability, Habib & Chimsom I. (2019) point to a seventh principle of the new industrial revolution - ecodesign -, which consists of developing technologies taking into account their impacts on the environmental level to ensure sustainable manufacturing.

Tables 1 and 2 list the opportunities and risks referred to in the articles analyzed in the literature review, concerning the three dimensions of the TBL.

Table 1. List of opportunities for the Economic, Environmental and Social dimensions in I4.0

Opportunities (References)
Economy <ul style="list-style-type: none">• New business models (Stock et al., 2018; Müller & Voigt, 2018; Stock & Seliger, 2016);• Reduction of logistics costs (Kayikci, 2018; Müller & Voigt, 2018);• Reduction of delivery times and distances; Decrease in the number of product losses and damages (Kayikci, 2018; Müller & Voigt, 2018; Braccini & Margherita, 2018; Manavalan & Jayakrishna, 2019);• Better demand forecast (Kayikci, 2018; Braccini & Margherita, 2018);• Increased efficiency (Manavalan & Jayakrishna, 2019);• Inventory optimization (Braccini & Margherita, 2018; Manavalan & Jayakrishna, 2019);• Economic transparency (Müller & Voigt, 2018);• Increase in EBITDA (Earnings before interest, taxes, depreciation and amortization); Increased sales; Increase in net income (Braccini & Margherita, 2018).

Environmental <ul style="list-style-type: none"> • Reduction in emissions of CO₂ and other greenhouse gases; Reuse of materials (Kayikci, 2018; Braccini & Margherita, 2018); • Waste Reduction; Increased recycling (Kayikci, 2018; Müller & Voigt, 2018); • Decrease in pollution (Kayikci, 2018; Stock et al., 2018); • Increased consumption of renewable energy (Stock et al., 2018); • Decrease in non-renewable energy consumption (Kayikci, 2018; Müller & Voigt, 2018; Braccini & Margherita, 2018); • Reduction of the ecological footprint (Müller & Voigt, 2018); • Reduction of water consumption (Stock et al., 2018; & Braccini Margherita, 2018).
Social <ul style="list-style-type: none"> • Better working conditions; Health (Kayikci, 2018; Stock et al., 2018); • Safety at work (Kayikci, 2018; Stock et al., 2018; Braccini & Margherita, 2018); • Fairer remuneration (Müller & Voigt, 2018); • Learning facilitated by artificial intelligence; Increased job satisfaction (Stock et al., 2018; Müller & Voigt, 2018; Braccini & Margherita, 2018); • New opportunities and job profiles (Müller & Voigt, 2018; Braccini & Margherita, 2018; Xu et al., 2018); • Decrease in child labor; More safety at work (Stock et al., 2018).

Source: Authors

Table 2. List of opportunities for the Economic, Environmental and Social dimensions in I4.0

Risks (References)
Economy <ul style="list-style-type: none"> • High and risky investments (Müller & Voigt, 2018; Birkel et al., 2019); • Unpredictable revenue; Loss of market position (Müller & Voigt, 2018); • Transformations of Business Models; Increased competitiveness; Dependence on some suppliers (Birkel et al., 2019).
Environmental <ul style="list-style-type: none"> • Increased energy consumption (Stock et al., 2018; Birkel et al., 2019); • Reduction of energy efficiency (Stock et al., 2018); • Increase in pollution; Increased waste (Birkel et al., 2019).
Social <ul style="list-style-type: none"> • Decrease in jobs (Müller & Voigt, 2018; Stock et al., 2018; Birkel et al., 2019); • Impact on organizational structure and leadership models; Resistance to change and the new organizational culture; Training need; Stress at work; Deficit of qualified personnel; Physical relocation of factories; Apprehension in relation to Artificial Intelligence (Birkel et al., 2019).

Source: Authors

3. METHODOLOGY

To answer the research question - What are the dominant concepts in the literature, emerging in the relationship between I4.0 and Sustainability? -, the selected methodology was the analysis of the content of a particular type of documents - articles published in leading journals. This type of methodology can be considered as a set of techniques, qualitative or

quantitative, used to infer in a systematic, credible, valid, and replicable way, from texts and other forms of communication (Drisko & Maschi, 2016, p . two). In this case, a mixed approach will be used because part of the study is quantitative and part qualitative.

The conceptual model used to summarize the focus of this investigation can be seen in Figure 1.

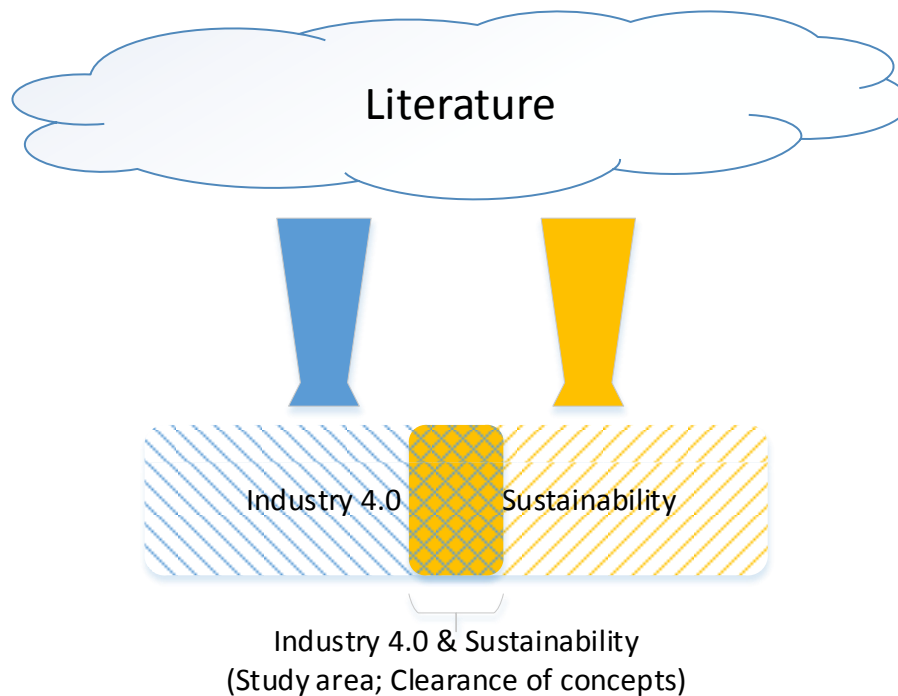


Figure 1. Conceptual model of the investigation.

Source: Authors.

To obtain the sample, the h-index (or Hirsch index) was used as a selection criterion (Ronda-Pupo & Guerras- Martin, 2012; Xu & Ma, 2020). Based on the number of publications and the number of citations, this parameter proposed by Jorge Hirsch, shows the quality and visibility of an investigator. However, this metric can also be applied to a set of publications, as is the case of the object of this study (Bornmann & Daniel, 2007).

The preparation of this study comprises three phases: obtaining the sample, processing data and, finally, obtaining results.

The first phase of the study sought to determine which research "key" is most appropriate for obtaining the final sample. Thus, on 05/12/2020, the possible equations were tested in the Scopus database in order to understand which one would obtain the highest h-index.

The research carried out conjugated synonyms of Industry 4.0 with Sustainability through the Boolean expression AND. The terms were searched in the title, abstract or keywords of the article. The types of documents article, conference article, review and conference review were selected, over a period of ten years (2010-2020). In Table 3 it is possible to observe the researches carried out, the number of documents obtained and the respective h-index.

Table 3. Research equations tested

Key of research			Total of documents	<i>h-index</i> 2010-2020	Number of articles covered by the <i>h-index</i>
<i>Sustainability</i>	AND	<i>Industry 4.0</i>	386	27	29 (4 articles were excluded)
			382	26	26
		<i>Industrie 4.0</i>	8	6	6
		<i>Industrial Internet of Things</i>	105	17	18
		<i>Fourth Industrial Revolution</i>	78	11	12

Source: Authors

It can be seen that the research key “Sustainability AND Industry 4.0” was the key with the highest *h-index*, having been selected to develop the study and thus proceed to the second phase of the research.

As can be seen in Table 3, using the search key with the terms Industry 4.0 and Sustainability, 386 articles were obtained and an *h-index* of 27. This means that of the 386 articles obtained, 29 had at least 27 citations. When analyzing this sample, 4 articles were excluded, which, for the purpose of this study, correspond to false positives. These are articles that do not address the dimensions under study, justifying their elimination, after which the *h-index* became 26. The sample now consists of 26 articles that had at least 26 citations. For data processing purposes, publications were numbered from 1 to 26 in decreasing order of the number of citations they presented in the Scopus database.

In the second phase of the research, the data obtained through the sample were processed. In this way, the words of the titles, abstract and keywords of the 26 articles were extracted into a Microsoft Word document and 5518 words were obtained.

The first criterion (C1) was applied, in which it was established that the words whose junction originated terms or expressions, would be united. According to this principle, it was defined that words beginning with capital letters in the middle of a sentence would not be separated, giving rise to an expression with or without an abbreviation / acronym, words between ‘ ’ and “ ” or italics and words between hyphens and “ / ”. Likewise, the keywords remained united with the exception of the following: Value creation assessment (article 10); Industry 4.0 challenges (article 7); Sustainability revolution (article 17); Sustainability impact (article 23); Cross-strait sustainability development (article 26). In addition, it was defined that the words whose sequence clearly gave rise to expressions relevant to the study in question would not be separated (as was done by Ronda-Pupo & Guerras-Martin, 2012).

The application of criterion C1 reduced the number of words to 4849. This list was exported to Microsoft Excel where the repeated words were eliminated and the frequency of each one was counted.

For the purpose of accounting for the frequency of words, five more criteria were established during this process, namely:

- C2 - The abbreviations between parentheses preceding of the expression that gave rise to them were not counted, avoiding double counting of the word in question (as was done by Muñoz-Leiva, Porcu & Barrio-Garcia, 2015; Muñoz-Leiva, Porcu, & Barrio, 2015);

- C3 - Acronyms were recorded in the respective words in full (as was done by Muñoz-Leiva et al., 2015);
- C4 - Equivalence was established between terms with slight spelling variations (as was done by Qin, 2000; Liu, Hong & Liu, 2012);
- C5 - Single / plural uniformity (89 word pairs) was carried out (as was done by Qin, 2000; Khaldi & Prado-Gásko, 2020; Muñoz-Leiva et al., 2015; Zhang, Zhang, Yu & Zhao, 2015);
- C6 - Words with the same root or meaning were grouped (as was done by Khaldi & Prado-Gásko, 2020; Xu & Ma, 2020; Zhang et al., 2015).

The application of the aforementioned criteria resulted in a list of 1033 words.

A third, and last stage, of the method that corresponded to the elimination of words according to the following criteria:

- C7 - Elimination of words with a single character, 3 words were excluded.
- C8 - Elimination of ordinal and nominal numbers, as well as percentages, 25 words were deleted.
- C9 - Elimination of words with 2 characters except acronyms, 17 words were deleted.
- C10 - Elimination of abbreviations, 4 words were excluded.
- C11 - Elimination of conjunctions, prepositions, adverbs and pronouns, except environmentally sustainable and in a sustainable way because they are words with relevance in the scope of the study, 119 words were eliminated.
- C12 - Elimination of auxiliary verbs, 17 words were deleted.
- C13 - Elimination of words of no interest to the scope of the study, 784 words were eliminated.

By the end of this phase, 969 words or groupings were eliminated, with 3857 repetitions in total. 62 words or groupings remained, with 992 repetitions.

From this list, the median of the total frequency of repetitions and the median of the frequency in articles were calculated, obtaining 14 and 6 (23.08%), respectively. These data supported the last criterion - C14 - Elimination of words / groupings with medians lower than those calculated (similar to Khaldi & Prado-Gásko, 2020). 35 words have been deleted.

The result corresponded to words or groupings with at least 14 repetitions and found in at least 6 articles (23.06% of the sample). Thus, a list of 27 words / clusters was obtained with 683 repetitions in total.

4. PRESENTATION AND ANALYSIS OF RESULTS

In this section, divided into three parts, a characterization of the sample consisting of the 26 articles will be carried out, the concepts found will be presented and, finally, an analysis of the results will be made.

4.1. SAMPLE CHARACTERIZATION

The results of this study were obtained from a sample consisting of 26 publications (listed autonomously in the references). The sample consists of 20 articles from journals and six conference articles.

The most cited publication had 395 citations (article 1) and the least cited only 26 (article 26).

The articles in the sample are distributed over a time between 2014 and 2019. The year with the most articles is 2018 with 11 articles, representing 42% of the sample, and the years with the least articles, that is, an article corresponding to 4% of the sample, were 2014, 2016, and 2019. In the graph in Figure 2, it is possible to see the distribution of the sample by year.

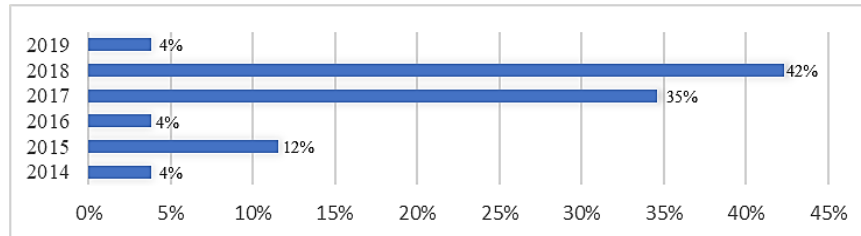


Figure 2. Distribution of the sample by year.

Source: Authors

The articles were analyzed concerning the typology of the study they presented, considering the same type of classification used by Ferrão (2016). Thus, it was observed that articles 1, 9, 11, 17, 21, and 23 are “Case studies”, articles 2, 5, 15, 19, 25, and 26 are “Conceptual studies”, articles 3, 6, 7, 8, 14, 16 and 22 are “Studies in Organizations”, articles 4, 12, 13, 18 and 24 are “Literature Studies” and articles 10 and 20 are other types of studies.

There is, therefore, a certain balance between the nature of the studies published since there are seven “Studies in Organizations”, six “Case Studies”, six “Conceptual Studies”, five “Literary Studies” and only two “Other Types of Studies”.

Concerning the authorship, the articles vary from a minimum of one author (article 23) and a maximum of six authors (article 25). Most articles - eight - have 4 authors. Thus, 96.15% of the articles are co-authored.

In total, the sample has 80 authors. Most of them appear in only one article in the sample. The authors who contradict this observation are Julian Müller and Kai-Ingo Voigt, responsible for 4 articles, as well as Tim Stock and Daniel Kiel who are responsible for 2 articles.

In the case of co-authored articles, 60% were written by authors from different institutions and 40% were written by authors from the same institution.

The authors of the sample publications are affiliated with organizations from 17 countries and four continents. Most affiliations - 23% - are from Germany. There is a predominance of the origin of articles from Europe (70% of affiliations), followed by America, Asia and Africa with 14%, 11% and 5% of affiliations, respectively. The geographical distribution of the sample by country of the sample can be seen in Figure 3.

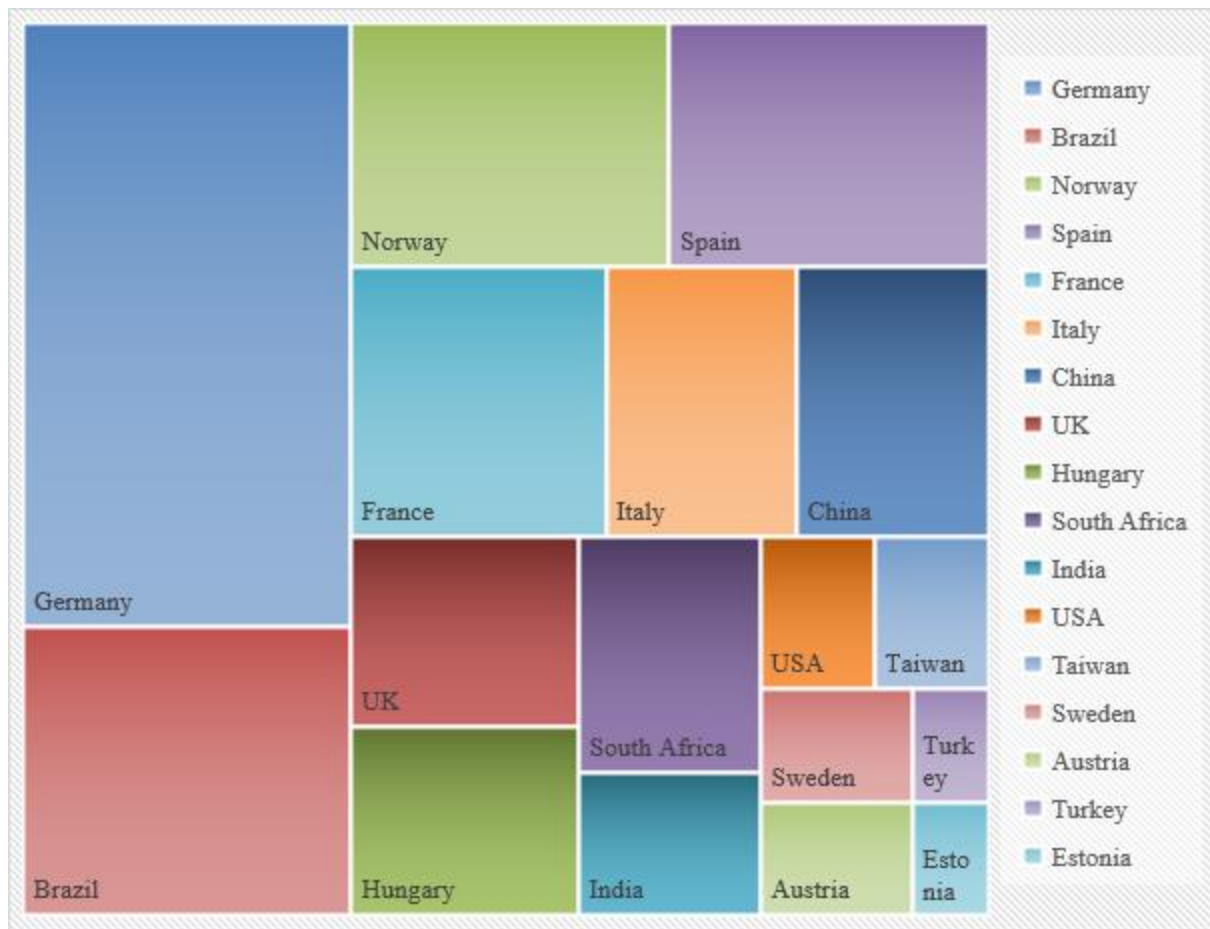


Figure 3. Geographic distribution of the authorship.

Source: authors

The sample comes from 16 journals, among which stand out with six articles in Sustainability, Procedia Manufacturing and Process Safety and Environmental Protection, both with 3 articles and in the International Journal of Precision Engineering and Manufacturing-Green Technology with two articles. The remaining journals have an article in the sample. It appears, therefore, that the sample publications were published mostly in journals in the areas of production and sustainability management.

An analysis was made of the frequency of words included in the title, abstract and keywords of each article in the sample. After the criterion of non-separation of expressions relevant to the study had been applied, in total the sample had 4849 words. Article 15 with 95 words in those fields is the one with the least words and the article with the most words has 340 (article 8). On average, each article has 187 words in those fields.

4.2. RESULTS

As described in the methodology section, the results correspond to the concepts formed by groupings of words that appear in the sample, simultaneously, 14 or more times and in 6 or more articles.

The frequency in articles and the total frequency of the concepts found can be seen in the graph in Figure 4.

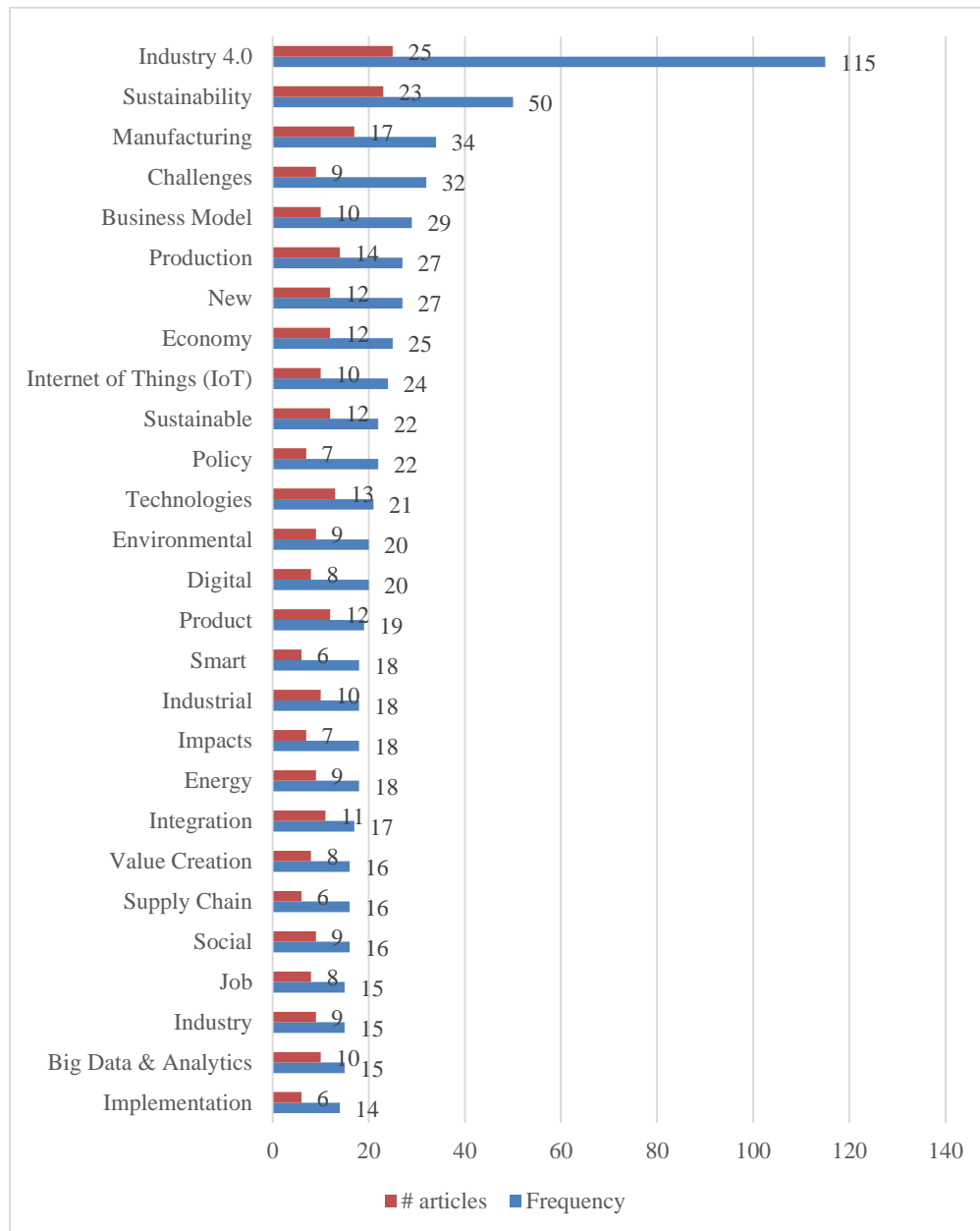


Figure 5. Concepts find out and respective frequency in the number of articles and total.
Source: authors

In Table 4 it is possible to observe which concepts are more frequent. On the left side of the table, these concepts are ordered by the number of articles in which they are present. On the right side of the table, the concepts are ordered in descending order concerning the total frequency of the sample. It was considered important to investigate the concepts, not only based on their total frequency in the sample but also through their presence in different articles. For this reason, criterion 14 (C14), mentioned above, was established.

Table 4. Concepts (sorted by number of articles / sorted by frequency)

Concept	N° articles	% articles	Concept	Total frequency
<i>Industry 4.0</i>	25 ^{**}	96,15%	<i>Industry 4.0</i>	115
<i>Sustainability</i>	23	88,46%	<i>Sustainability</i>	50
<i>Manufacturing</i>	17	65,38%	<i>Manufacturing</i>	34
<i>Production</i>	14	53,85%	<i>Challenges</i>	32
<i>Technologies</i>	13	50,00%	<i>Business Model</i>	29
<i>New</i>	12	46,15%	<i>New</i>	27
<i>Economy</i>	12	46,15%	<i>Production</i>	27
<i>Sustainable</i>	12	46,15%	<i>Economy</i>	25
<i>Product</i>	12	46,15%	<i>Internet of Things (IoT)</i>	24
<i>Integration</i>	11	42,31%	<i>Sustainable</i>	22
<i>Business Model</i>	10	38,46%	<i>Policy</i>	22
<i>Internet of Things</i>	10	38,46%	<i>Technologies</i>	21
<i>Industrial</i>	10	38,46%	<i>Digital</i>	20
<i>Big Data & Analytics</i>	10	38,46%	<i>Environmental</i>	20
<i>Challenges</i>	9	34,62%	<i>Product</i>	19
<i>Environmental</i>	9	34,62%	<i>Energy</i>	18
<i>Energy</i>	9	34,62%	<i>Impacts</i>	18
<i>Social</i>	9	34,62%	<i>Smart</i>	18
<i>Industry</i>	9	34,62%	<i>Industrial</i>	18
<i>Digital</i>	8	30,77%	<i>Integration</i>	17
<i>Value Creation</i>	8	30,77%	<i>Supply Chain</i>	16
<i>Job</i>	8	30,77%	<i>Value Creation</i>	16
<i>Policy</i>	7	26,92%	<i>Social</i>	16
<i>Impacts</i>	7	26,92%	<i>Big Data & Analytics</i>	15
<i>Smart</i>	6	23,08%	<i>Industry</i>	15
<i>Supply Chain</i>	6	23,08%	<i>Job</i>	15
<i>Implementation</i>	6	23,08%	<i>Implementation</i>	14

Source: authors

On average, 11 concepts (or words covered by those concepts) were counted in each article. The articles that had the most words on the result list were articles 12, 21, and 22 with 16 of the 27 words. The articles with the fewest words included in the result were articles 17 and 25 with seven of the 27 words.

^{**} Zhang et al. (2017) is about biomanufacturing 4.0. The article was selected by the selection filter because This article differs from the rest of the sample, however, what distinguishes the biomanufacturing 4.0 phase from the previous phases has similarities with what distinguishes Industry 4.0 from the previous phases of industrialization. This similarity is assumed in the article "As compared to Industry 4.0, biomanufacturing 4.0 would become an enabling platform to produce new products or existing products in far better ways than current technologies."

Thus, the article was not considered a "false positive", however, it should be considered an outlier.

4.3. ANALYSIS OF RESULTS

The analysis of the results is mainly qualitative. First, we will interpret the results in a two-dimensional structure. In a second layer, we will group the identified words creating clusters, and, finally, we will interpret these clusters.

The graph below was constructed from the data provided in Table 4. Two guidelines are signed (the vertical and the horizontal) indicating the medians for the data for each of the axes.

Thus, 4 sectors are formed:

- The upper right - frequently used words and in many articles;
- The upper left - frequently used words but in a few articles;
- The lower left - little-used words and few articles;
- The bottom right - little-used words but many articles.

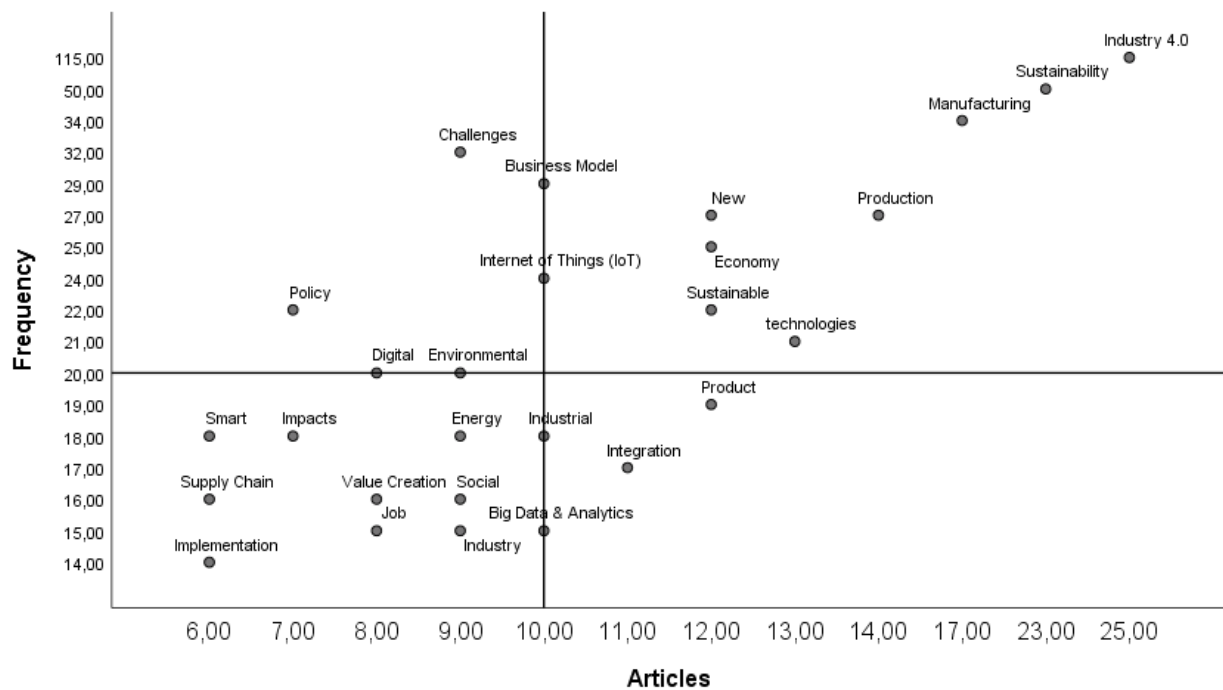


Figure 5. Articles / Frequency dispersion

Source: Authors

The words of group A (Industry 4.0; Sustainability; Manufacturing; Business Model; New; Production; Economy; Internet of Things; Sustainable; Technologies) - the most frequent and used in most articles - reflect the core of the intersection of the two concepts. In this group, we find industry (including production, manufacture); technology (with emphasis on the Internet of Things); sustainability (including its economic dimension).

The last two words not yet analyzed are Business Model, and New. New reflects the novelty and does not require further argument. Business Model is an unforeseeable novelty. The results show that the implementation of practices based on industry 4.0 and sustainability requires the reevaluation of the companies' business models. This fact has not been pointed out in a significant way by the literature, however, it emerges in an evident way.

The second group - B - includes the words Digital, Environmental, Policy, and Challenges. In this group, the words do not appear in many articles but in those where they appear they are used a lot, which gives the idea of the centrality of these concepts in the articles where they appear. The first two words were somewhat expected, however, the last two were not predictable. The greater complexity associated with the change introduced by industry 4.0, in the context of the sustainability challenge, apparently constitutes a challenge that requires more structured responses - policies.

In the third group - C - shows a heterogeneous group of concepts (Energy, Impacts, Smart, Industrial, Supply Chain, Value Creation, Social, Industry, Job). Words related to the social dimension (Social, Job) stand out.

A fourth group - D - includes the words Product, Integration, Big Data & Analytics, Implementation. These are words that are few in the articles but are present in many of them. They seem to be related to the operationalization of the concept (Integration, Implementation).

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. MAIN FINDINGS

The objective of this work is to determine which concepts are dominant in the literature, emerging in the relationship between I4.0 and Sustainability.

The results were obtained through a sample consisting of 26 very recent publications, mostly from 2017 and 2018, developed mainly by European authors (70%), and, in particular, German authors (23%). The publications were mostly published in journals in the area of production organization and sustainability. Most of the articles were co-authored and in 60% of these cases, the authors are from different institutions.

The identified concepts are, in descending order of their frequency in different articles of the sample, the following: Industry 4.0, Sustainability, Manufacturing, Production, Technologies, New, Economy, Sustainable, Product, Integration, Business Model, Internet of Things (IoT), Industrial, Big Data & Analytics, Challenges, Environmental, Energy, Social, Industry, Digital, Value Creation, Job, Policy, Impacts, Smart, Supply Chain and Implementation.

The dominant concepts can be grouped in:

- **Production**, mainly of an industrial nature (Industry 4.0, Manufacturing, Production, Industrial, Industry, Supply Chain - although the word Industry has a meaning that goes beyond the concept of manufacturing industry, in this context, the situations to which it refers are fundamentally within this framework);
- **Sustainability** (Sustainability, Sustainable), and its environmental dimension (Environmental, Energy), social and human dimension (Social, Job) and the economic dimension (economy, business model, value creation);
- **Technologies** (Technologies, Internet of Things (IoT), Big Data & Analytics, Smart, Digital); and, finally,
- **A more heterogeneous set**, in which concepts related to the practical application of the two dimensions under study and their interaction (New, Product, Integration, Challenges, Policy, Impacts and Implementation) stand out.

The results obtained also allow us to conclude that there are marginal fringes about the relationship between I4.0 and Sustainability, which is reasonable in a field of study that is under development. The concepts identified are still generic and comprehensive, making it impossible

to assess concepts with greater specificity. In the case of the present study, it is important to consult the words or expressions that made up the groupings represented in the result.

I4.0, whose main technologies are the Internet of Things and Big Data & Analytics, proved to be a dimension with a lot of versatility in terms of its applicability, although with a greater tendency in the manufacturing industry.

The implementation of I4.0 must take into account not only the balance between the social, economic, and environmental dimensions but also other concepts, such as the political/legal aspects, the creation of value, the new business models to guarantee Sustainability. To promote the integration between the two dimensions under analysis is to take the best advantage of the implementation of I4.0 and its technologies, placing them at the service of sustainable objectives.

Also, note the absence of applications of the concept in services. In the past, concepts that initially developed in the industry (manufacturing) later evolved into services (e.g. quality - in its various nuances; the concept of lean production (lean services), etc.). It is possible that, in the future, the concept will expand to services, at this stage, the study does not reveal that this expansion has already started.

Finally, the results highlight the wide use of words grouped in an economic dimension (economy, business model, value creation). This situation indicates the high transformational character of Industry 4.0, not only concerning how business is done and how value is created but also to the economy as a whole.

5.2 LIMITATIONS AND FUTURE RESEARCH

During the study, it was noted the difficulty in defining criteria in the separation and elimination of words, due to the subjectivity inherent in this type of essay, in which decisions may vary according to the researcher.

The realization of this study intended to contribute, namely so that future studies that have I4.0 and Sustainability in their common denominator can have a reference in relation to the concepts to be addressed. In relation to possible new study steps, it is suggested, for example, to carry out the research in several databases and with broader search keys, or to select metrics other than the h-index since it has its own limitations.

The data were obtained through the title, summary and keywords of the sample. It is suggested to obtain more assertive results to cover the entire sample text.

ACKNOWLEDGMENT

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Annex I

Studied articles (sample)

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IMPACT ASSESSMENT OF THE UNIVERSITY EDUCATION QUALITY, SCIENCE, ECONOMIC DEVELOPMENT, AND SOCIAL RELATIONS ON THE GLOBAL INNOVATION INDEX (GII) USING MULTIPLE LINEAR REGRESSION ANALYSIS (MLRA) AND ARTIFICIAL NEURAL NETWORKS (ANNs)

Marija Panić*, Živan Živković

*University of Belgrade, Technical Faculty in Bor, Engineering Management Department,
Bor, Serbia*

Abstract: This paper examines the impact of the quality of the university education (UE) and science, the achieved economic level, and social relations (Democracy Index – DI, Corruption Perceptions Index – CPI) on the achieved level of Global Innovation Index (GII) in 2020 based on data from forty two European countries. Multiple linear regression analysis (MLRA) and artificial neural networks (ANNs) were used to establish a correlation between the predictors: quality of UE, quality of science, achieved economic level and social relations, and output (GII). The obtained results R^2_{MLRA} (0.638) < R^2_{ANNs} (0.918) show a significant correlation between these predictors and GII, which indicates that these predictors have a special impact on the size of GII, where, in the case of ANNs, a higher degree of correlation is achieved, which indicates that the relationships in the proposed model are complex.

Keywords: Global Innovation Index (GII), university education, science, democracy, corruption, MLRA, ANNs

1. INTRODUCTION

In the business world, innovation is far more than synonyms for research and development (R&D) (Ulku & Pamukcu, 2015). According to the OECD, innovation means: "Innovation goes far beyond the boundaries of laboratories for users, suppliers and consumers in government, business and non-profit organizations, across borders, between sectors and different institutions." The Global Innovation Index (GII) ranks world economies based on their innovative capabilities. GII consists of about 80 different indicators grouped into inputs and outputs, in order to define the multi-dimensional essence of innovation (Cornell University et al., 2020).

Starting from the fact that innovation plays a key role in the development of the economy (Mihaela & Tițan, 2014), GII ranks around 130 economies in the world based on economic indicators, at the end of each year, and the first ranking was made in 2011 (Cornell University et al., 2020). Over the last decade, GII has established its position in relation to innovation and has become an "action tool" for economic activity, on whose agenda it has

* Corresponding author: mpanic@tfbor.bg.ac.rs

found itself. GII ranks innovative capacities and results of world economies. The measurement of innovation is based on criteria that include: institutions, human capital and research, infrastructure, credit, investment, linkages, the creations, absorption, and diffusion of knowledge and creative output (Cornell University et al., 2020).

Developing countries are increasingly aware of the important role that innovation and work efficiency play on the road to economic growth. The effects of technological efficiency stem from the entry of innovation into the enterprise, technology adoption, and human capital development, where R&D departments in companies play a key role (Un & Asakawa, 2015). Innovation represents the conversion of knowledge and ideas into benefits in terms of new or improved products, services, or processes whether they are intended for commercial use or represent a public good (Beraha, 2019). Innovation is also important in terms of its ability to successfully address global challenges such as environmental protection, health promotion (vaccine production in a pandemic), and the general well-being of the population, on which the EU Commission conducts an annual comparative analysis of research and innovation performance of EU member states and candidate countries (EC, 2020).

Innovation is the process through which economic and social value is extracted from knowledge, through the creation, diffusion, and transformation of ideas, in order to produce new or improve products, services, strategies, or opportunities (Cornell University et al., 2020). In order to create knowledge and be the starting point for creating innovation, quality university education (UE), quality science, favourable economic conditions as well as harmonious social relations (development of democracy and non-existence of corruption) are needed (Agerberg, 2019; Agasisti & Bertolotti, 2020).

The level and scope of innovative activities in a country depend on the level of knowledge acquired within UE, the achieved quality of scientific work, economic level and standards of people, as well as social relations (Democracy Index – DI and Corruption Perceptions Index – CPI) (Rock, 2009; Freedom House, 2020).

The quality of UE is measured by the position of the university on the ARWU list, which depends primarily on the achieved scientific results: the number of publications on the JCR list, the number of citations, and the number of the most cited people in the top 500 in a field. This is the starting point for creating quality innovations and their transfer in cooperation with the R&D sector in the economy in the domestic country and abroad (Docampo, 2013; Avelar et al., 2019; Živković et al., 2017). The achieved level of economic development, which is measured through Gross Domestic Product (GDP) per capita and Gross National Income (GNI) per capita, determines the achieved level of human development (HD), quality of life, and the level of state allocation for science and education (Cooray, 2009; Baumann & Kritikos, 2016; Lendel, 2010). No less influential is the motivation of employees in science and education to create knowledge and transform it into an innovative product, which depends on the level of democracy in the country and the presence of corruption.

This study examines the impact of UE and science quality factors, achieved economic level, and social relations (DI and CPI) on GII in forty two European countries in 2020 in order to establish correlations between individual predictors on GII using multiple linear regression analysis (MLRA) and artificial neural networks (ANNs) (Dreyfus, 2005; Ho, 2006; Hanula et al., 2008; Liu et al., 2009).

2. RESEARCH METHODOLOGY

Since 2011, at the end of each calendar year, the World Intellectual Property Organization (WIPO) publishes the results of the ranking of countries in the world according to GII. For 2020, results have been published for 130 countries around the world. The existing GII calculation model is shown in Figure 1.

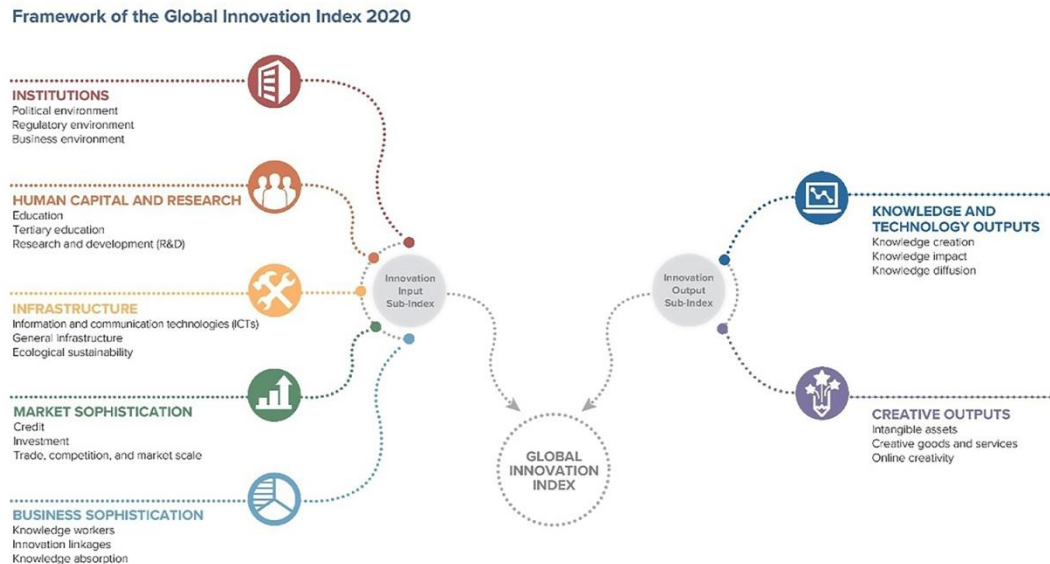


Figure 1. Structure for calculating GII (Cornell University et al., 2020)

In the model tested in this study, the impact of the quality parameters of education and science, the achieved level of economic development and social relations (DI and CPI) as predictors, on the defined level of GII as the output of the model (Cornell University et al., 2020) for 2020 was investigated using MLRA and ANNs. The following indicators were used as input parameters (predictors):

- X_1 – GDP per capita ($\$ 10^3$) (2020)
([http://en.wikipedia.org/wiki/List_of_Countries_by_GDP_\(nominal\)_per_capita](http://en.wikipedia.org/wiki/List_of_Countries_by_GDP_(nominal)_per_capita));
- X_2 – Gross National Income (GNI) per capita ($\$PPP 10^3$)
(<http://hdr.undp.org/en/countries>);
- X_3 – Number of papers in journals with IF per million inhabitants (2019),
- X_4 – Number of papers in journals with IF per million inhabitants (1996–2019),
- X_5 – Number of citations per paper (2019),
- X_6 – Number of citations per paper (1996–2019),
(<http://scimagojr.com/countryrank.php>);
- X_7 – Number of the top 500 quoted per million inhabitants (2019)
(<http://recognition.webofscience.com/awards/highly-cited/2020/>);
- X_8 – Number of universities on ARWU list in the top 500 quoted per million inhabitants (2019) (<http://schangairanking.com/ARWU2020.html>);
- X_9 – Democracy Index (DI) (https://en.wikipedia.org/wiki/Democracy_Index);
- X_{10} – Corruption Perceptions Index (CPI)
(https://en.wikipedia.org/wiki/Corruption_Perceptions_Index).

Global Innovation Index – GII (score 0–100) is defined as the output parameter of the model (Y) (http://wipo.int/edocs/pubdocs/en/wipo_pub_gii_2020_intro4.pdf).

MLRA and ANNs were used to determine the dependence $Y = f(X_1, X_2 \dots X_{10})$. The analysis included available data on these parameters for forty two European countries using the SPSS software package v.17.0 (Landau & Everitt, 2004).

3. DISCUSSION OF RESULTS

3.1. MODELING THE DEPENDENCE OF GII ON INPUT PARAMETERS (PREDICTORS) USING MLRA

Modelling of the dependence of GII (Y) on the mentioned input predictors (X_1 – X_{10}) was first performed using MLRA. Linear regression (LR) refers to examining the relationship between two or more variables, using the same set of paired scores taken from the same subjects, with a focus on prediction. As for a prediction, if two variables are in perfect correlation, then knowing the value of one variable allows predicting the results of another variable, i.e. the result of one variable can be used to predict the result of another variable (Ho, 2006).

In order for an MLRA to be implemented, certain requirements and assumptions must be met (Ho, 2006). The requirements are as follows: for each subject in the study, there must be related pairs of scores, i.e. if a subject has a score on variable X, then the same subject also has a score on variable Y; the variables should be measured at least at the ordinal level. In addition, the following assumptions must be met: linearity (the relationship between the two variables must be linear, i.e. the relationship can be more accurately represented by a straight line; as well as homoscedasticity (the variability of scores on the Y variable should remain constant at all values of the X variable).

As a result of the MLRA over the available data set, a prediction equation is obtained:

$$Y = a + b_1X_1 + b_2X_2 + \dots + b_nX_n \quad (1)$$

where Y represents the predicted dependent variable, a is the constant, b is the unstandardized regression coefficient, and X is the value of the predictor variable.

Table 1 shows the values of descriptive statistical analysis for all ten input parameters (X_1 – X_{10}), as well as for the output parameter (Y).

Table 1. Descriptive statistical analysis of the input and output parameters values of the model

Variable	Range	Minimum	Maximum	Mean	Std. Deviation	N
X ₁	106.2	3.4	109.6	30.26	24.44	42
X ₂	82130	3370	85500	30961.67	23361.70	42
X ₃	5625	143	5768	2284	1528.57	42
X ₄	85925	1862	87787	32220.19	23125.81	42
X ₅	0.86	0.38	1.24	0.85	0.22	42
X ₆	24.10	6.82	30.92	16.57	7.17	42
X ₇	19.52	0	19.52	3.01	4.18	42
X ₈	7	0	7	0.72	1.16	42
X ₉	7.39	2.48	9.87	7.34	1.67	42
X ₁₀	59	28	87	58.90	18.04	42
Y	38.94	27.12	66.06	44.65	9.64	42

In order to define the correlation dependence of the output parameter of the model (Y) as a function of the input parameters (X_1 – X_{10}), bivariate correlation analysis was performed, and thus Pearson correlation coefficients with the appropriate degree of statistical significance were calculated (Table 2).

Table 2. Correlation matrix for inputs and output of the model

	Y	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀
Y	1										
X ₁	0.796**	1									
X ₂	0.850**	0.954**	1								
X ₃	0.852**	0.816**	0.897**	1							
X ₄	0.897**	0.771**	0.882**	0.958**	1						
X ₅	0.791**	0.796**	0.830**	0.852**	0.820**	1					
X ₆	0.887**	0.755**	0.866**	0.862**	0.919**	0.872**	1				
X ₇	0.796**	0.773**	0.841**	0.834**	0.856**	0.740**	0.793**	1			
X ₈	0.209	0.271	0.300	0.267	0.254	0.095	0.240	0.221	1		
X ₉	0.812**	0.752**	0.801**	0.813**	0.800**	0.783**	0.781**	0.633**	-0.012	1	
X ₁₀	0.896**	0.848**	0.902**	0.877**	0.889**	0.851**	0.863**	0.769**	0.148	0.853**	1

Note: **Correlation is significant at the 0.01 level

In order for the correlation to be considered significant, it is necessary for the Pearson correlation coefficients to be greater than 0.5. It can be seen from Table 2 that the values of this coefficient are very high in all cases, which indicates the existence of a very strong correlation between the observed variables, with a high level of reliability ($p < 0.01$), except in the case between X_8 (Number of universities on the ARWU list) and all other predictors. The mentioned predictor X_8 is in a very weak positive correlation with all other predictors, without statistical significance, while with X_9 (Democracy Index) it is negatively correlated, also without statistical significance. Therefore, conditions have been created for the application of MLRA, as an appropriate tool for modelling the dependence of GII in the function of the considered predictors (X_1 – X_{10}) using the software package SPSS v.17. Over 90% of randomly selected data from the initial database were used for the model training phase using MLRA, and the rest was used for the testing phase.

The calculated linear dependence of the size GII (Y) on the input parameters – predictors (X_1 – X_{10}) obtained using MLRA is shown using the following prediction equation:

$$Y = 21.307 + (0.259 \cdot X_1) + (0.001 \cdot X_2) + (0.001 \cdot X_3) + (0.001 \cdot X_4) - (12.877 \cdot X_5) + (0.774 \cdot X_6) + (0.412 \cdot X_7) + (0.322 \cdot X_8) + (1.051 \cdot X_9) + (0.221 \cdot X_{10}) \quad (2)$$

$$(R^2 = 0.901)$$

A measure of the strength of the computed equation is the coefficient of determination (R^2) which represents the square value of the correlation coefficient (R). The correlation coefficient refers to the linear correlation between the observed and the model predicted values of the dependent variable. Its high value of 0.949 indicates a strong correlation. The value of R^2 is very high and amounts to 0.901, which confirms that over 90% of the variation in the dependent variable Y can be explained by the influence of input variables (X_1 – X_{10}), which also confirms the relationship between Regression and Residual (90.08% : 9.92%), obtained using the ANOVA test (Table 3).

The standard error of the estimate allows the 95% confidence interval to predict between which values the corresponding value of the predicted Y (GII) score lies. By

modelling the dependence of Y on the input parameters (X_1 – X_{10}) using MLRA, the standard error of the estimate is 3.49, which is drastically lower compared to the value of the standard deviation for Y of 9.63 (Table 1). Thanks to the parameters obtained in this way, the model defined in this way can be considered adequate for predicting the size of the GII depending on the stated predictors (X_1 – X_{10}).

Table 3. The results of ANOVA^b test in the training phase

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	3431.81	10	343.18	28.14	0.000 ^a
Residual	378.06	31	12.20		
Total	3809.87	41			

^a Predictors: (Constant), X_{10} , X_8 , X_7 , X_5 , X_9 , X_1 , X_6 , X_3 , X_4 , X_2

^b Dependent Variable: Y

The results of the ANOVA test shown in Table 3 represent the results of testing the null hypothesis that $R^2=0$. This value of the coefficient of determination indicates a nonlinear relationship between the predictors and the dependent variable. The obtained value of F statistics is 28.14, with high statistical significance ($p < 0.001$). Therefore, the hypothesis that there is no linear relationship between the predictors and the dependent variable is rejected.

Identifying an independent relationship was performed using the obtained values of standardized Beta coefficients between the predictors (X_1 – X_{10}) and the dependent variable (Y) (Table 4).

Table 4. Values of standardized Beta coefficients

Predictors	Standardized Coefficients	t	Sig.
	Beta		
X_1	0.657	2.632	0.013
X_2	-0.924	-2.682	0.012
X_3	-0.021	-0.072	0.943
X_4	0.262	0.778	0.442
X_5	-0.25	-1.699	0.099
X_6	0.575	2.516	0.017
X_7	0.179	1.372	0.180
X_8	0.039	0.523	0.604
X_9	0.182	1.382	0.177
X_{10}	0.413	2.365	0.024

The Beta coefficients are shown to be positive but not statistically significant for predictors X_1 , X_4 , X_6 , X_7 , X_8 , X_9 and X_{10} . Therefore, the higher the value of these predictors, the higher the value of GII is. The value of the Beta coefficients for X_2 , X_3 and X_5 is negative, also, without statistical significance.

After the phase of training and development of the model, the testing phase within the MLRA followed, in which the validation of the model was performed. Figure 2 shows the linear relationship between the recorded and the MLRA model predicted GII values. Compared to the training phase, the coefficient of determination (R^2) is now lower and amounts to 0.638, which means that greater reliability was achieved in the training phase of the model, which is logical, because it included over 90% of data from the initial database.

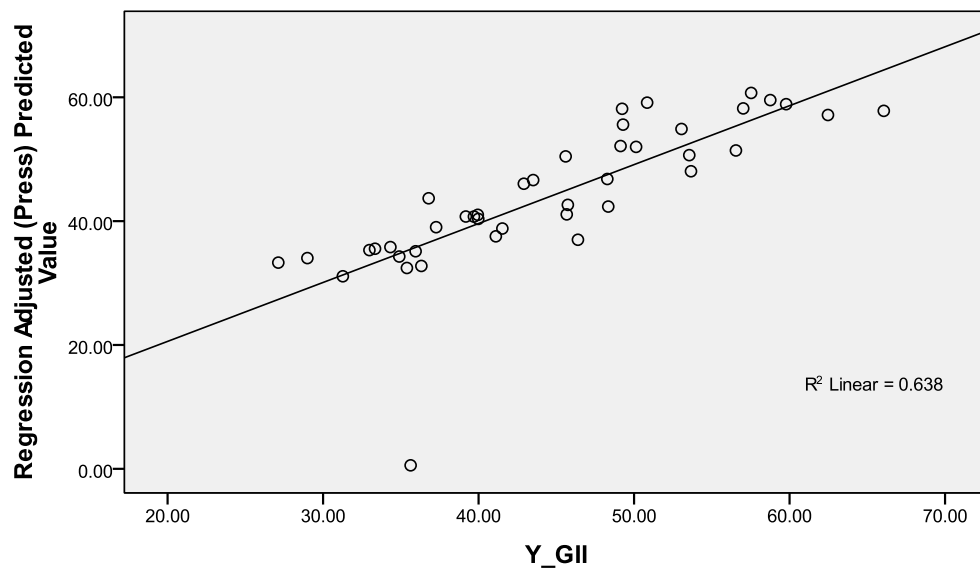


Figure 2. Dependence between recorded and predicted GII values

3.2. MODELING THE DEPENDENCE OF GII ON INPUT PARAMETERS (PREDICTORS) USING ANN_S

ANNs, usually simply called neural networks (NNs), are computing systems vaguely inspired by the biological neural networks that constitute animal brains (Chen et al., 2019). An ANNs is based on a collection of connected units or nodes called artificial neurons, which loosely model the neurons in a biological brain. Each connection, like the synapses in a biological brain, can transmit a signal to other neurons. An artificial neuron that receives a signal then processes it and can signal neurons connected to it. The "signal" at a connection is a real number, and the output of each neuron is computed by some non-linear function of the sum of its inputs. The connections are called edges. Neurons and edges typically have a weight that adjusts as learning proceeds. The weight increases or decreases the strength of the signal at a connection. Neurons may have a threshold such that a signal is sent only if the aggregate signal crosses that threshold. For more than twenty years, the ANNs methodology has stood out as a reliable tool for nonlinear modelling of the dependence of one or more dependent variables on a number of independent input parameters, especially in situations where conventional regression models become impractical or too complicated. ANNs approach is a computer modelling approach that learns from examples through iterations, without the need for prior knowledge of the relationships between the studied parameters. In this way ANNs can process indeterminate and disordered data as well as nonlinear dependencies (Dreyfus, 2005). Many studies publish the results of research on the impact of different parameters using ANNs on economic growth (Jahn, 2020; Kordanuli et al., 2017; Milačić et al., 2017; Stevanović et al., 2018). For modelling in this study, a single-layer ANNs' architecture showed in Figure 3 was used (Meradi et al., 2006).

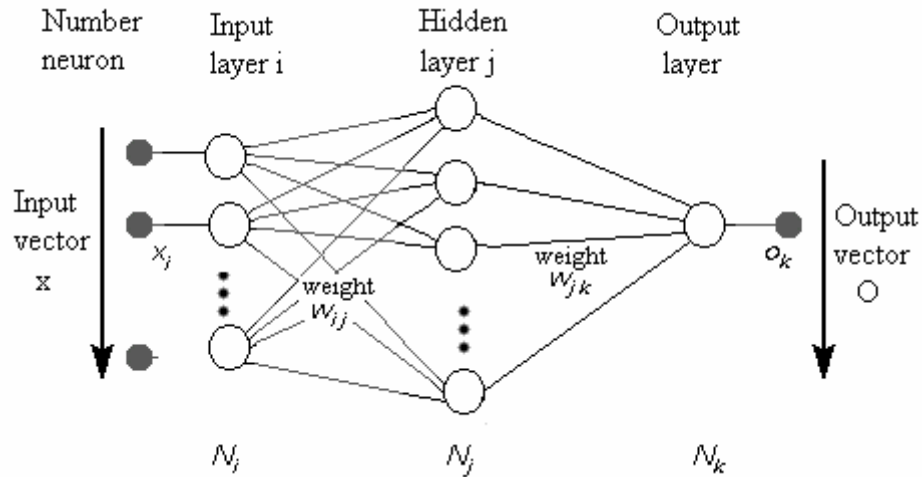


Figure 3. Architecture of a single-layer ANN (Meradi et al., 2006)

Typically, neurons are aggregated into layers. Different layers may perform different transformations on their inputs. Signals travel from the first layer (the input layer), through the one or more hidden layers, to the last layer (the output layer), possibly after traversing the layers multiple times. Each layer comprises one or more neurons, which are interconnected by using weight factors (Arsić et al., 2020).

The input for any neuron (j) in the hidden layer, without the appropriate bias is given by the expression:

$$I_j = \sum W_{ij}X_i \quad (3)$$

where: W_{ij} – weights of the interconnection between neurons i and j, and X_i – signal on the considered connection.

An important component of ANNs is its activation function, which appears behind the input layer. Each hidden and output node applies an activation function to its net input. To process the results in this paper, a hyperbolic tangent activation function was used for the hidden layer, and an identity activation function was used for the output layer. Hyperbolic tangent activation function is an alternative to sigmoid function and produces outputs in scale of $[-1, +1]$. In other words, the function produces output for every x value and has the form:

$$f(x) = \tanh(x) = \frac{(e^x - e^{-x})}{(e^x + e^{-x})} \quad (4)$$

Identity or linear activation function takes the inputs, multiplied by the weights for each neuron, and creates an output signal proportional to the input. It has the form:

$$f(x) = x \quad (5)$$

The general function of neuronal transfer is thus structured as:

$$O_j = A_j = f(\sum W_{ij}X_i) \quad (6)$$

In equation (6), O_j is the output of the neuron, A_j is its activation, and X_i is the input to the neuron in a hidden layer that is identical to the output of the previous neuron, with the index j of the observed element.

The goal of the ANNs learning process is to reduce overall network error:

$$E = \frac{1}{2} \sum (Y_j - O_j)^2 \quad (7)$$

where Y_j represents the target output value.

During the ANNs application process, a back propagation algorithm is used to modify the weight coefficients to minimize the mean square deviation between the network outputs obtained by modelling and the actual outputs of the considered model (Dreyfus, 2005). Back propagation uses supervised learning in which the network is trained with controlled input variables as well as with the desired output dependent variable (Eberhart & Dobbins, 2002).

The application of ANNs methodology usually consists of three phases: (1) correction of weight parameters through the required number of iterations until the error between the calculated and measured values is brought to a minimum, (2) testing – "network training" on the remaining 20–30% of the data when the network uses the calculated weight parameters from the learning phase, and (3) validation of the network performed on new data that have already been measured or will be measured, and assessment of network success or failure (Dreyfus, 2005). Performance evaluation is measured via $R^2_{\text{ANNs}} > R^2_{\text{MLRA}}$ data (Živković et al., 2009).

The initial database is divided into two parts. The first part of 81% of the data was used for the training phase and the second part (19%) for the ANNs testing phase. The ANN architecture used in this study to develop a model of the dependence of GII (Y) on independent parameters (X_1 – X_{10}) is shown in Figure 4. It consists of three layers: i (input layer), j (hidden layer), and k (output layer) with the number of neurons N_i , N_j , and N_k , respectively in each layer. The input variables in the model are called the input vector, and the output variable is called the output vector. In this case, the number of input variables is 10, and the number of variables in the output layer is 1. The number of neurons in the hidden layer was determined by training and testing several different ANNs with an iterative approach, changing the number of neurons (from 2 to 10) in the hidden layer and changing the hidden and output layer activation function, resulting in a minimum of prediction errors. The most optimal results were achieved with the ANNs architecture shown in Figure 4, with 4 neurons in the hidden layer. The relative error value in the training phase is 6.4%, while in the testing phase it is slightly higher and amounts to 14.2%. The obtained value of the coefficient of determination (R^2) in the testing phase of the network is 0.918, i.e. almost 92% of the variation in the dependent variable (Y) can be explained by the influence of the predictors X_1 – X_{10} .

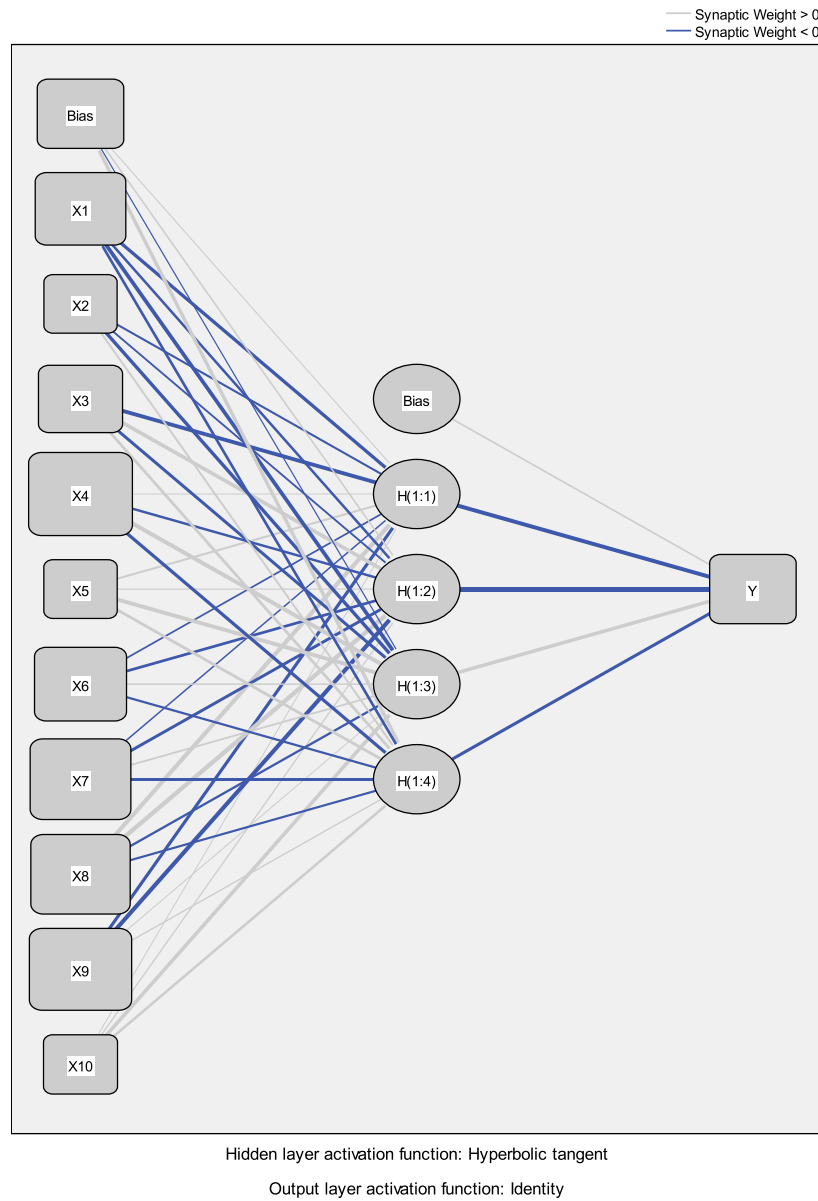


Figure 4. ANNs' architecture for modelling the dependence of GII (Y) on input parameters

Each neuron in the input layer is connected to all neurons in the hidden layer via weight coefficients W_{ij} , and neurons from the hidden layer are connected to neurons in the output layer via weight parameters W_{jk} (Meradi et al., 2006). Table 5 shows the calculated weight parameters for the considered ANNs architecture shown in Figure 4.

Table 5. Weight parameter estimates

<i>Predictor</i>		<i>Predicted</i>				
		Hidden Layer 1				Output Layer
		H(1:1)	H(1:2)	H(1:3)	H(1:4)	Y
Input Layer	(Bias)	0.029	0.151	-0.049	0.444	
	X ₁	-0.411	-0.310	-0.494	-0.323	
	X ₂	-0.213	-0.164	-0.414	0.187	
	X ₃	-0.499	0.491	-0.364	0.335	
	X ₄	0.005	-0.304	0.562	-0.410	
	X ₅	0.200	0.038	0.512	0.337	
	X ₆	-0.157	-0.332	0.101	-0.220	
	X ₇	-0.143	-0.351	0.159	-0.235	
	X ₈	0.701	0.811	-0.231	-0.215	
	X ₉	-0.388	-0.662	0.009	0.089	
	X ₁₀	0.003	0.068	0.488	0.319	
Hidden Layer 1	(Bias)					0.151
	H(1:1)					-0.517
	H(1:2)					-0.751
	H(1:3)					0.485
	H(1:4)					-0.387

In addition, an independent variable importance analysis was performed, which gives the results of sensitivity analysis, which computes the importance of each predictor in determining the neural network. Table 6 displays the importance and normalized importance for each predictor.

Table 6. Predictors' importance in determining the neural network

Variable	Importance	Normalized Importance
X ₁	0.106	61.8%
X ₂	0.020	11.5%
X ₃	0.074	43.1%
X ₄	0.172	100%
X ₅	0.021	12.1%
X ₆	0.113	66%
X ₇	0.156	91.1%
X ₈	0.150	87.2%
X ₉	0.164	95.6%
X ₁₀	0.024	14%

Figure 5 shows a comparative presentation of recorded and predicted GII values using the ANNs method.

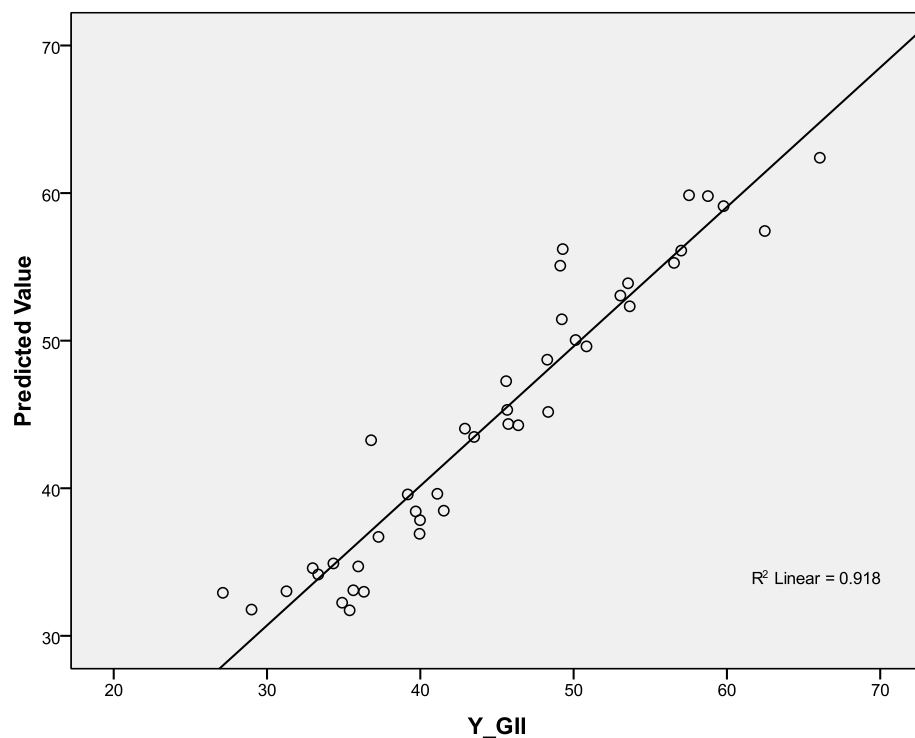


Figure 5. Comparative presentation of recorded and predicted GII values using ANNs

Comparing the results obtained using the ANNs method with the results obtained using the MLRA method, it can be concluded that better agreement was achieved using the ANNs methodology because of $R^2_{MLRA} (0.638) < R^2_{ANNs} (0.918)$. These results indicate that the data on defined predictors (X_1 – X_{10}) are more adequate for predicting GII values by a nonlinear ANNs model.

4. CONCLUSION

The obtained results of the assessment of the influence of individual predictors on the size of GII using MLRA and ANNs show that the proposed model via nonlinear ANNs is more reliable with a higher coefficient of determination (R^2).

Pearson correlation coefficients indicate a high degree of correlation between GII and X_2 , X_3 , X_4 , X_6 , X_9 , and X_{10} in the range 0.8–0.9 with correlation significant at the 0.01 level, while predictors X_1 , X_5 , and X_7 have a lower degree of correlation (0.7–0.8) with the same correlation level significant. Predictor X_8 (Number of universities on the ARWU list) has the lowest correlation with GII and is 0.209 with no statistical significance.

Based on the analysis of results in more than forty European countries, it was determined that, in addition to the seven predictors defined in the original model shown in Figure 1, the quality of education and science, the level of economic development and social relations have a significant impact on GII in the country.

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THE APPLICATION OF MANAGEMENT ACCOUNTING TOOLS IN HEALTHCARE ENTITIES

Aleksandra Szewieczek^{1*}

*¹University of Economics in Katowice, College of Finance, Department of Accounting,
1 Maja Street, 40-287 Katowice, Poland*

Abstract: Business conditions are becoming more and more complex and sophisticated. The process of creating financial and non-financial value also follows this line. As a result, information needs of the managers are growing. These needs are met primarily by appropriately adapted financial and non-financial reporting. At the same time, due to strong regulatory restrictions, management accounting becomes the most relevant in this area. Simultaneously the functional aspects of management accounting are different in different sectors. This also applies to health care sector. The main purpose of the study is the assessment of the possibility of using management accounting tools in healthcare entities and the indication of motivations that lead the management to utilize these tools. The study uses the following research methods: literature studies, case study and observation method, inference method and the methods of deduction and synthesis for formulating final conclusion. Empirical results leads to the conclusion that the utilization of management accounting tools in hospitals is low. The main reasons are: instability of law and organizational environment, fluctuation of management staff and weak competences, limited resources, company size and employees' attitude. It seems incomprehensible in the disadvantaged situation of the medical entities sector. It is also worrying, that these units spend a large part of public funds. This spending process should be under additional internal supervision assisted by the advanced management accounting tools.

Keywords: health care, management accounting, behavioral accounting, motivator, manager, hospital

1. INTRODUCTION

Accounting is a language of business. It is an information system which overriding goal is to generate relevant and useful information in the decision-making process. This process takes place in various environmental conditions, within the framework of various organisations and their goals. However, the most important feature is that the decision-making process, is carried out by an individual – the particular user of the information that was reported. Accounting as applied science develops as society and the economy grow. The manifestation of this is its reorientation from the initial focus on financial data mainly on the purpose of reporting, towards presenting various financial and non-financial data, as well as integration with management accounting (Brandau et al., 2017), aimed at their adoption by various user groups. Healthcare units are a special, though certainly not the only, example of slightly

*Corresponding author: aleksandra.szewieczek@ue.katowice.pl

different organisations in this area. The difference is so determined not only by the purpose of their operation, but also by the organisational and financial conditions within which they operate. Therefore, the management accounting aspects of these entities are unique. What is very important, it is very difficult to understand hospital behaviours with respect to management accounting design and outcomes (Eldenburg et al., 2017), mainly because of the presence of the contextual variables (Pizzini, 2006; Hammad, et al., 2010). The assessment of the possibility of using management accounting tools in healthcare entities and the indication of motivations that lead the management in this area were adopted as a goal of the paper. The author belief that the research results will contribute to the research in the field of cost accounting and management accounting for health care (Cardinaels et al., 2004; Carrol & Lord, 2016; Labro & Stice-Lawrence, 2020).

The presented research results are based on the literature studies, observation method as well as the method of deduction, inference method and synthesis for formulating final conclusions.

2. CHARACTERISTICS OF HEALTHCARE ENTITIES AND CONDITIONS OF THEIR FUNCTIONING ON THE EXAMPLE OF POLAND

Medical care is an element of health care. Medical care is provided by various healthcare units. These are the entities whose main goal is to save, restore, improve and preserve the health and lives of people. Their activities satisfy one of the basic social needs. The provision of health services is a social good, largely a public good, while universal and equal access to health services is guaranteed in most developed and developing countries around the world. The same is true in Poland. The role of medicine is growing, because together with social and economic development, improving living environment conditions and education (Włodarczyk, 2010) public awareness and expectations, social needs in the area of health care are increasing, and certainly boundlessness is their attribute.

Healthcare entities operate as public and commercial entities. Among these entities, the dominant position in terms of the range and specialization of activity is occupied by hospitals (general hospitals: 956 in 2016), in terms of numbers by health clinics and medical practices of various kinds (basic health care and specialist care, in total about 26,000). Of course, apart from these two basic types of healthcare units, there are also other (research institutes, entities involved in health promotion, rehabilitation centres, terminal care and other long-term care centres, and others). In this respect, there is a diverse typology of healthcare units.

In Poland, an insurance system has been brought to finance health services in the last 20 years. Most of the health services (the hospital services mostly) are financed from public funds collected by the National Health Fund (NHF) in the form of compulsory contributions from insured persons. Private funds of patients and employers paid directly to medical entities or by voluntary health insurance are the supplementary source of financing (Szewieczek, 2011). Funds collected by NHF are redistributed in a twofold form (figure 1) – lump sums (variation of a block contract) are directed to hospitals located in the so-called hospital networks, obliged to carry out a set of defined health services and in the form of contractual agreements, under which the payment is made to hospitals or other entities, for the provision of a specific type of health service (fee for service/case mix, capitation).

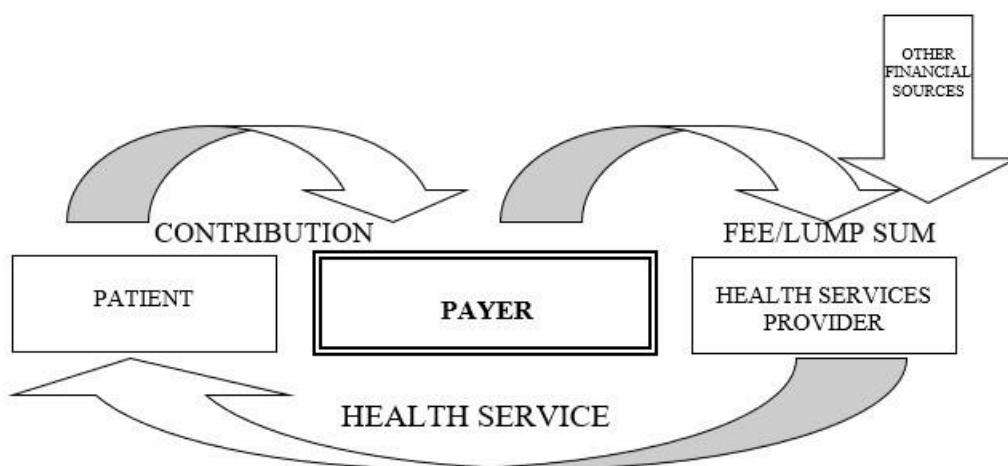


Figure 1. The process of financing health services in the health insurance system
(based on: Szewieczek, 2011).

The level of financing health care in Poland is much lower than in most OECD countries. Total expenditure on health care in Poland is about 6.34% of GDP (2015), and per capita USD 1,798 (in 2015), while the average in OECD countries was USD 4,004 (OECD, 2015).

The low level of financing health care directly translates into financial problems in healthcare units. This is particularly evident among public hospitals, which largely generate negative financial results, have problems with financial liquidity and increasing indebtedness, as well as related debt servicing costs. This situation has further exacerbated in recent years (Magellan, 2017). Considering the relative rigidity of the sources of financing their activities, the hospital management staff must look for alternative ways to increase the efficiency of management, which requires the use of different supporting tools.

3. MANAGEMENT ACCOUNTING TOOLS AND MOTIVATIONS FOR THEIR SELECTION BY THE MANAGEMENT

The development of management (managerial) accounting was preceded by the advancement of financial accounting first and then by the cost accounting. These stages, focused mainly on the reporting function, but in increasingly complex operating conditions, they proved to be insufficient. As a result, apart from financial accounting, its second, clearly distinct branch, management accounting started to develop. This part of accounting system is the most important and useful source of an organization (Sharma et. al., 2006).

Management (managerial) accounting „is a profession that involves partnering in management decision making, devising planning and performance management systems, and providing expertise in financial reporting and control to assist management in the formulation and implementation of an organization's strategy” (IMA, 2008). Davis and Davis (2011) stressed, that „managerial accounting is the generation and analysis of relevant information to support managers' strategic decision-making activities”. In this definition, particular attention should be paid to the issue of the decision-making usefulness of the presented information, which should improve the efficiency and effectiveness of decisions made by managers, and therefore generate value. What is common for both of the above presented views is undisputed fact of using management accounting (MA) for the management of the entity.

The evolution of management accounting continues. After the initial period of focus on the cost area mainly (period up to 1950), the interests were directed to earnings management techniques, performance measurement, non-financial aspects of operating, intellectual capital and creating value for different stakeholders, performance management (Nita, 2009). In Poland, due to historical and systemic issues, the development of management accounting lags behind other leading countries in this field. Sobańska (2016) indicates the year 1990, as particularly important in the development of management accounting sub-discipline in science and practice, as well as the creation of a new profession of a controller/specialist in management accounting.

Management accounting uses many methods and tools. In contrast to financial accounting, there is a lack of mandated principles and time limits, deadlines or other reporting requirements. And above all, it is aimed at internal users (managers). This system has no uniform structure, and consequently is not uniformly perceived by researchers (Piosik, 2006; Sestanj-Peric et. al., 2012; Sobańska, 2016). However, one can indicate three basic pillars of management accounting (Piosik, 2006):

- cost accounting structures and systems,
- analyses and tools supporting operational management, and
- analyses and tools supporting strategic management.

As part of management accounting, the following techniques/tools can be listed (this is not a closed catalogue):

- Variable and Absorption Costing,
- Standard Costing,
- Cost-Volume-Profit (CVP) analysis,
- Throughput Accounting,
- Activity Based Costing and Activity Based Management,
- Target Costing,
- Budgeting (strategic and operational) and Budgetary Control,
- Balance Scorecard,
- Lean Management Accounting.

The application of the management accounting system in the enterprise may be carried out partially (in selected areas), or as a whole, as a system supporting the management of the entity, with a strong position and role, through a clear separation in the organisational structure of the enterprise. The design of the management accounting system in the entity should proceed in stages (Figure 2).

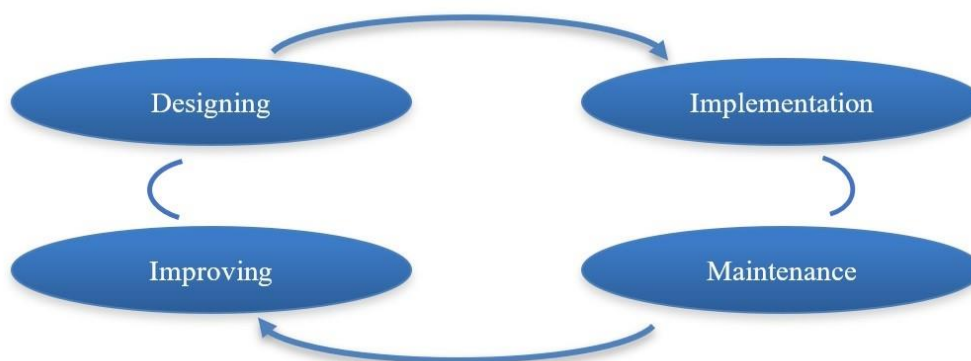


Figure 2. Development and functioning of management accounting system (Nita, 2009).

After the initial stage of proper preparation and description of the concept of this system, it is launched, followed by the widespread and full functioning. It is also necessary to carry out permanent facilitation and improvement works in response to the changing conditions of the entity's functioning and, as a result, the requirements of the management accounting.

Considering management accounting as an internal system supporting managers, it is necessary to look for motivators of its application for this group of people. Behavioural aspects in the management group have a significant impact not only on taking action or abandoning it, but also on its effectiveness. They determine certain motivations and behaviours. In the study of personality traits, the use of the five-factor Personal Characteristics Model (PMO) was adopted, within which Costa and McCrae distinguished (Kaczmarek, 2014):

- neuroticism, shaping the level of anxiety, anger, feelings of guilt and shame as well as sensitivity to stress and impulsiveness in action,
- extraversion, associated with the energetic action, seeking an additional stimulant, cordiality, communicativeness and openness in contacts with the tendency to dominate,
- openness to experience, expressing curiosity and seeking new experiences, also unconventional solutions in the field of emotions, ideas, impressions, moral values,
- agreeableness, influencing the tendency to cooperate, accept other views, empathy level, modesty and honesty, positive attitude,
- conscientiousness, connected with the sense of own competence, perseverance, prudence, pursuing the goal and orderliness.

Research into personality traits in the context of management sciences has been intensifying in recent years, which is the result of increased interest in behavioural aspects, first in finance, and subsequently in accounting. In the study of behavioural aspects, apart from personality traits, other areas can also be indicated:

- personality types,
- gender issues,
- other reasons.

Jaworska (2014) indicates that the theories of psychology of motivation explain human behaviour from the perspective of what motivates them and why they are motivated. She emphasizes the important role of aspirations and pursuing accepted goals in the motivating process, as well as tendency to behave in accordance with accepted expectations, and the tendency to compare with other people in similar positions (organisational justice theory). She also indicates the aspects related to cognitive dissonance, including the issue of ethics in behavior.

Sulik-Górecka and Strojek-Filus (2107) among the significant traits of the management staff (as well as other groups of people) influencing the accounting solutions indicated:

- professional qualifications and experience,
- behavioral traits,
- personal interests (f.e. conditions of management contract),
- ethical attitude,
- subordination to other factors, f.e. legislative processes, internal and external audit, type and size of a company, availability of resources, qualifications of accounting staff.

Background in economics and knowledge of advanced management techniques are important factors in the implementation of modern tools supporting this process. Management accounting and the use of applications generated in this system requires slightly wider knowledge of economics, and what results from the lack of such education and experience can be an important factor limiting the degree of implementation. It is worth mentioning the principle that the information presented is to be relevant, and at the same time the person using it must have the ability to use it. While considering the personality traits that drive the

management accounting tools, it is certainly worth pointing to the skill of analytical and multi-directional thinking, because management information is often presented at random but with a strong contextual setting. Risk propensity and entrepreneurship are also important. Personality traits, as shown by research, also have an impact on the results (indicators) of the conducted activity.

The conditions of employment, and often their dependence on effective restructuring, and the implementation of financial objectives are an important factor favouring the implementation of tools supporting the decision-making process, although the horizon of implementation of these conditions is also important, as full implementation of management accounting requires time and stability of the managerial staff.

Attitude to ethical issues is equally important, because analytical tools of management accounting allow for in-depth analyses of specific areas of activity, and consequently easier linking them with responsibility and its enforcement.

Other important factors are, in whole or in part, independent (mainly within a short period of time) of the management, but at the same time affect its motives in the implementation of management accounting. It is possible to mention here the lack of appropriate resources, external regulations (e.g. the recommendation of the founding body), or employees' attitude.

4. THE ADOPTION OF MANAGEMENT ACCOUNTING IN HEALTHCARE UNITS – EMPIRICAL STUDY RESULTS

Taking into account the financial difficulties of healthcare entities and the objectives of management control, as well as the current development of applied computational techniques, tools supporting current and strategic management, and the complexity of operational processes, it seems indisputable and obvious that management accounting has its place in these entities.

An important step on the way to management accounting development was not only systemic transformation in Poland, change of the model of financing health services and organisation of healthcare entities, but also introduction of DRG (Diagnosis Related Groups) as a method of health services financing. The next stage of support was the reform of the public finance sector towards the implementation of the New Public Management idea, which was reflected in the form of introducing a specific (public form of) management control system (Fatemi & Behmanesh, 2012; Szewieczek, 2015). Although the indicated management control is focused on the supervision the effectiveness and efficiency of activities carried out by subordinate entities of the public finance sector, it contains elements close to management accounting, such as performance indicators, risk analysis, setting goals and tasks.

The mentioned premises allow to indicate important elements in the current management process of healthcare entities (mainly public), determining and encouraging the use of management accounting tools:

- defined mission and strategy,
- goals, tasks and measures of their implementation are developed and monitored,
- financial plans in public hospitals, at the level of the entire hospital (required by legal regulations),
- internal reports – mainly about the medical nature,
- external reports – financial and non-financial, including for founding bodies,
- adoption of specialised software for cost accounting.

The place of management accounting in the organisational structure of the healthcare entity should not be accidental. As indicated by Sobańska (2016) management accounting is not a 'toolbox' available to various specialists. The profession of accountant for management accounting should be clearly distinguished, because it requires specialist knowledge and skills

as well as gains recognition and interest (Davis & Davis, 2011). This profession develops from the area of standardised reports into the interpretative field, non-standard reports and involved in decision-making processes. Some researchers indicate that more detailed accounting system and its organization is positively related to company size (Haldma & Laats, 2002). There is also evidence that for-profit organizations use practices that encourage managers to use accounting information to improve performance (Eldenburg & Krishnan, 2008).

The empirical part of the research focused on the assessment of management accounting processes in four randomly selected hospitals of various sizes and with various forms of ownership, with a majority of public holding. Each of the examined hospitals is multi-profile, which additionally contributes to the complexity of day-to-day management. The study was to verify the separation of the management accounting or controlling (these names are often used interchangeably) area in the entity and the tasks they implement, the cost accounting system used, the scope of managerial reporting, the valuation of medical procedures and the use of management accounting tools, as well as support for this process through IT resources (Table 1). This part of the study was mainly carried out using the methods of observation, deduction and inference method. The observation method was based on particular case studies (hospitals) and accounting and management systems and processes that were observed by the author while working daily.

Table 1. Scale of management accounting utilization in selected health care entities (own study).

Hospital	Type of ownership	Organization of a management accounting system	Management accounting tools used	Type of cost accounting systems used	The range of internal reporting (managerial)
Hospital K	Public	Separate organizational unit	Medical services cost valuation; Cost based pricing and market based pricing	Cost accounting for managerial purposes based on absorption costing	Medical information; Selected financial information
Hospital E	Private	None	Generally none; Periodic medical costs valuation for external users needs (without IT support)	Cost accounting for management decision based on absorption costing; lack of cost calculation within organizational units	Medical information
Hospital W	Public	None	Partial medical services cost valuation; Market based pricing	Cost accounting for managerial purposes based on absorption costing	Medical information; Selected (rarely) financial information
Hospital R	Public	Separate organizational unit	Medical and other important services cost valuation; Incremental budgeting; Variable Costing (partly); Cost based pricing	Cost accounting for managerial purposes based on absorption costing and partially on variable costing	Medical information; Financial information, also connected with budget utilization

In the examined hospitals, a dual reporting system clearly stands out in the following areas:

- medical,
- non-medical.

As part of medical reporting, periodic and routine reports are prepared but also ad hoc reports on demand are drawn up on topics closely related to medical activities. These reports usually concern information about bed occupation, average length of stay, the number of patients admitted, drug and medical equipment utilization, the quantity and cost of medical consultations, staffing on duty, the number of surgical procedures carried out, and the number of drugs administered when they are separately accounted for. Medical reports are presented mainly (with some exceptions) in the form of natural units other than cash. The source of these reports is in every case units/positions/people in the area of medical statistics or similar (e.g. medical secretaries, pharmacy, etc.). This attribute clearly differentiates this area from non-medical reporting. Non-medical reports can be clearly divided into financial and non-financial, with the predominance of the former.

What is surprising is the fact of the low use of management accounting mechanisms. Only one of the surveyed hospitals uses budgeting of organisational units combined with ongoing monitoring, for which it allocates fixed and variable costs (accounting method). At this point, it should also be noted that Hospital W and R are generating losses, while Hospital W does not even practically apply the calculation of medical procedures (only selected, and their update is significantly delayed), and their prices are based on market prices. It should also be noted that in each public hospital there is a base to introduce budgeting, based on annual financial plans drawn up for the entire hospital, required by legal regulations. They are also obliged to monitor these plans on an ongoing basis.

The study shows very low applicability of management accounting mechanisms, which seems incomprehensible in the disadvantaged situation of the medical entities sector, all the more so because every public hospital had adequate IT support to implement it. The exception is a private hospital in this group, which does not have such resources.

Poor adoption of management accounting in the examined hospitals is also confirmed by the results of other studies. It turns out that already at the level of using basic tools of cost accounting, the degree of implementation of more advanced techniques is small (Pielaszek, 2016). For example, in the Lubelskie Province, only less than 60% of the group of surveyed entities calculated the unit costs of patient treatment, and in this group slightly more than 1/3 of hospitals departed from the average cost for specific items according to the ICD-9 classification. Only less than 40% of the surveyed group valued medical procedures (Jaworzyńska, 2013).

However, it is important to emphasize that the context and circumstances, in which the actions are undertaken, are important for explaining human behaviour (Jaworska, 2014). Taking into account this fact, as well as the traits presented above, indicated by Sulik-Górecka and Strojek-Filus (2017) it is possible to further study managers in charge of managing the examined entities. Among the surveyed entities, the majority of managers are (or were) people with the main medical education (usually physicians), which does not exclude the supplementation with specialist courses in economics. On the other hand, a negative phenomenon is significant fluctuation on management positions in the public sphere. Of the three public hospitals, only one has long-term employment as a managing director, in the other two in the last 10 years the changes in that position have occurred at least several times. This instability is a significant limitation to the implementation of management accounting, which, as indicated, requires a longer period of time.

Bearing in mind the specific nature of healthcare entities, it is also necessary to emphasize the resistance of medical staff to mutual cooperation existing in these entities. The full implementation of the MA requires the integration of this sphere with the administrative sphere, while excessive bureaucracy and the burden of medical staff with additional, non-medical duties, is already a fact.

An additional limitation is the lack of sufficient resources, both qualified personnel, due to the low level of earnings, as well as the staff available at all (poor financial condition of health service is conducive to employment reduction).

5. CONCLUSIONS

The healthcare sector consumes huge financial resources, both public and private, and meanwhile, it turns out that the entities that use these funds do not adopt specialized and advanced tools to use them efficiently and effectively. This allows to conclude that the reasons for the poor financial condition of this sector do not only lie in the insufficient sources of its financing (Szewieczek & Lisicki, 2019; Szewieczek, 2021), but also in the organisation and management of these entities. It turns out, therefore, that motivators of management staff of medical entities are not strong enough to support these implementations, or, on the contrary, they make it difficult.

The main obstacles to the implementation of MA in healthcare units are:

- instability of the legal and organisational environment (mainly in the area of financing sources),
- large fluctuation to the positions of the management staff of healthcare entities,
- limited financial, human and IT resources,
- inadequate competences of the management and lower-level specialists,
- scale of operation (company size^{**}),
- difficulty in cooperation between the medical and non-medical spheres,
- employees' attitude, unwillingness to change and introduction of new duties.

Management accounting can be successfully applied in smaller entities; it can also be adopted for less complex scope and tools. In smaller entities one can focus on the operational sphere of management and use variance analysis and reporting, planning and cost accounting (Sestanji-Peric & Kušec, 2012).

Undoubtedly, it is essential to fully apply the full and reliable cost accounting, valuation of health services and budgeting in the cross-section of organisational units (primarily medical) in entities that consume public funds.

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^{**} The author's experience indicates that in larger healthcare entities the situation is not undergoing a sea-change, which is also apparent in the research, as the hospital R belonged to a group of large entities.

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THE DUAL ROLE OF MANAGERS AS AN OBJECT AND SUBJECT OF INFLUENCE

Emil Kotsev*

University of Ruse, Bulgaria

Abstract: The report examines the dual role of managers as leaders and followers. An underestimated aspect of managers' work is discussed – their activity as executors of decisions made by a superior. The term "inferior manager" is defined and the thesis is defended that besides the object of influence managers can also be the subject of influence. The results of an international survey of 15 English and 49 Bulgarian managers are presented and their leadership-followership attitudes are compared. The report discusses several hypotheses about the observed differences. It is concluded that inferior managers have to choose style alternatives that correspond to the peculiarities of the managerial subordination and influence the superior in a way that best satisfies the interests of the company. On this basis, three main groups of factors that determine inferior managers' direction of influence have been identified: inferior-related factors, superior-related factors, and situational factors. Guidelines for future research are proposed.

Keywords: inferior manager, upward influence, superior, subordinate, followership

1. INTRODUCTION

Regardless of whether they are managers or regular performers, subordinates have the potential to influence their superiors. Experts have already reached a consensus on this issue. As early as the 1970s, Smith and Wakley (1992) considered three types of subordinates: constructive, destructive, and routine. According to them, only the routine subordinate "duly obeys orders and does not try to influence his boss or colleagues, but is much less common than many think." Gabarro and Cotter (1980) later wrote that effective managers "need to establish and manage relationships with everyone on whom they depend – and that includes the boss". They place superior-subordinate relationships at the core of organizational effectiveness. According to them, only bilateral, targeted actions to maintain these relations can provide better organizational performance.

Despite the existence of such concepts, Peter Drucker (1997) claims that management textbooks and courses abound with advice on how to manage subordinates, but few, if any, barely mention how to manage the boss. To many professionals, the possibility of a boss being managed by subordinates seems either too revolutionary or not serious enough. In fact, the reverse link "subordinate-superior" and in particular its heterogeneity is poorly studied, and the relevant problems remain downplayed and therefore unsolved. It is clear that subordinates need

* Corresponding author: ekotsev@uni-ruse.bg

to be taken out of the framework of their assigned passive role and to be acquainted with some heuristic models of their behavior and style.

The improvement of subordinate-superior relationships can effectively combine the strong power and awareness of the leader with the specific knowledge and pragmatism of the subordinate. This partnership has the potential to improve the results of their joint and individual efforts but requires the active engagement of both parties. A good example of active involvement could be a subordinate's behavior, which leads to increased motivation of the superior. It is most often assumed that the responsibility for the motivation in the organization lies primarily with the leader, and the role of others in this regard is reduced to finding and building mechanisms for self-motivation. Usually out of sight is the opportunity of contact with highly motivated subordinates to lead to a synergistic effect, expressed in increased motivation on both sides. This opportunity becomes a reality when subordinates are also leaders and are well aware of the importance of motivation in achieving organizational goals.

Similar examples can be given for other activities related to the management function. The influence of subordinates can be decisive in solving problems and decision-making, in managing change and conflict, in improving teamwork, and using informal groups to optimize organizational performance. On this basis, Drucker's (1997) statement that "the management of the boss is the responsibility of the subordinate manager and the key – perhaps the most important! – to his or her effectiveness as a senior executive" sounds quite relevant.

In management theory and practice, an invariable element as an object of influence is the subordinate. Accordingly, the manager is primarily considered as a subject of influence directed at the immediate down-level employee. The interpretation of the manager as a subject of influence directed at the superior is necessitated mainly by the need to meet the new requirements of modern management. The development of subordinate behavior models responds to existing needs, increasingly realized and perceived by managers. Many of them are capable as leaders but incompetent as subordinates.

The paper aims to shed some light on this lesser-known side of managerial work by trying to answer the following questions: Are the managers ready to accept that they can (and sometimes should) influence the superior and what factors determine this influence?

2. MATERIAL AND METHOD

The survey was conducted among 15 English and 49 Bulgarian managers during management training courses they attended. Participants from the UK were first-line managers from various industries, while Bulgarian participants were middle and lower-level managers from five garment companies (three large and two middle-sized). The UK participant demographics included: 11 (73.3%) females, average age of 29.15 (SD = 4.05) and 3.08 (SD = 4.89) average years of managerial experience. The BG participant demographics were as follows: 42 (85.7%) females, average age of 41.11 (SD = 9.26), and 15.83 (SD = 9.69) average years of managerial experience

The subject of the study were individual beliefs, attitudes, and preferences that allow the prediction of managers' behavior (Ali & Schaup, 1992). Three conventional research tools were used to collect and process the information: questionnaire, interview, and content analysis.

The questionnaire was completed by all 64 participants in the study. It was made up of twelve questions with two statements in each. Respondents had to assign a score from 0-10 to each statement to show how strongly they agree ("0" indicating strong disagreement and "10" – strong agreement). The points assigned for each pair had to total ten.

The first part of the questionnaire included 10 pairs of statements rated by the managers in regards to whether they preferred a Theory X or a Theory Y mode of thinking (a tool already used by Little, 2005 and Hunsaker, 2005). The gravity of the result to 0 testifies to the belief of the studied object that people are lazy and need constant control (Theory X assumptions). As the result approaches 100, the opposite view gradually prevails – that people see work as an opportunity to express themselves and take responsibility (Theory Y assumptions).

The second part consisted of two pairs of statements (Table 1). The first pair measured the psychological readiness of managers (whether they wish or not) to influence their superiors, while the second referred to their physical readiness (whether they assume they can). Due to a need of compatibility with the first part of the questionnaire, the scores were multiplied by 10.

Table 1. Readiness to influence the superior questionnaire

<i>Statement</i>	<i>Score</i>
(a) If you think the superior's decision is wrong, you look for a way to change it, because the responsibility for solving the problem is mutual.
(b) If you think that the superior's decision is wrong, you prefer not to interfere, because the responsibility for the decisions made lies with the superior. (10)
(c) My resources as a subordinate are not sufficient for me to influence my superior.
(d) Despite my limited resources as a subordinate, I can always find a way to influence my superior. (10)

Interviews were conducted with all Bulgarian managers. The opinions and positions expressed by the interviewees confirmed their answers in the questionnaire.

3. THEORY

For a long time, leadership research has been focusing on leaders and neglecting followers. Leader-centric theories and approaches have been emerging one after another. As a balancing response, at the end of the XX century, follower-centric theories have begun to arise. Among them, the Implicit Leadership Theories (Eden & Leviatan, 1975; Rush et al., 1977), the Leader-Member Exchange Theory (Dansereau et al., 1975; Graen et al., 1982), and the Courageous Follower Concept (Chaleff, 1995) became most popular. A common feature of all of them is that they recognize the role of the subordinate and the importance of superior-subordinate relations. According to Baird & Kram (1983), if people carefully analyze and understand the needs of their bosses and subordinates, as well as their own needs, they will be in a much better position to take advantage of superior-subordinate relationships. Knowing the needs of others enables the manager to exert interpersonal influence on them, both downward and (sometimes) upward.

Interpersonal influence is a critical element in most organizations (Ansari & Kapoor, 1987; Farmer et al., 1997). It is not a surprise that most researchers consider downward influence as the basis of managerial activity (Deluga, 1990; Higgins et al., 2003; Seifert & Yukl, 2010). Thus a lot of studies concentrate on the role of the subordinate as an object of influence (Bass, 2008; McColl-Kennedy & Anderson, 2002; Cheng et al., 2004, etc.) and transfer responsibility for managers' performance entirely to their superiors (Longenecker, 1991). Some

attempts to view the subordinate as a subject of influence have been made (Ferris et al., 1994; Ehrhart & Klein, 2001), but they have not been widely acknowledged. Influencing higher-level managers in an upward direction has been relatively recently recognized as an essential ingredient of managerial success (Singh, 1998).

Upward influence has been defined as the attempt “to influence someone higher in the formal hierarchy or authority in the organization” (Porter et al., 1983). Most often the majority of these attempts are directed at immediate superiors (Kipnis et al., 1980) and are usually aimed at obtaining assistance or resources from them (Yukl et al., 1995).

Managers can be both, a subject and an object of influence (Downs & Conrad, 1982) because they belong to two teams: the team of the superiors and the team of the subordinates. This is actual for all management levels (even CEOs have to report to a board of directors). Managers switch their roles all the time: they are bosses one moment and subordinates the next (Bhawuk & Ferris, 2000). And obviously, as bosses managers are more distinguishable and interesting for most observers. As Laurent (1978) puts it, “Every manager a subordinate” probably is less attractive as a slogan than the more glamorous Myers’ (1970) book title “Every Employee a Manager”.

This partly explains the limited attention that has been paid to managers’ upward influence and the short supply of suggested upward influence tactics (e.g. Kipnis et al., 1980; Schriesheim & Hinkin, 1990). Another reason for the limited research on the role of managers as subordinates could be hidden in its contradictory and heterogeneous nature. The perception of their active role in the management process at first glance contradicts the understanding that subordinates (regardless of their position) are passive executors of decisions made by others. However, managers are not regular executors – they usually organize the implementation process and are responsible for the final results.

Downs & Conrad (1982) and Laurent (1978) are among the few who have found in the manager as a subordinate both an object and a subject of influence. Neglect and underestimation of the issue are unjustified not only from the point of view of organizational efficiency and effectiveness, but also from the point of view of the managers themselves: successful influence attempts are associated with increased earnings, rapid advancement, and improved confidence and encourage managers to become more active in trying to influence superiors (Case et al., 1988).

It is not yet clear to what extent managers are aware of and able to combine the two roles. The situation is further complicated by the fact that they are objects and subjects of influence for their superiors, but at the same time, they are also objects and subjects of influence for their subordinates. The importance of context for understanding managers and their influence has been a focus of prior research (Vecchio & Sissman, 1991; Johns, 2006). However, there is not enough data (at least to my knowledge) to determine whether psychologically and physically managers are ready for such a “dual role challenge”. The existing descriptions of the factors that affect the direction and strength of their influence are also incomplete. Some experts point out broader contextual factors (Siegall & Gardner, 2000), others accentuate on trust (Brower et al., 2009), leadership style (Epitropaki & Martin, 2013), followers’ personality (Ehrhart & Klein, 2001; Liborius, 2014) and subordinate attitude in particular (Jung et al., 2009) or work style fit (Bayl-Smith & Griffin, 2018).

This report makes a modest attempt to systematize the existing views and to suggest a comprehensive perspective of the interaction of the factors that influence the style of the manager as an object and subject of influence.

4. RESULTS AND DISCUSSION

All managers participating in the survey were inferior managers – most of them first-line managers and a few middle managers. For the needs of this study, an inferior manager can be defined as any employee who performs managerial tasks and is responsible for the results of his or her work to a superior member or body. The exercise of power over other individuals is not a must (Mullins, 1993) – for example, in some companies, the public relations manager is the only member of that department.

After processing the data the following significant differences were obtained (Figure 1):

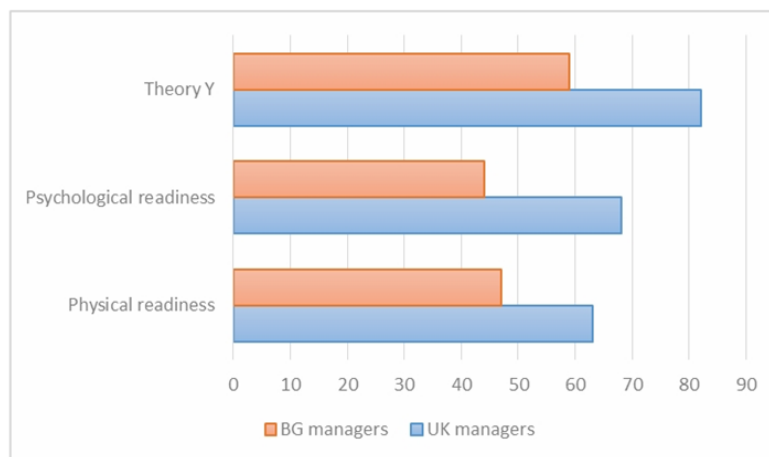


Figure 1. Survey results

In general, all respondents turned out to be adherents of Theory Y. This was much more clearly expressed by the UK managers, while Bulgarians showed a moderate bias (82 vs 59). The UK inferior managers also manifested a relatively high readiness to influence the superior – their average score in the dimension Psychological readiness was 68 (versus 44 of BG managers) and 63 (versus 47) in the dimension Physical readiness. In other words, UK managers stated their strong belief that people are generally responsible and do not need to be controlled all the time. In addition, they announced greater willingness and potential to influence their superiors compared to their Bulgarian counterparts.

These differences can be interpreted in many ways, but two things need to be explicitly noted here. First, the relatively low trust of Bulgarian managers in people. This gives ground for a reasonable assumption that most of them have a feeble inclination for delegation in their work. At the same time, they, as subordinates, face a similar attitude on the part of their superiors, which can find expression in reduced management effectiveness throughout the whole hierarchy. Second, Bulgarian managers do not think they have enough resources to influence a superior (47), but even if they had the necessary resources, they would hardly use them – they lack the desire to do so (44). Thus, some wrong decisions can be implemented with unpleasant consequences for the organization.

The general principles of subordination provide a favorable opportunity for inferior managers to see the world through the eyes of a subordinate and a superior simultaneously. Their dualistic position presupposes, if not equal, then at least a corresponding distribution of time, resources, and creativity. Moreover, the dual role allows inferior managers to use their experience as subordinates to increase their effectiveness as superiors, and to apply their experience as superiors to increase their efficiency as subordinates.

In this respect, Bulgarian managers demonstrate low interest and a deficit of desire for self-improvement. Successful management and development of any business require not only knowledge but also adequate skills for working with people. For example, teamwork requires awareness and application of different behavioral patterns. Effective teamwork is possible only if subordinates freely express their opinions, participate in decision-making, and take responsibility. Actually, this is a recognition of the qualities of the subordinate (often called an associate) and testifies to the existence of a certain influence of the subordinate on the superior.

The specifics of the educational system in Bulgaria suggest a certain underestimation of the importance of skills and focusing mainly on the acquisition of knowledge. In reality, however, even in the first years of their careers, management graduates need not only technical but also interpersonal skills. Lack of skills expected by the corporates can be crucial for youth professional development and future career. Skill shortages can complicate the subordinate-superior relationships and make it almost impossible to apply the teamwork principle. As a result, a tendency appears to downplay the subordinate's role and overestimate the superior's.

The roots of this situation can be traced to the traditional notion of Bulgarian managers about subordinates' behavior. During totalitarian times, subordinates' purpose was not only to cope with the tasks and improve organizational performance but also to win the favor of the boss. Central to their arsenal of means to achieve it was servility. Inferior managers in state-owned enterprises (in fact, all enterprises were state-owned) had developed this quality perfectly, as their career depended to a large extent on the superior. Subsequent political and economic changes have imposed new requirements on managerial behavior. Constantly accepting the opinion and satisfying the desires of the superior is no longer enough to please her. Currently, private company owners need managers with fresh ideas and adequate skills to implement them. The comfortable subordinates from the past who have always taken the form that was convenient for the boss are no longer admired. Survey results indicate that many inferior managers still cannot throw away the old notions and find it difficult to perceive the self-thinking concept and the need to influence superior's decisions and actions.

To meet today's challenges, it is not enough for inferior managers to be ready (physically and psychologically) to influence a superior. They must be able to decide when and how to do so while keeping in mind their management responsibilities towards their own subordinates. Present-day managers must be able to choose among the many style alternatives those that correspond to both the interests of the company and the characteristics of managerial subordination in both directions – upwards and downwards. To do this, they need to be aware of the factors that affect their leadership and followership styles.

Since a lot has been written on leadership styles, here I prefer to focus on the style of the manager as a follower. Some analyses made in the field of leadership can serve as a starting point for reflection. For example, Tannenbaum and Schmidt (1973) distinguish three main groups of factors (they call them forces) that a manager should consider in deciding how to lead: forces in the manager, forces in the subordinates, and forces in the situation. A similar grouping can be done to the factors that influence the style of the inferior. The interrelationships of superior/inferior styles and the influencing factors are shown in Figure. 2.

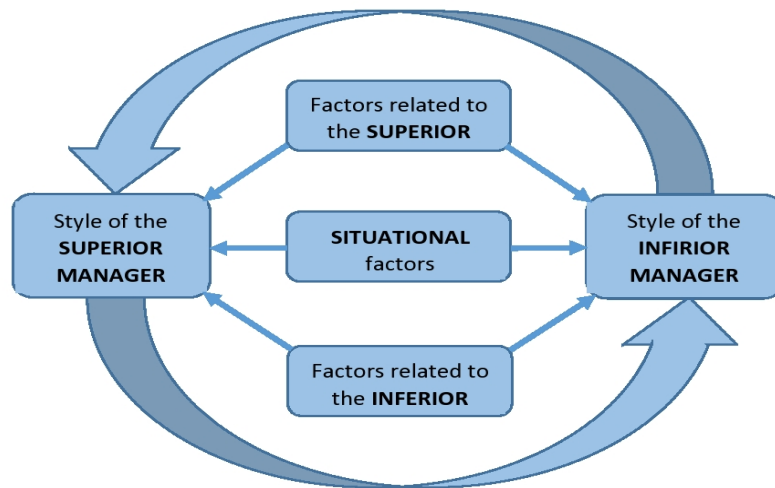


Figure 2. The interrelationships of superior/inferior styles and the influencing factors

In terms of their content, the factors that determine the style of the inferior manager do not fully correspond to the factors on which the style of the superior depends, but they are based on the same sources of influence: superior, inferior, and situation. The specificity of combination and interaction between the different groups of factors determines the degree of mutual influence between the superior and the inferior. There is rarely a balance – more often the factors favor the influence of the leader, but the influence of the subordinate, although sometimes close to zero, always exists.

Of particular interest is the impact of these factors on the superior, mediated by the style of the inferior. The degree of this impact is equal to the magnitude of the influence that the style of the inferior manager can have on the style of the superior. In order to make the right decision on when and how to reduce or increase this influence, it is useful for the subordinate to know the factors from each group. A change in the intensity of any of them would lead to an immediate change in the degree of upward influence of the inferior's style. Ignoring or overestimating the impact of such changes runs the risk of inaccuracy of the decision to act.

Without any claim for completeness, some significant factors grouped by sources of influence are shown in Table 2. The first column presents the factors deriving from the characteristics of the inferior manager, and the second and third include factors from external sources – superior manager and situation. Knowing the impact direction and strength of these factors allows the inferior manager to participate proactively in the management process.

Table 2. Factors of influence

Internal factors	External factors	
Related to the Inferior	Related to the Superior	Related to the Situation
1. Maturity 2. Proactivity 3. Self-confidence 4. Sociability 5. Position power 6. Independence 7. Awareness 8. Work interest	1. Leadership style 2. Knowledge in the inferior's professional field 3. Predictability 4. Expectations/perception of the inferior 5. Power resources 6. Extraversion	1. Organizational type 2. Company culture 3. Nature of the situation 4. Relationship (formal or informal) 5. Environmental issues

Inferior managers must consider the impact of the internal and external factors both as leaders and as followers. As an object of influence on the part of the superior, they are obliged to follow the principles of organizational subordination and to perform the tasks assigned to them in accordance with the responsibilities set out in their job descriptions. As an object of influence by their subordinates, they must recognize the tactics and techniques used on them so that they can neutralize them if necessary. Otherwise, they risk losing their objective assessment of the situation and their focus on organizational goals and interests. As a subject of influence, they are obliged to direct and control the work of their subordinates, while at the same time not forgetting that they themselves are also responsible for the quality of the decisions made by the superior. In this complex tangle of relationships, the style the inferior manager chooses to adopt in dealings with other agents is important.

The choice of a particular style by the inferior manager should not be a consequence of fleeting creative inspirations (although this approach may be justified in an extreme situation requiring an extreme reaction) but should be based on a scientifically sound methodology. This means that among the arsenal of managerial tools, intuition must give way to a more analytical interpretation of the situation. To assist inferior managers, followership decision-making models need to be developed (similar to the models that guide them in choosing a leadership style) that reflect as much as possible the overall influence of the factors of all three groups.

5. CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS

The study explores the dual role of managers as leaders and followers. The results of an international survey of 15 English and 49 Bulgarian inferior managers are presented and their leadership-followership attitudes are compared. The results show that UK managers state a stronger belief in people and their responsibility, while Bulgarians report a moderate bias. In addition, the UK managers announce greater willingness and potential to influence their superiors compared to their Bulgarian counterparts. The report discusses several hypotheses about the observed cultural differences. It is concluded that inferior managers have to choose style alternatives that correspond to the peculiarities of the managerial subordination and influence the superior in a way that best satisfies the interests of the company. On this basis, three main groups of factors that determine inferior managers' direction of influence have been identified: inferior-related factors, superior-related factors, and situational factors.

The attempt to analyze the manager simultaneously as an object and as a subject of influence is definitely a strength of this study. A positive feature is also the involvement and comparison of managers from different countries. However, the study is not without limitations. First, the limited number of participants makes it useless to apply statistical methods, which calls into question the reliability and validity of the study and does not allow the formulation of significant conclusions. Second, future studies should try to expand the list of factors that determine the degree of upward influence of the inferior manager and carefully examine the impact of each of them. Third, the survey mainly covers employees from lower management levels in garment companies. Perhaps future researchers will be interested in comparing the assumptions of inferior managers from different levels and industries.

Finally, the study did not cover in the least the variety of aspects that describe the style of the manager as a subordinate. In comparison with the expansion of leadership concepts, followership theories are still under development, and followership style models have yet to be identified and explored. When do subordinate managers have to follow instructions and when do they have to be proactive? When to trust and when to question superior's decisions? What

factors to consider in order to find the proper distance with a superior? These and many other challenging questions wait to be answered.

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CREATING STRATEGIC VALUE CHAIN IN MUNICIPAL SOLID WASTE MANAGEMENT: A PLATFORM FOR SUSTAINABLE DEVELOPMENT IN LAGOS, NIGERIA

A.E. Otiike-Obaro^{*}, B.E.A. Oghojafor

Faculty of Management Sciences, Department of Business Administration, University of Lagos, Lagos, Nigeria

Abstract: The high volume of daily municipal solid waste generated and the multitude of stakeholders involved in the Lagos metropolis offers significant opportunity through the creation of strategic value chain (SVC) for sustainable business development (SBD). However, the business potential of solid waste in the metropolis seems not apparent. This study seeks to evaluate the volume of different waste streams generated and the potentials for future growth, examine the influence of waste sorting at source, waste diversion, waste recycling and the mediating influence of the informal sector on the value chain for sustainable business development of municipal solid waste management in Lagos megacity.

The study was carried out in Lagos State. Using non-random sampling techniques, a total of 784 respondents were sampled. Primary data were collected with the aid of questionnaire structured on a 7- point Likert Scale. Data were collected from 625 respondents but only 572 could be analysed using IBM SPSS Statistical Package.

Results showed that each of the variables forming the strategic value chain has significant influence on sustainable business development. Engaging the Sobel test, informal sector, the mediating factor, was revealed to partially mediate the relationship between SVC and SBD, but the PROCESS version 3.3 in IBM SPSS 23 showed the regression of SVC on the mediator (informal sector), was significant with SBD

Keywords: waste recycling, sorting at source, value chain, sustainable business development

1. INTRODUCTION

At the United Nations Conference on Environment and Development in Rio de Janeiro, Brazil in 1992, 178 governments agreed that more sustainable municipal solid waste management (MSWM) was needed in both developed and developing nations. Sustainability was defined as the design of human and industrial systems to ensure that humankind's use of natural resources and cycles do not lead to diminished quality of life due either to losses in future economic opportunities or to adverse impacts on social conditions, human health and the environment, (Mihelcic et al., 2003).

^{*} Corresponding author: andrewoobaro@gmail.com

It has been observed that much of the resources extracted from nature are used in unsustainable manner and end up as waste. This can be defined as a cradle-to-grave scenario in which the resources have a “lifetime” and are disposed of after they are used, ending up in a “grave” (a dumpsite/landfill). If this practice were to continue relentlessly, it may result in complete depletion of our natural resources. The only way to avoid this dead end is to advance novel production and processing philosophies that use up resources in an alternative cradle-to-cradle scenario. (El-Haggar, 2007).

The World Commission on Environment and Development, (WCED, 1987), defined sustainable development as "development which meets the needs of the present without compromising the ability of future generations to meet their own needs". A sustainable entity is one that backs sustainable development by providing concurrently economic, social, and environmental benefits; the concept of triple bottom line, (Elkington, 1994). The concern for sustainable business development with regard to urban solid waste management emanates from the fact that human imagination can convert waste to resource (compost, energy, recycled products and so on); because waste only becomes waste when human imagination fails. Through the concept of value chain in municipal solid waste management, it is feasible to consider the idea of zero waste where all waste generated in the city is converted to economic use as in the case of an eco-industrial park in Kalundborg, Denmark and in Sweden, (Braungart and McDonough, 2002). The conservation of limited natural resources for future generation is sustainable development. The creation of value chain for the promotion of recycling of municipal solid waste is a strategy for the achievement of sustainable business development.

A positive relationship exists between the human development index level (HDI), gross national income level (GNI) and per capita waste generation volume of any country, (Hoornweg and Bhada-Tata, 2012). As a result of varying lifestyles and feeding patterns, the amount of waste generated has enlarged and the structure of waste has become more diversified. If economic growth progresses on current pattern, at a point in time, a blend of population growth, rural–urban migration and upsurges in waste generation per capita would undoubtedly double municipal solid waste volumes in emerging and relatively poor-income nations by 2025, Hoornweg and Bhada-Tata (2012).

Municipal solid waste management through strategic value-chain is a reverse logistic in supply chain; commencing from collection at point of generation, transport, treatment and final disposal of waste at the dumpsite or landfill. Actors in the value chain include the formal sector, Lagos Waste Management Authority (LAWMA), the Private Sector Participants, (PSP), engaged in waste transportation, informal sector waste collectors and scavengers, composters, resource retailers, wholesalers, middlemen, waste crushers, recyclers, end-user industries and exporters. The activities of each actor along the chain creates values for the subsequent actor or actors.

The objective of this paper is to test the following hypothesis with a view to confirm their influence on sustainable business development in municipal solid waste management.

1. The different waste streams generated in Lagos metropolis would not have any influence on sustainable business development in municipal solid waste business;
2. waste sorting at source would have no influence on sustainable business development
3. waste diversion would not impact sustainable business development in the Lagos metropolis;
4. off-takers would not influence sustainable business development;
5. waste crushers would not have impact on sustainable business development;

6. recycling and manufacturing activities would have no influence on sustainable business development
7. delivery strategies would have no impact on sustainable business development
8. informal sector has no moderating role on the relationship between strategic value chain and sustainable business development.

2. WASTE STREAM IN LAGOS METROPOLIS

Lagos is a port city which is comprised of the mainland and a string of islands with population currently estimated at 25.6 millions, (Lagos Bureau of Statistics, 2018). This qualifies Lagos to be recognized as a mega city and one of the world's most populous city. The average density is over 20,000 persons per square km in the built-up areas of the Metropolitan Lagos, (Ekpete and Michael-Agwuoke, 2014).

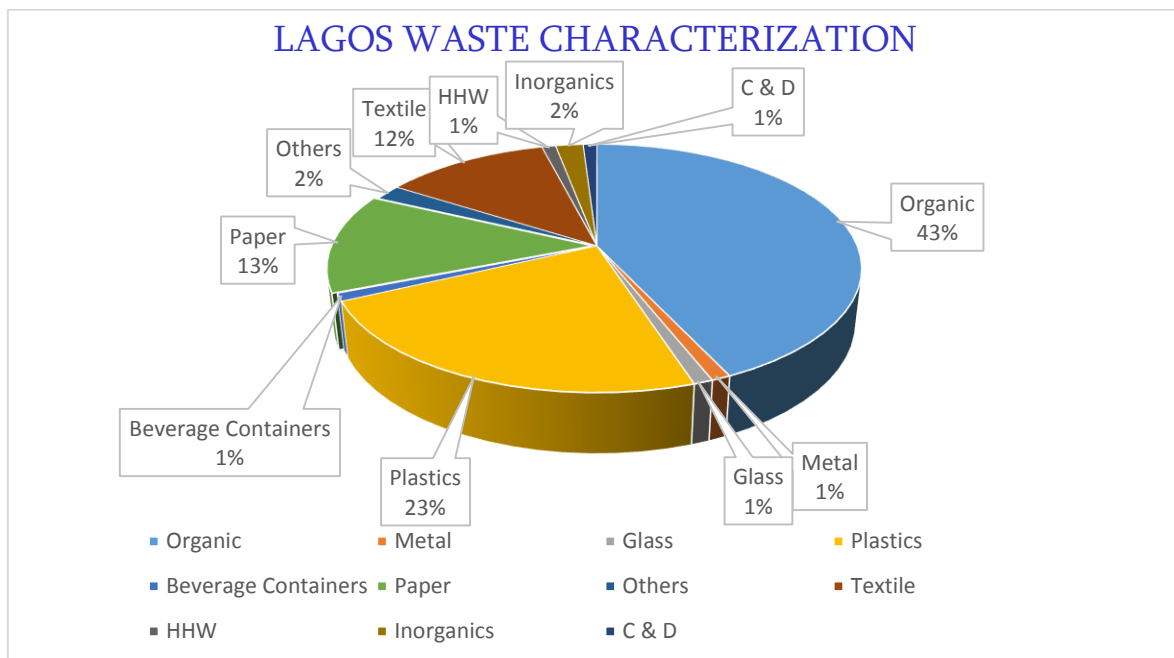


Fig.1: Lagos Metropolis Waste Stream

Source: (LAWMA, 2012)

Lagos is a mega-city of leading commercial significance in the West Africa sub-region. The city produces about 10,000 metric tonne of waste daily. The Lagos population, with about 27.4 per cent municipal inhabitants is increasing about ten times quicker than major cities of the world, LAWMA (2010). Being a coastal city in addition to daily unabated rural-urban migration and limited land space makes municipal solid waste management in the city a critical public concern. Moreover, all that are available are open dumpsites.

This study will focus on glass, metal, paper and plastic waste recycling and green waste. Wiard and Sopko (1989), defined recycling as the process of thoroughly accumulating, categorizing, disinfecting and returning of waste materials to market as merchandises for use or exchange. Recovering is one of the waste management strategies which did not receive attention till producers retorted to public tension on issues such as waste generation, dumping and salvaging, (Muller, 1992); (Murphy, 1986).

2.1. GLASS WASTE

Glass waste refers to glass ampules such as bottles and jars which are rejected after the contents have been used up. It also includes small items such as perfume bottles, deodorants rollers, herb jars etc. Glass is 100% recyclable. Glass does not lose value, the number of times it is recycled notwithstanding. Usually, recyclers collect glass waste according to their colour as glass retains the same colour even after recycling. Glass wastes in household waste stream normally include bottles, bulbs, glass ware etc. Glass recycling normally consumes less energy in comparison to making new ones. The collection of one metric tonne of glass waste into new items saves 31.5 additional kilogram of carbon dioxide from being released into the air during the production of new ones.

2.2. METAL WASTE

Aluminum and steel are the common metals in production with a large quantity in packaging waste. Beverage cans, cans and aluminum foils, are the most popular metals in the waste stream. Reprocessing of metal waste can reduce the ecological effects from the mining industry, the space required at dumpsite and the emission from land fill sites, (Melanen, et al., 2000). The production of new metals definitely consumes more energy than recycling. Besides aluminum and steel, the other metals which can be found in varied items such as computers, phone sets, cars etc. include copper, nickel, silver, gold, lead, brass etc.

The scrap of metals is of two main categories: ferrous and non-ferrous metals. Ferrous scrap includes iron and steel from households, cars, steel beams, ships, rail road, food packaging etc. Non-ferrous metals include metals other than iron and steel. In this category, aluminum constitute the major percentage and includes can, foil, nickel, zinc, lead, copper and other metals in small proportions. Millions of tonne of non-ferrous metal scraps are processed and used again in different industries as their raw material.

2.3. PAPER WASTE

A very high percentage of paper comes from wood pulp which implies the consumption of wood material as a primary source. Paper production from the recycled fibers consumes less energy; conserves the natural resources viz. wood and decreases the environmental pollution, (Cabalova, et al., 2011). It has been discovered that recycling one tonne of newspaper would save about 1 tonne of wood, while the recycle of 1 tonne of printing/copier paper would save about 2 tonne of wood, (Marcot, 1992).

Many advantages of paper recycling have been observed from energy, air and water pollution. Energy Information Administration claims that power utilization is lessened by about 40% when paper is recycled rather than the production of virgin paper. Other calculations say reprocessing one tonne of paper saves sufficient energy to power a house for a whole year. Pollution in water is reduced by 35% and 74% in air when paper is recycled as compared to virgin paper, (United States Environmental Protection Agency, 2007).

2.4. PLASTIC WASTE

Plastic is obviously one of the most extensively used goods in the universe. It is used to bundle buyer's products, bill procurements with credit cards. It is fashioned by coalescing petroleum or natural gas with oxygen or chlorine. This procedure necessitates the consumption of large amount of oil. Therefore, oil consumption could be reduced and land space saved through recycling.

PET (polyethylene terephthalate) is fully recyclable and may be applied as raw material for the production of packing resources such as bottles, ampules for packaging a wide range of food products and other buyer's goods. PET has good safety and hygiene elements for food packaging, exceptional thermal and electrical padding properties and comparatively cheap to manufacture. PET bottles abound everywhere on the streets of Lagos metropolis and in the gutters to be picked free of charge

The polymers are categorized in two main ways: thermoplastics and thermo sets plastics. Thermoplastics which is composed of almost 80% of total plastics can be further re-melted and re-formed, (Curlee and Das, 1991); (Brandrup et al., 1996). This is helpful for material recycling. The major source of plastic waste is the household because statistics has shown that the largest market for plastic is packaging, whose share is about 33.5%.

2.5. GREEN WASTE

Green waste is decomposable left-over that consist of garden, food or flora waste, such as grass, flower cuttings and weeds, plants, twigs and hedge trimmings. Green waste can be turned into natural fertilizer or compost due to its high nitrogen content. Green waste is ready material for composting as it is cheaper than chemical fertilizer, provides sustainable improvement to the soil, less stressful on roots, gradually releases nutrients and diverts waste from the dumpsite.

The core objectives of contemporary waste management is to ascend the waste hierarchy. That is, decrease dependence on dumping and emphasize recycling for the eventual achievement of zero waste, (Wilson et. al., 2006); (Zaman and Lehmann, 2013). Open dumping has been the predominant discarding method available in Lagos Metropolis. Inadequate gathering, unrestrained street droppings and inappropriate dumping in exposed landfills permit waste to be wittingly obtainable for scavenging endeavours, (Medina and Dows, 2000).

According to LAWMA, Lagos State generates more than 10,000 metric tonnes of wastes daily but the percentage of resource recovery or waste diversion is not yet known because it is almost the exclusive preserve of the informal and few private sector organisations, (Oyedele, 2015) These wastes are enormous materials for the industries for their production: aluminum cans can be smelt and remould as aluminum sheets. Foundries abound in Lagos and elsewhere in Nigeria in demand for scrap metals for their iron rod, waste papers from the offices can be turned into fresh pulps for cardboards, papers, newsprints and tissue papers with deinking technology and avoid the need for virgin materials, saw dust from the multiplicity of saw mills can be transformed into briquettes or particle boards, the animal bones and horns from the abattoir can be converted into buttons, necklaces and bangles for women while the discardable innards double for anaerobic digestion if the waste in Lagos are managed from the private sector perspectives.

According to the Wall Street, Waste Management Inc, a New York Stock Exchange quoted company and provider of comprehensive waste services in North America, covers gathering, loading, recovering energy from waste services and final disposal. The company's locations include 271 landfills, 294 transfer stations, 130 beneficial-use landfill gas projects,

100 material recovery facilities and 22 waste-to-energy plants. Collection and landfill services account for three-quarters of sales. In 2010, it had 42,800 employees, (Hoover, 2011).

There are many organisations that recycle waste materials in Nigeria. The whole of Kishi Township in Oyo State of Nigeria, is a town of over 3000 metal recyclers. Plastic recoveries abound in Lagos, Ibadan and virtually in all the cities of Nigeria. Waste quantities for the dumpsite will be largely reduced if paper, plastic, aluminum, iron and glass are detached at source and preserved in separate containers.

Stridhar and Hammed, (2014), have made substantial impacts on the waste to wealth ingenuities: They invented necessary equipment locally to recover plastic/nylon, metal scrap and organic matter at the underlisted sites:

A 10-ton per day capacity “pace setter organo-mineral fertilizer plant” planned and fabricated for Bodija market in Ibadan, (1998).

A 5-ton per day capacity “pace setter organo-mineral fertilizer plant” planned and built for Ayeye community, Ibadan, (2002).

A 5-ton per day capacity food residual conversion to compost designed for a flow station at Shell Petroleum Development Company, Forcados, Delta State (2002) The compost produced was planned to sustain their lawns and gardens.

A 10-ton per day capacity “pace setter integrated waste management complex” planned and built for Oyo State Government at Orita-Aperin, Ibadan (2005), where an organo-mineral fertilizer plant, a plastic recycling plant and a scrap metal recycling plant were designed and built for management of solid waste generated in Ibadan.

A 5-ton per day organic fertilizer plant and 2 ton per day plastic flakes plant built at Aleshinloye market, owned and managed by the Traders Association. Waste water from abattoir serves as possible source of nitrogen to augment organic fertilizer at Aleshinloye market. (Hammed, Soyingbe and Adewole, 2011).

Solid waste recovery in emerging nations is commonly undertaken by the informal sector. The integration of the informal sector within the solid waste collection and recycling services has economic merits. The informal recycling economy in solid waste management financially augments the formal system through reduction in transportation costs. Scrap collectors are entrepreneurs who add value by picking and then altering waste into tradable commodities.

Opeyemi, (2012) acknowledged that the informal recycling sector is an institution in its own right, with knowledge of integrated waste management approaches concerning the collection, transportation, recovery, recycling, and sale of recycled materials to companies within and outside Nigeria. Informal sector recycling has been an avenue for employment opportunities and the development of entrepreneurship in developing countries, (Martinez and Pina, 2016).

The main field of activity of the solid waste informal sector is recovery of materials and recycling. This activity diverts a lot of materials from disposal, and supports livelihoods for millions of poor people. There are cases (OECD, 2006) where informal recyclers divert 15-20 per cent of the city recyclables. So, in most emerging megacities, informal recycling is a “survival activity” for hundreds of thousands of people which in some cases provides people an income by far better than the minimum wage, Scheinberg, (Simpson and Cupt, 2007).

The attitude of public authorities and formal waste management sector to informal recycling is often very negative regarding it as backward, unhygienic and generally incompatible with modern waste management systems. On the other hand, it has been noted by Wilson, Velis and Cheeseman, (2006) that it would be ironic to eliminate already existing and well performing recycling systems trying to apply the waste hierarchy framework. Moreover,

it is an approved strategy for poverty reduction as advised by Millennium Development Goals, (UN, 2005). Therefore, it would seem illogical to propose upward movement of the masses and at the same time remove the ladder by which they would ascend, (Wilson et al., 2006).

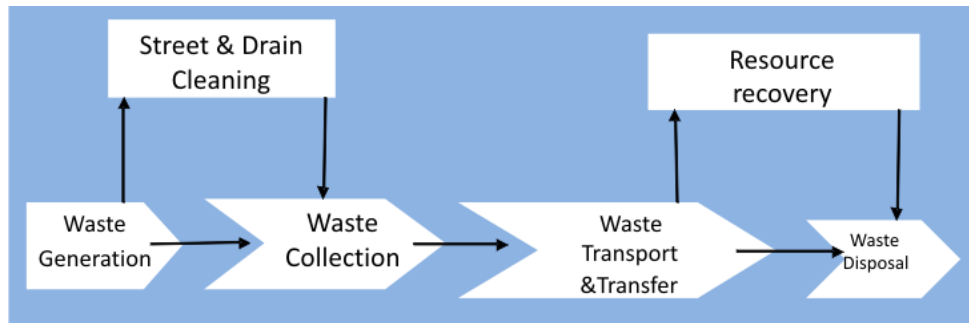


Fig. 2.: Waste Logistics

Source: (World Bank, (2014)

All materials recycled or recovered by formal or informal segment of the market are disposed of into the industrial value chain. Secondary materials gathered by informal salvaging sector are ordinarily disposed of locally. The buyers are resident crushers and manufacturers, plus other artificers. A network of middlemen, merchants and brokers connect foragers with the final users. This chain, in the form of a ladder, is made up of prime and subordinate dealers, recovery MSEs, flea markets, midway grinders, agents and dealers, both formal and informal segment actions. Nevertheless, some materials such as pet bottles are exported by foreigners.

Zabbaleen in Cairo, an informal recycling system, has displayed high level of efficiency with recovery as high as 80% in view of painstaking rigorous labor-intensive categorization and skill at mining waste of high worth, (Iskandar, 2003). Commonly gathered resources include plastics, paper, cardboard, aluminium, steel, other metals, glass and textiles, (Haan et al., 1998). Bio-degradable refuse, human and animal faeces likewise have financial, nutrient and energy values, as they are used as either livestock fodder, soil improvers or fuel through anaerobic digestion, (Dulac, 2001).

2.6. BIO-GAS GENERATION

Both solid and humanoid left-over digestion in an anaerobic breakdown processes, that is, without oxygen have the capacity to create treasured bio-products in the form of energy through bio-gas and solid pellets for lightning and cooking and fertilizer with higher nutrient value as earth food. This has been in practice in Uganda, (Pandey et al., 2007). It implies, therefore, that solid waste management can be a spring for universally inadequate-supplied nutrients, such as phosphorous.

This is achievable by a simple sealed container that permits microorganisms to digest organic materials. When the bacteria digest the carbon-based resources, by-product methane and CO₂ are produced. This course occurs in a closed ampule due to the fact that the nature of microorganisms that digests the bio-degradable material cannot survive oxygen. Moreover, the closed vessel permits the arrest and storing of gas usable as fuel. The digested organic material becomes a neutral fluid referred to as bio-slurry, an exceptional compost as the nitrogen embedded is changed to ammonia which tolerate instant lure into vegetations, (Walekhwa, Mugisha, and Drake, 2009).

This is an initiative which the campuses of tertiary institutions in Nigeria could embrace to convert their waste water into energy and plant nutrient thereby reducing reliance on energy companies and also generating revenue from the sale of earth food. Recently, the former Head of Department of Electrical in University of Nigeria, Nnsuka, Prof. Emenike Ejiogu, and his research team have designed and fabricated a 100kva generator from refuse derived fuel (RDF). The objective of the project is to make University of Nigeria, Nsuka (UNN) generate its electricity with organic waste that will serve as fuel. As a follow up to this breakthrough, the research team is set to embark on fabrication of 250kva, 12 of which will be sufficient to supply the energy needs of the university, (UNN, 2019).

3. LITERATURE REVIEW

3.1. THEORY OF SUSTAINABLE DEVELOPMENT

Sustainable development (SD) has become a fundamental strategy to guide the world's social and economic transformation Shi et al. (2019). The theory of SD has gone through three periods: the embryonic period (before 1972), the molding period (1972–1987), and the developing period (1987–till date). The goal of SD evolves from pursuing the single goal of sustainable use of natural resources to Millennium Development Goals (MDGs) and currently Sustainable Development Goals (SDGs).

Since the advent of the Industrial Revolution, the population has increased rapidly and production has been growing. Human beings have been exploiting wealth from nature and the volume of wastes and pollutants thrown into the environment has also greatly increased. Preserving the global life support systems have become more difficult due to the rapid and continuing human-caused environmental changes, (Kates and Parris 2003). Meanwhile, these changes posed a serious threat to the survival of human beings, (Du Pisani, 2006).

Developmental policies primarily focusing on economic growth increased the frequency of serious environmental problems. The United Nations held a world summit in Stockholm, Sweden in 1972 and agreed that the resources and energy on earth was insufficient for the needs of human development; therefore, current developmental models must be changed for the interests of present and future generations.

Although the theory of SD has been widely promoted, in practice, many theoretical and methodological problems of SD have not been fundamentally resolved. Even though the goals of SD have developed from addressing ecological sustainability to more comprehensive goals, those goals only consider SD within the next 15 years rather than a longer term. Furthermore, the definition of SD seems to be without boundaries.

3.2. CRADLE TO CRADLE THEORY

Braungart and McDonough, (2002) anticipated a shift from a cradle-to-grave approach in municipal solid waste management, where waste products are dumped in a dumpsite/landfill, to a cradle-to- cradle philosophy where waste can be converted to other products. They suggested the “eco-effective” recycling view which permits material reprocess with high quality. They argued that mingling dissimilar materials in one product prevents the products from being wholly recycled. Therefore, product originators need to anticipate the reuse of their products in order to avoid waste generation. This change in products' design method will

demand an extra obligation of the producer. This is the origin of expanded producer responsibility (EPR).

The cradle-to-cradle concept is a structure of reasoning which derives from the belief that human endeavors can rival nature's system of safe and regenerative productivity. Examples are eco-industrial parks, where industries are grouped together to have a continuous flow of material and no waste generation as in the case of an eco-industrial park in Kalundborg, Denmark and also in Sweden.

3.3. REVERSE SUPPLY CHAIN (REVERSE LOGISTICS) THEORY

The coverage of the forward supply chain has been stretched to comprise the reverse stream of goods and packaging materials from the point of application back to the basis, (Rogers and Tibben-Lembke, 2001). Firms have also realized that a strategically managed product returns and resourceful reverse logistics can promote competitive lead, (Stock and Mulki, 2009); (Kannan, et al., 2012a). In reality, waste management is described as reverse movement issues in supply chain administration. (Bautista and Pereira, 2006). An integrated MSW management system usually consists of many actors: waste generators, collectors, transporters, crushers, recycling and disposal agents.

In the recent past, the concerns of reverse logistic problem were closed-loop supply chain management, that is, reverse chain for a company's own products, (Guide and Van Wassenhove 2009); (Chen and Sheu, 2009). In an open-loop reverse supply chain, products do not get back to the original producers, but are recovered by individuals and entities not necessarily within the original distribution channel, (Gou, et al., 2008).

3.4. SUSTAINABILITY THEORY

Abrate et al., (2014) argued that sustainability concept has spread and wandered into the domain of business. A novel model called "triple-bottom-line" (environment, economic and social) then developed. It evolved from a threefold idea of corporate responsibility considered as measure for gaging the level of sustainability practice of an organisation on the basis of environmental, social and economic parameters. It was argued that, notwithstanding a wide-ranging opinion that recycling plans are more onerous than landfill-based systems, the charge for new landfills, once the space in current ones are filled would make recycling a more favourable option particularly in cities with limited territorial capacity like Lagos. Recycling provides hidden cost savings from the disposal stage by a reduction of reliance on dumpsites and new land fill construction, (Larsen et al., 2010)

3.5. STAKEHOLDER THEORY

As the choice for methods of waste gathering and treatment is always increasing due to the shifting economic circumstances, decision makers are consistently challenged with contemporary questions relating to the most cost-effective method, and healthier blend of more innovative options for the achievement of the same objectives, (Allesch and Brunner, 2014); (Rogge and De Jaeger 2012). Decision makers are also under the burden of varied stakeholder groups to consider choices that support more sustainability, new skills, and cheaper waste management, (Wilson, Smith, Blakey and Shaxson, 2007). The applications of support models

for planned or policy choices to waste management started in the late 1960s. Early studies which were followed in 1980 were studies evaluating whole waste management focused principally on functional elements of gathering paths, and facility sites, (Kamperis et al., 2013). Computer-aided choice began in the 1980s, (Banar, Cokaygil and Ozkan, 2009) and were objective concern indicative of the merits and demerits of diverse choices, (Allesch and Brunner, 2014).

3.6. CRITIQUE OF THE THEORETICAL BACKGROUND

The cradle-to-cradle theory though logical is dependent on the producer's willingness and responsibility to alter the material input into their products. In developing countries like Nigeria, most products consumed are produced from outside our environment where opportunity does not exist to influence producer's input decisions. The reverse supply chain postulates merely advocate the need for packaging materials and cardboards to be returned to the original producer through the closed loop concept or the open loop without tangible addition to the debate for value chain creation in municipal solid waste business. The sustainability theory refers to sustainability concept from the perspective of regularity of gathering and transportation of waste and makes a case for dumping rather than waste recycling. Institutional theory argued that when organisations comply with the pressure for increased recycling, this could improve their market place acceptability without a concern on how to improve the economic status of the actors. Stakeholder theory considers the choices of waste management options that support more sustainability and cheaper waste management options without necessarily suggesting any particular choice.

UNEP, (2015) has defined recycling is an integral part of sustainable waste management that can be a formal or informal sector valorisation activity. It counts on source segregation, collection, sorting, mechanical processing and trading into local, national and international industrial and agricultural markets, (Scheinberg, 2012). Much of the literature explores opportunities for integration of informal recyclers within the municipal solid waste management system (Mavropoulos et al., 2014); (Scheinberg and Savain, 2015).

Conceptual Framework

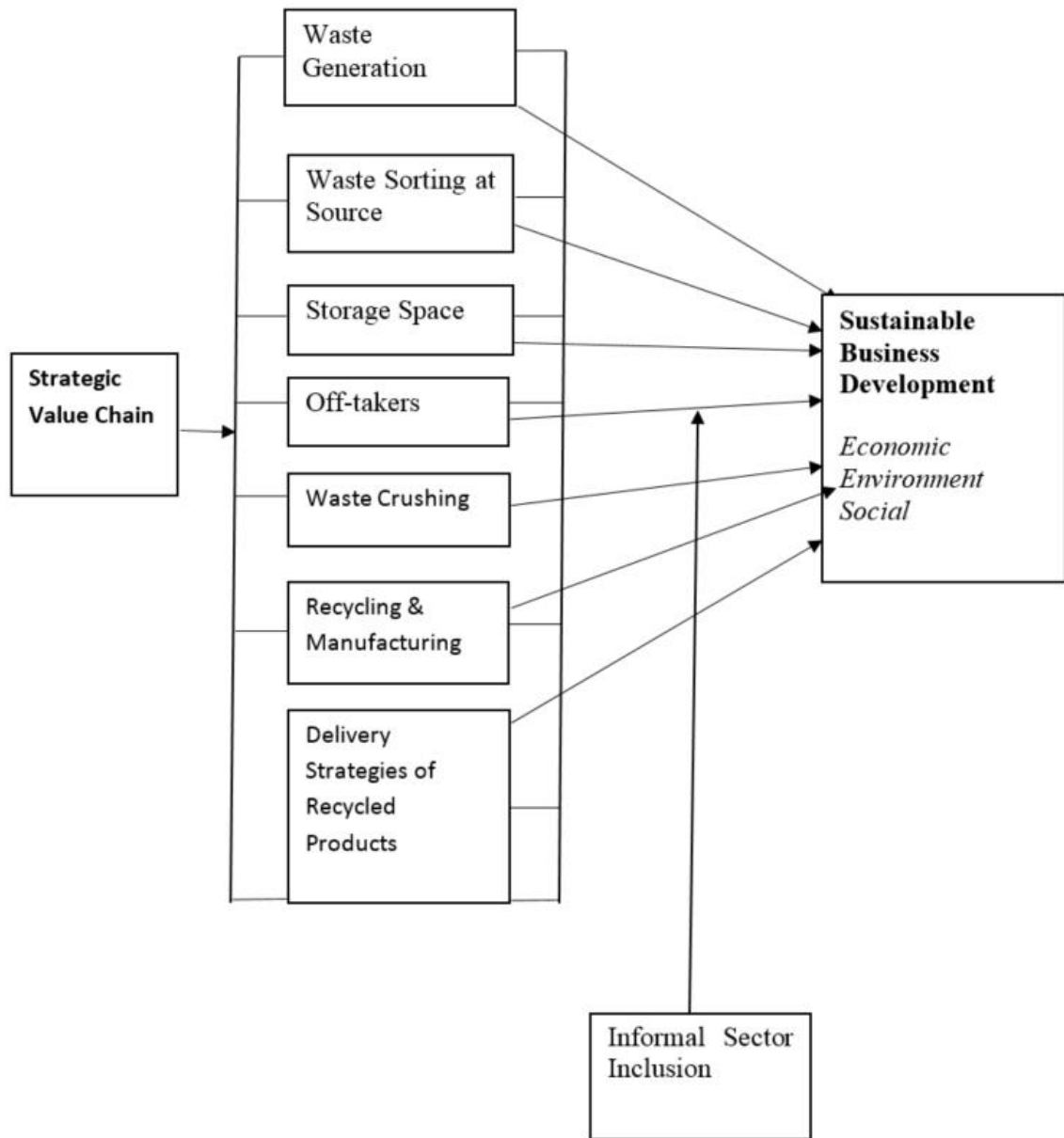


Fig. 3. Conceptual Framework

Source: Developed by the Researcher

4. METHODOLOGY

Non-probability sampling methods was engaged for the choice of respondents. As the population of the study is not deterministic, it was necessary to deploy judgmental sampling technique, quota and convenience sampling. The sample size 784 was determined using Cochran (1963) formula for the determination of sample of infinite population. The locations are subdivided into three zones. Zone one comprises Lagos West and Lagos Island. Within

Zone one is Agunlejika, Epe and Sangotedo dumpsites. Zone two comprises Badagry, Oko Filling, and Lanre Industrial Estate. These locations were notable for wastes dumps in Lagos State Metropolis. Zone 3 covers Lagos Mainland and Ikorodu. Lagos mainland comprises: Olusosun along Oregun axis, covering 1.5 hectares of land, Abule Egba dumpsite, Omole and Owutu. A total of 784 respondents were sampled. Using quota sampling, an appropriate number of respondents were judgmentally determined from each site and then convenience sampling for the individual participants.

The data collection for this research was administered questionnaire of a 7-point Likert rating scale designed to elicit requisite information from the target stakeholders to gather enough data required to evaluate the hypothesis. The survey was analyzed using IBM SPSS Statistics version 25.

4.1. TEST RESULTS

Hypothesis one: The result showed that waste streams generated had a joint significant influence on sustainable business development. This outcome is in consonance with Sharpe and Agarwal, (2014) who argued that the diminishing availability of virgin raw material resources and the negative ecological impacts of sustained exploitation of prime resources for productive engagements forced greater emphasis on value chain of waste streams and salvaging activities (Larsen et al., (2010) and (Lavee, 2007). They also argued that recycling provides hidden cost savings from the disposal stage by a reduction of reliance on dumpsites and new land fill construction. Beside the issue of livelihood for the urban poor, waste recycling enhances the sustainability of the economy. It curtails the depletion of non-renewable resources such as ores, timber, petroleum etc. The objective of value chain is to improve the livelihoods of those upstream, towards the beginning of the chain by changing particular steps within the chain and the interactions between them, (Humphrey and Navas-Alemán, 2010).

Hypothesis Two: waste sorting at source was discovered to have significant influence on SBD. The result confirmed the experience of the Zabbaleen in Cairo, an informal recycling system which has displayed high level of efficiency with recovery as high as 80% in view of painstaking rigorous labor-intensive categorization and skill at mining waste of high worth, (Iskandar, 2003). Commonly gathered resources include plastics, paper, cardboard, aluminium, steel, other metals, glass and textiles,

Hypothesis Three: Waste diversion has significant influence on SBD. Though the municipal established authority does not rate the informal actions of waste selection and scavenging, they are at the moment the main movers of municipal solid waste diversion from dumpsite, (Fehr, 2002). The main field of activity of the solid waste informal sector is recovery of materials and recycling. This activity diverts a lot of materials from disposal, and supports livelihoods for millions of poor people. There are cases OECD, (2006) where informal recyclers divert 15-20 per cent of the city recyclables. So in most emerging megacities, informal recycling is a “survival activity” for hundreds of thousands of people which in some cases provides people an income by far better than the minimum wage, (Scheinberg, Simpson and Gupta, 2007).

Hypothesis four: Waste off-takers have significant influence on SBD. The informal recycling in developing economies and in municipal solid waste management financially augments the formal system through the reduction of the overall transportation costs. Scrap collectors are entrepreneurs who add value by picking and then altering waste into tradable commodities Opeyemi, (2012).

Hypothesis five: Waste crushers have significant influence on SBD. Kaplinsky and Morris, (2001) truly defined value chain as the full range of activities which are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers, and final disposal after use.

Hypothesis six: Recycling and manufacturing activities have a significant influence on SBD. Larsen et al., (2010) and Lavee (2007) have argued that recycling provides hidden cost savings from the disposal stage by a reduction of reliance on dumpsites and new land fill construction, (World Bank, 2014). All materials recycled or recovered by formal or informal segment of the market are disposed of into the industrial value chain. Braungart and McDonough, (2002) anticipated a shift from a cradle-to-grave approach in municipal solid waste management, where waste products are dumped in a dumpsite/landfill, to a cradle-to-cradle method where waste can be converted to other products.

Hypothesis seven: Delivery strategies have a significant influence on SBD. An integrated MSW management system usually consists of many actors: waste generators, collectors, transporters, grinders, recycling and disposal agents. Each step or link in the value chain involves a source input, a process of value addition and selling the material to the next link in the chain. Each step adds value to the product and often generates more revenue than the previous step, (Martinez and Pina, 2016).

Hypothesis eight: The findings revealed that the informal sector partially mediates the relationship between SVC and SBD. This result is somewhat curious. Solid waste recovery in emerging nations such as Nigeria is commonly undertaken by the informal sector, (Gutberlet, 2010; Medina, 2011). It has been noted by Wilson, Velis and Cheeseman, (2006) that it would be ironic to eliminate already existing and well performing informal sector recycling systems trying to apply the waste hierarchy framework. Moreover, it is an approved strategy for poverty reduction as advised by Millennium Development Goals, (UN, 2005). Therefore, it would seem illogical to propose upward movement of the masses and at the same time remove the ladder by which they would ascend, (Wilson et al., 2015).

Velis et al. (2012) argued that developing the value chain is essential to fully integrate the informal sector into the waste management system. Informal sector recycling in developing countries often exists independent of the formal municipal solid waste management sector, seeking otherwise unoccupied economic niches within the formal industrial or agricultural value chains, (Scheinberg, 2011), (Mavropoulos et al., 2014); (Scheinberg and Savain, 2015).

5. CONCLUSIONS

Some useful conclusions drawn from this study include: Waste streams generated in the Lagos metropolis were discovered to have joint significant influence on sustainable business development. The test result also confirmed each of the activities involved in the value chain of municipal solid waste business to have positive significant influence on sustainable business development. Solid waste recovery in emerging nations is commonly undertaken by the informal sector. Therefore, developing the value chain is essential to fully integrate the informal sector into the waste management system. Consequently, much of the literature explores opportunities for inclusion or integration of informal recyclers within the municipal solid waste management system towards achieving sustainable development.

5.1. RECOMMENDATIONS

This study provided some recommendations which were largely derived from its findings:

Conscious and deliberate policy should be adopted to enhance recycling rates and maximize the volume of waste diversion from landfill, by introducing effective schemes to integrate the informal sector into waste management practices and to raise public awareness on the importance of recycling while the informal sector (waste pickers and scavengers) should be encouraged to form business groups for proper monitoring and coordination of municipal solid waste. Formation of waste pickers cooperatives naturally eliminates middlemen in the value chain to release profit potentials of the municipal solid waste business towards sustainable development.

Product stewardship where companies contribute in the management of wastes generated by their products should be introduced. This may call for a policy that requires producers of drinks in aluminum cans, pet bottles, plastic bottles for soft drinks to be responsible for their recovery through a scheme of redemption for reward. This will encourage even school children to collect and accumulate these materials for a redemption reward.

Lagos State Waste Management Authority (LAWMA) should endeavour to convert the existing open dumpsite into engineered sanitary landfills with built-in leachate and gas control system to reduce the continuous ground water pollution and ozone layer depletion including new legislation stipulating that production of pet bottles be a mixture of virgin and recycled raw materials.

Tertiary institutions in Nigeria should take the lead in the waste to energy projects by converting their waste water into energy and fertilizer through the process of anaerobic digestion. This could provide energy for street lighting in the campuses, reduce dependence on the energy companies and the use of fossil fuel, generate income from fertilizer which could encourage State governments to embark on similar projects for market illumination,

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SERBIAN RURAL NEET YOUTH INCLUSION THROUGH THE DEVELOPMENT OF DIGITAL ENTREPRENEURIAL COMPETENCES AND DIGITAL ENTREPRENEURSHIP

Nevenka Popović Šević¹, Milutin Dobrilović², Milena Ilić P.^{1*}, Marko Ranković³

¹ Faculty of Contemporary Arts Belgrade, Serbia; Information Technology School ITS-Belgrade; ² University of Belgrade, Faculty of Economics Belgrade, Serbia; ³ Faculty of Information Technologies and Engineering, Belgrade, Serbia

Abstract: As a way of the social inclusion of rural youth in Serbia, the paper suggests the development of digital entrepreneurial competences and digital entrepreneurship. In this regard, visible barriers are imposed in terms of the availability of platforms for the development of digital competences and subsequently the support and funding of digital entrepreneurial ventures. The article also states that the use of all Internet opportunities in a situation when additional training or online training is concerned is extremely important for NEETs in Serbia, with an emphasis on the development of digital skills, in order for them to develop their computer knowledge, and digital literacy generally speaking, based on acquired knowledge and skills, which would enable them to be involved more easily in the world of labor or be empowered to engage in entrepreneurship. Digital entrepreneurship is assumed as a business model due to the fact that it offers the possibilities of working from home in informal conditions, on the one hand, and erasing the geographical boundaries of the market, on the other. The preconditions for the implementation of the offered model, which implies the provision of equal chances for all young people, the involvement of the government, universities, the civil sector, the economy and the media, and cooperation with the COST association.

Keywords: NEETs, digital competences, digital entrepreneurial competences, digital entrepreneurship, Internet

1. INTRODUCTION

Youth Not in Education, Employment or Training (or NEETs) is the term that includes a group of young people who do not have access to the fields comprised in the acronym and who mostly come from rural areas. NEET: “Not in Education, Employment or Training” is a category from the British Policy for Young People between the age of 16 and 18, who are presumed to be at a high risk of social exclusion. In 2003, Japanese researchers created their own version of this category, naming it “niito”, which represents the Japanese category of young people that can be subsumed under the described NEET category. These are usually young people (or this is usually a young adult person) outside the workforce category, who are assumed to be idle and inactive due to laziness and a lack of commitment to work ethic (Goodman, et al., 2012).

* Corresponding author: milena.ilic@its.edu.rs

In terms of the age range which the young people of the mentioned group belong to, a range from 16 to 18 years of age was initially defined (Furlong, 2006). In the meantime, this range has differently been defined, primarily due to the time transition present from adolescence to early adulthood, and that range covers a period from 15 to 34 years of age today (EUROSTAT, 2017). The term NEET includes several groups of young people ranging from marginalized youth, the young people no longer actively looking for work, to even the groups of the young people who have completely voluntarily decided that they did not want to go to school or attend a training course or seek employment at all (Carcillo, et al., 2015).

Due to its informal character (in the form of work from anywhere or work from home), digital entrepreneurship can present a good model for the social inclusion of NEETs from the rural parts of Serbia in the world of labor or the economy. Before that, of course, it is necessary to use the Internet as a medium to develop digital competences in general, as well the digital entrepreneurial competences of the young people included in this category, with the help of various distance learning platforms. The Internet will also be used as a market for future NEET entrepreneurs. In order to ensure that they have all the necessary resources available to them (an Internet connection, software, hardware, mentoring, coaching, financial resources, training programs, etc.) through the process of learning and the development of their entrepreneurial endeavor, it is necessary that a complete ecosystem should be built or that the existing opportunities for inclusion in NEET support programs, such as the COST initiative, should be taken an advantage of.

2. DIGITAL ENTREPRENEURSHIP AND DIGITAL ENTREPRENEURIAL COMPETENCES

Digital competences refer to the confident and critical use of the full range of digital technologies for communication, information and basic problem solving in all aspects of life (Digital competence: the vital 21st-century skill for teachers and students, 2020). Digital competences closely relate to digital literacy, which is a survival skill in the digital age (Eshet-Alkalai, 2004). According to authors (Hatlevik & Christophersen, 2013), digital skills focus on dealing with technical conditions, whereas digital competences are a broader term emphasizing what kind of skills, understanding, and critical thinking students can use. Digital competences refer to the reliable and crucial use of the full range of digital technologies for communication, information and solving basic problems in all aspects of life (Simović & Domazet, 2021).

Digital entrepreneurship is closely linked to digital competences. Ngoasong (Ngoasong, 2018) defines digital entrepreneurial competences (DEC) as a set of the knowledge and skills needed to seek and acquire new information, identify and implement entrepreneurial opportunities and innovate. Fayolle and Benoit (Fayolle & Benoit, 2015) suggest that digital entrepreneurial competences can be acquired through formal education, context-specific training and some prior experience.

Ngoasong believes that a combination of high technology, the institutional and local contexts are interconnected, implying that entrepreneurial competences and ICTs are crucial for digital entrepreneurship (Ngoasong, 2018). He also finds that human capital (entrepreneurs' education and experience) conditions founders' certain choices and expectations in a transition economy, namely that the knowledge and skills used to create a new entrepreneurial venture or run an existing one can be conditioned by a context. Ngoasong believes that the impact of a context on digital entrepreneurship is exerted through entrepreneurial digital competences (Ngoasong, 2018).

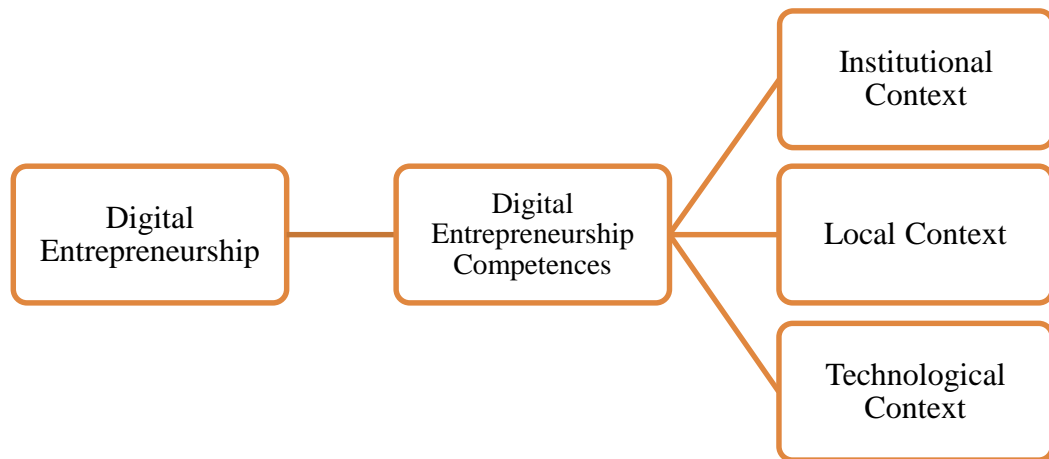


Figure 1. The mediation role of entrepreneurial digital competences (Ngoasong, 2018)

One of the NEET social inclusion models was the development of their digital competences and digital entrepreneurial competences in order for them to obtain a good basis for inclusion in the world of labor, i.e. in order for them to be empowered to deal with digital entrepreneurship, through the various support platforms of civil society, governments and various educational institutions, would enable them to use the distance learning courses necessary for the development of digital competences and through the economy's and institutional support which would offer them the necessary support and funding assistance in the form of grants.

3. THE INTERNET AS A DIGITAL ENTREPRENEURIAL COMPETENCES DEVELOPMENT MEDIUM AND A CHOICE OF A BUSINESS MODEL

In the late 1980's and in the early 1990's, the Internet was commercialized. The number of the Internet users has constantly been increasing since then. Table 1 shows the current world statistics of the Internet users in 2020 (Internet World Stats, 2021).

Table 1. Worldwide Internet users and the demographic statistics for Q4 2020 (estimated) (Internet World Stats, 2021)

World regions	Population (the 2021 estimation)	% of the world population	Internet users 31 st Dec. 2020	Breach (% of the population)	Growth 2000 - 2020 %	Internet World %
Africa	1,357,198,684	17.3	633,8856,924	46.7	13,941	12.8
Asia	4,309,503,789	55.0	2,563,503,922	59.5	2,143	51.8
Europe	835,700,837	10.7	727,848,547	87.1	593	14.7
Latin America / Caribbean	658,382,700	8.4	477,824,732	72.6	2,545	9.7
Middle East	263,933,993	3.4	184,856,813	70.0	5,528	3.7

North America	370,146,066	4.7	332,910,868	89.9	208	6.7
Oceania / Australia	43,138,089	0.6	29,066,532	67.4	281	0.6
Total	7,838,004,158	100.0	4,949,868,338	63.2	1,271	100.0

According to the Internet World Stats, Serbia had a total of 73.4% of the Internet users in relation to the total population as at 31st December 2020, which is shown in Table 2 (Internet World Stats, 2021).

Table 2. Internet statistics and Facebook users in Europe in January 2021 (Internet World Stats, 2021)

	Population (2021 estimation)	Internet users as at 31 st Dec. 2020	Breakthrough (% of the population)	Users % in Europe	Facebook as at 31 st Dec. 2020
Serbia	8,733,407	6,406,827	73.4 %	0.9 %	3,400,000
Europe total	829,173,007	727,559,682	87.7 %	100.0 %	340,891,620

According to the data of the Statistical Office a total of 81% of households have an Internet connection. This data accounts for an increase of 0.9% compared to the year 2019, and 8.1% compared to the year 2018 (RZS, Use of information and communication technologies in the Republic of Serbia, 2020).

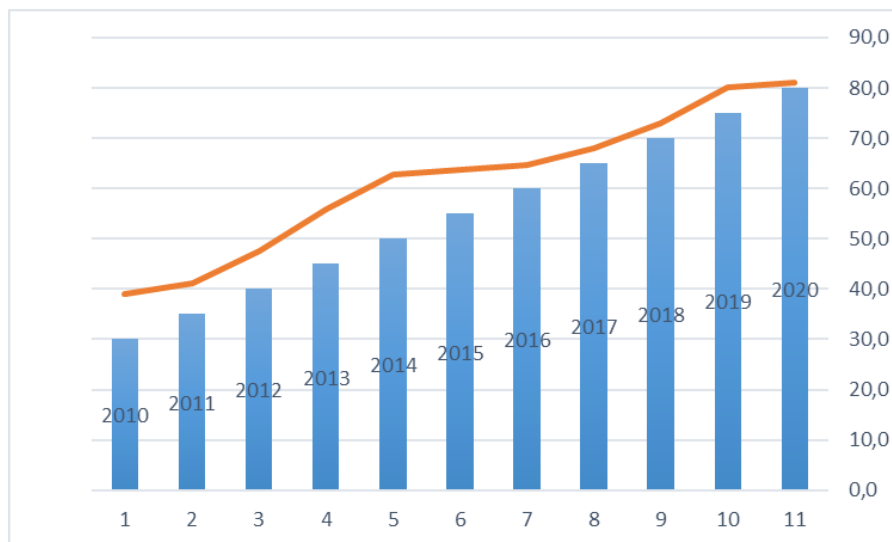


Figure 2. The Internet in households in the Republic of Serbia (RZS, Use of information and communication technologies in the Republic of Serbia, 2020)

The largest number of internet connections accounts for Belgrade (94.1%), only to be followed by Vojvodina (75.3%), whereas the smallest number of them accounts for Southern

and Eastern Serbia (77.3%). There is a big difference between the presence of internet connections in urban areas in comparison with rural areas (87.1% in urban areas, and 70.4% in other areas) (RZS, Use of information and communication technologies in the Republic of Serbia, 2020).

As far as the number of the Internet users in the Republic of Serbia is concerned, the data of the Statistical Office of the Republic of Serbia presented in the Report on the Use of Information and Communication Technologies for the Year 2020 show that more than 4,110,000 people have used the Internet in the last three months (RZS, Use of information and communication technologies in the Republic of Serbia, 2020).

The creation of a huge virtual market accessible to practically everyone is conditioned by the fact that more than 4.9 billion people on the planet Earth use the Internet. Some companies have recognized the potential of this market at the time of the beginning of the commercial use of the Internet. Those companies are global leaders in the Internet business today (Google, Amazon, eBay). A happy circumstance is that the virtual Internet market constantly grows and there is room for positioning on that market. Numerous Internet startups are the best proof of this (Simović, 2016).

4. NEETS IN THE EUROPEAN UNION AND IN THE BALKAN COUNTRIES

As many as 3.3 million young people between the age of 15 and 24 were registered as unemployed in the European Union in 2019 (European Commission, 2019). Due to the consequences of the Covid-19 pandemic, that number is believed to have been even higher in a short period of time. What actually poses a burning problem to NEET youth is the fact that a long-term lack of educational opportunities, as well as employment opportunities, is far riskier than when the groups of older people are concerned, because it leaves unenviable consequences for young people's self-confidence and the derogation of the quality of life.

Various activities carried out by and the participation of youth in society, as well as support through intercultural dialogues in European countries, are present within the framework of the ERASMUS program. About four million young people and their lecturers have been working on training courses and various training courses through this program alone in order to train themselves in a specific job, which it was planned to spend 14.7 billion euros for by 2020 (Arenas, et al., 2017).

Exclusion from the labor market with the impossibility of any training, coaching or schooling gives rise to a possibility of social exclusion and a higher probability of inclination towards a negative behavior, subsequently inadequate inclusion both in society and in the community (Mascherini, 2017). One of the suggestions is to improve the efficiency of the labor market when speaking about young people by increasing the number of practical school-to-work cases, in which young people would have an opportunity to start work immediately upon completion of some form of education. The mentioned group of authors state several reasons leading to an increase in the NEET population in Europe, namely: i) complex and prolonged conditions for studies-to-work transitions; ii) increasing insecurity among young people, due to difficult conditions for obtaining a job; iii) increasing inactivity among young people when education, training and finding a job are in question; iv) labor market closures towards the young people who are particularly vulnerable, such as young people with disabilities or migrants.

The NEET youth's needs vary across European countries and regions. Such inequalities and differences are primarily a consequence of the different policies adopted and differently implemented in each of those systems. The main reason for a different degree of the

implementation of this program lies in the inconsistency of stakeholders at both a local level and a regional level (Tosun, 2017), which further contributes to an increase in the sensitivity of the youth of rural regions (Sadler, et al., 2014). This is so especially bearing in mind the fact that, otherwise, rural areas have limited access to education, both formal and nonformal, and employment as well.

A great challenge European youth are faced with today is the segmentation of the labor market, in which young people are in a far more unfavorable position than job seekers of an older age. The data of the European Commission (European Commission, 2017) indicate the fact that young people are often forced to do part-time, temporary and seasonal jobs and that contracts of temporary employment are concluded accordingly, which may further discourage them.

It is estimated that more than one-half of the young people from the Balkan countries are unemployed (ILO, 2016), which leads to the further effects of increasing the informal employment rate (WB, 2016). This further results in the fact that even educated young people or young people with certain skills (if they fail to find a job) very often accept a job not in line with their qualifications and expectations. Numerous political, economic and even financial crises that have affected the Balkans have caused an increase in the number of poor people, which has further resulted in a decline in employment rates, slower birth rates and increased inequality, which has emotionally meant to many young people that they should look for the only way out from the country, being involved in some conflicts (crime) and so forth. The inability to find work, long-term unemployment and low income is precisely what leads to poverty, which further leads to marginalization and complete exclusion from the community.

Subsequent support is usually lacking, because the countries in the Balkans cannot boast of providing special support when the social protection of young people, who are often completely isolated and in despair due to inactivity, is in question. Table 3 presents an insight into the comparative relations between the labor force and the total unemployment rate in % by the Balkan countries, where high rates of total unemployment and the unemployment of Serbia's youth are noticeable compared to the available labor force.

Table 3. The Balkan countries – the labor force and the unemployment indicators in % in 2017 (CIA, 2018)

Countries	Labor force (mill.)	Total unemployment rate (%)	Youth unemployment rate (%)
Albania	1.18	17.3	30.2
Bosnia-Herzegovina	1.48	43.2	62.8
Bulgaria	2.52	8.9	23.8
Croatia	1.61	15.8	45.5
Greece	4.76	24.6	52.4
Macedonia	0.96	24.9	53.1
Montenegro	0.26	18.5	41.1
Romania	9.13	6.7	24.0
Serbia	2.91	18.9	49.4
Slovenia	0.92	11.6	20.2
EU	232.90	9.5	N/A

5. YOUTH NOT IN EDUCATION, EMPLOYMENT, OR TRAINING IN SERBIA

A labor market policy is implemented when supporting young people in Serbia is concerned. The activities mainly include organized events at job clubs, certain training courses where young people actively prepare themselves for finding a job (resume writing, job interview simulations, volunteering, internships, etc.), as well as the existence of “The First Chance” specialized program, through which employers accept to hire young people for a period of 3–6 months, receiving subsidies from the state in return for that.

As for the education of young people from rural areas, the education systems are considered not often to be up to date with the real world, i.e. with the real needs of the labor market. In that sense, dual education, which in the most pragmatic view is focused on entrepreneurship, which young people become familiar with already in high school, has correctively been launched recently.

According to Youth Not in Education, Employment or Training in Serbia, neither institutional frameworks nor administrative procedures have been harmonized yet. What rural youth in our country for the largest part encounter is a lack of relevant information for “those who have just graduated from a university”, even in situations where a youth has completed some form of formal or nonformal education. In rural areas, young people are also faced with the problem of a lack of legal regulations on conducting various trades, something that would be quite applicable and acceptable to the environment which they come from.

It is estimated that as many as 24% of youth in Serbia are NEETs and that they are mainly found in the rural youth population and among young women (Bobić, 2017). These young people are unreasonably sociologically, as well as economically, almost completely invisible to the relevant institutions of the state that may support their inclusion. A number of social prejudices or a lack of an institutional capacity (either manpower or the infrastructure) to support the NEET youth is believed to be the reason for the same. Table 4 gives a comparative overview of the NEET workforce in Serbia, comparing the years 2019 and 2018.

Table 4. The basic contingent labor force in the Republic of Serbia by age groups (Bulletin - Labor Force Survey in the Republic of Serbia, 2019)

	2019	2018	Changes according to the last year	
	(in 000)	(in 000)	(in 000)	%
Population aged 15 and over 15	5923,9	5955,1	-31,2	-0,5
Active	3236,9	3245,1	-8,2	-0,3
Employed	2901,0	2832,9	68,1	2,4
Unemployed	335,9	412,2	-76,3	-18,5
Inactive	2687,0	2710,0	-23,0	-0,8
Young population (15–24)	716,0	727,1	-11,1	-1,5
Active	212,1	218,2	-6,1	-2,8
Employed	153,8	153,4	0,4	0,3
Unemployed	58,3	64,8	-6,5	-10,0
Inactive	503,9	508,9	-5,0	-1,0

In the population of young people 15 to 24 years of age, the employment rate was 21.7% in 2020 (which was 1% less than in the same period of the last year). The youth unemployment rate was without significant changes compared to the year 2019, with the youth unemployment rate increasing in the male population (by 2.5%), amounting to 25.1%, and decreasing in the female population (by 2.5%), amounting to 28.8% (RZS, Labor Force Survey, III quarter 2020, 2020).

The NEET (Not in Education, Employment or Training) rate, which is calculated for young people between the age of 15 and 24 who neither are in the educational process nor work, was 15.7% in 2020, having decreased by 0.8%. In the population between 15 and 29 years of age, the NEET rate was 20.4% in 2020 (RSZ, Labor Force Survey, III quarter, 2020).

One way to engage rural youth in Serbia is through various forms of entrepreneurship, especially so digital. However, there are already the major barriers visible through a frequent lack of fixed assets (capital) to start one's own business and a lack of experience. Marjanović states that insufficient initial capital for starting a business is the biggest problem for starting business activities for as much as 36.9% of the population of young people. However, a lack of business skills at starting a business becomes a major problem for the largest number of young rural areas in Serbia (Marjanović, 2016).

The authors find that it is extremely important for the NEET youth of Serbia to use all Internet opportunities, both when speaking about additional training or some online training with an emphasis on the development of digital skills in order to find an adequate job. Also, many new forms of digital entrepreneurship are promoted via the Internet in the form of "work from home" in informal conditions, which young people from rural areas would also need additional digital skills for. First of all, the government, universities, the civil society sector, the economy and the media might be included in the offer of nonformal education programs. It is necessary to provide equal opportunities for all young people, with a strong sense of solidarity, and support innovation and creativity among young people. It is also necessary that participants should be involved in the project CA18213 – Rural NEET Youth Network: Modeling the Risks Underlying Rural NEETs Social Exclusion in the European COST Association (COST, 2021).

6. CONCLUSION

The recommendations for encouraging the youth of the rural areas of Serbia to become more involved in education, training and employment would be as follows: a) the action of the responsible governmental departments aimed at more adequately preparing the educational and training programs that would enable a more efficient transition to employment; b) activities carried out with the aim of reducing early school leaving in young rural areas and providing additional forms of the so-called nonformal education; c) supporting particularly vulnerable categories of young people in rural areas (namely national minorities, young people without parental care, young people with special needs, etc.).

It is necessary to prepare the youth for permanent education, which presupposes continuous learning alongside work. This also applies to mobility when speaking about work, no matter whether it is the occupational mobility that requires retraining or the geographical mobility that presupposes relocation to the place where a job position is provided.

From the point of view of supporting the Serbian NEET youth in rural areas, the exchange of the positive experiences of some countries in the region or in Europe so far is especially valuable. The engagement of both state and an increasing number of private educational institutions closest to rural areas that might synergistically support young people's education and training would be significant, all with the aim of enabling them to more adequately prepare

themselves for finding a job and work itself. The same applies to the employers who could make multiple contributions to the inclusion of this vulnerable group through rural youth monitoring partnership programs while young people are still at school/attend training courses.

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ANALYSIS OF THE LEVEL OF IMPACT OF PANDEMIC RISKS IN MINING

Slobodan Radosavljević^{1*}, Nikola Ille², Ivana Radosavljević³, Milan Radosavljević⁴

¹RB "Kolubara" d.o.o., Svetog Save 1., 11550. Lazarevac, R. Serbia; ²The Wolrd Bank, Bulevar Kralja Aleksandra 86-90, 11000, Belgrade, R. Serbia, Washington, United States;

³GO Lazarevac, Karađorđeva 42., 11550. Lazarevac, R. Serbia; ⁴GO Lazarevac, Karađorđeva 42., 11550. Lazarevac, R. Serbia

Abstract: The impact of the great world pandemic crisis caused by infectious factors is unquestionably reflected in all types of activities of the Republic of Serbia, including mining. It is not possible to find an area of work in which the crisis is not felt, mostly to a greater extent with significantly expressed health risks, whose factors in the format are very high, which leads to complete cessation of work or complete closure of a large number of them. Mining has special specifics in its production processes, and given the obligation of constant production that it must achieve, as well as the overall electricity balance for the Republic of Serbia, it becomes particularly sensitive to various crisis situations, especially the current one. The problem of safety measures that must be implemented is significantly aggravated, given the configuration of technological processes and the format of technical systems that mining has as well as the personnel potential of a very large number of professions, which must be included in the complete work and safety situation. In addition to all this, it is important to emphasize the overall economic effects that arise from everything and which need to be maintained at least close to the planned levels, because it is quite certain that they are more difficult to achieve, and the pandemic crisis is not coming to an end. it can envisage the return of the economy and even mining to the state before the beginning of the mentioned crisis. The paper presents an analysis of the level of security risks (through observing the deterioration of the health situation of executors in technological processes and the possibility of improving the overall health format) in the conditions of a large global pandemic crisis. The fact that the crisis is difficult to predict the end, further complicated the above risk analysis, which lacked answers to some of the questions that the authors believe are very important in the context of the stability of production in mining. Nevertheless, the authors believe that the paper provides an interesting formatting of the analyzed safety and health risks.

Keywords: pandemic, crisis, analysis, risk, mining

1. INTRODUCTION

The great world infectious pandemic, caused the biggest world economic crisis not recorded in history so far. Suddenly, the whole world was terribly brutally shaken, where there was no adequate response to the crisis, and the world almost stopped for a moment. Until then, this was

* Corresponding author: drslobodanr@gmail.com

unthinkable. In addition to so many successes and advances in almost all scientific fields, it has been shown that this is not enough, and that the world is not ready for this kind of challenge.

This crisis has its specifics in relation to everything before, and it is characterized by sudden and almost simultaneous shocks both on the supply side and on the demand side. The main trigger of negative components was caused by global measures to prevent the spread of the virus, which required temporary suspensions or limited work of mostly service activities, while in some countries there was a reduction in business in almost all industries (including world mining) and almost complete suspension of production activities. As the pandemic spread, so did the number of sectors that were negatively affected. The initial shock on the supply side, but also the general fear of the spread of the virus in society, together produced negative chain effects on the entire world economy. There has been a decline in demand and a slowdown in the global supply chain, which has reduced employment, investment, production and productivity. Although the duration of the pandemic is still uncertain, some analyzes by international institutions indicate that the consequences will be great and far-reaching, which can already be seen now, (UN Women, 2020) and (S.F. EU., 2020).

However, not all sectors and parts will be equally affected by the crisis. Some sectors of activity that are most covered by the measures, such as the trade sector and tourism-related activities, will suffer more damage than other activities. Due to the lack of liquid potential and stocks, small and medium enterprises will bear greater consequences than large enterprises. It is small and medium enterprises that make up the largest number of economic activities. Similarly, in the labor market, low-wage labor will suffer greater consequences than higher-wage labor. The world will get millions of new poor due to rising unemployment, and due to difficult education during the pandemic, the crisis will have a negative impact on the quality of human capital.

Recovery will most likely not be quick and easy for all activities. Highly technologically developed industries, which include the mining sector, will have higher chances for growth than other industries, due to technological development and robotics that marked the earlier period on the one hand, but also the increased needs of these activities during the crisis on the other. The pandemic also further highlighted the importance of preventing climate change, which will affect the formation of new growth models. In the future, world economic policy will largely determine the further recovery of the overall world economy.

2. SAFETY AND HEALTH RISKS IN MINING

Safety health risks in mining can be analyzed in a multifaceted context. The technical and health aspects that are generated in mining during the great world pandemic crisis are very important.

The mining of each country has planned balance positions on an annual level, which need to be realized in as large a volume as possible (striving for complete realization), considering the economic results that certainly result from that.

With the beginning of the viral infection that spread all over the world and was declared a pandemic by the (world health organization), all activities showed certain thresholds of sensitivity to the newly created living and working conditions, and mining in that context experiences a similar situation.

The analysis of mining in this paper primarily refers to surface exploitation and processing of coal, ie its preparation for combustion in thermal power plants in order to obtain electricity.

It is known that all activities depend on electricity, so even the smallest technical disturbances in the mining industry are on the one hand almost undesirable and on the other a real reality.

The work of technical systems on surface exploitation and coal processing implies 24-hour engagement, with the possibility of minimizing unplanned downtime and full realization of all

planned activities on the system during planned downtime. With minor fluctuations, this is achievable, but it has been shown that during the great world pandemic health crisis, larger disturbances are generated, which in total results in greater downtime and less production and processing of coal, (UN Vomen, 2020), (S.F. EU., 2020), (I.D. EPS, 2020) and (I.D. EPS, 2021).

One can ask how much mining, not only in the republic of serbia but also in other far larger and more developed countries of europe and the world, stopped with the beginning of the great pandemic crisis, and how it gradually adapted and still does, to all the challenges it faces. Brought. As no one can predict with certainty how long the mentioned pandemic and the crisis it causes will last and with what destructive intensity it will affect all economic and non-economic activities, primarily limiting the health ability of the labor force, ie executors on technical systems in mining. More questionable, (I.D. EPS, 2020), (I.D. EPS, 2021), (Blau et al., 2020) and (UN Vomen, 2020).

Modern world trends are of the opinion that the production of electricity from coal is gradually decreasing in favor of renewable energy sources, ie obtaining green energy. No country in the world implicitly immediately stops producing electricity from coal, but adopts long-term strategic plans for gradual reduction, and in the context of the balance to the predominance of green energy or energy from renewable sources. Smaller countries should certainly follow similar strategies given that their potential for such a rapid green transformation is almost ruled out. It is quite certain that the mentioned process will take much longer with them, which means a great resource depletion of coal, so that future generations will have less of such resource potential at their disposal until it is almost completely zero. So there is a real possibility that coal as a potential strategic resource will be completely inaccessible to generations in the near future because it will not even exist, (ID EPS, 2021), (Main et al., 2005), (Main, 2015) and (UN Vomen, 2020).

Some of the technical problems with the risks that may arise due to the pandemic crisis can be seen through:

- Reduced volume of coal mining in surface mines; (Risk range 2.3-2.8).
- Reduced volume of coal overburden in surface mines; (Risk range 2.1-2.4).
- Reduced volume of processing / crushing of coal required granules for combustion in the furnaces of boiler blocks of thermal power plants; (Risk range 2.3-2.5).
- Reduction or partial realization of daily preventive inspections of technical systems in coal exploitation and processing; (Risk range 1.7-2.1).
- Difficult or prolonged emergency repair due to sudden failures of technical systems for coal production and processing; (Risk range 3-3.2).
- Reduction or partial realization of weekly preventive inspections and services of technical systems in coal exploitation and processing; (Risk range 2.7-2.9).
- Reduction or partial realization of monthly preventive inspections and services of technical systems in coal exploitation and processing; (Risk range 2.8-3.2).
- Limited and partial implementation of investment repairs on an annual basis of technical systems in coal exploitation and processing; (Risk range 2.9-3.2).
- Reduced or reduced scope of production and procurement of required aggregate units and components for all technical systems in operation; (Risk range 3.5-3.6).
- Difficult or insufficiently active complete technical logistical support to the production process of coal production and processing; (Risk range 2.9-3).
- Difficult or insufficiently active complete non-technical logistical support to the production process of coal production and processing; (Risk range 2.8-3.1).
- Slowed down until the realization of all currently started projects in the eps system was stopped; (Risk range 3.1-3.3).
- Slow implementation of all programs and projects in the field of environmental protection; (Risk range 3.2-3.5).

- Slow implementation of programs and projects in the field of health and safety at work; (Risk range 3.5-3.6).
- Difficult to engage the necessary resource potentials outside EPS; (Risk range 2.8-2.9).
- Difficulty maintaining the required level of quality system; (Risk range 2.9-3.1).
- Partial non-compliance with the prescribed procedures and work procedures, obligations and business policy of the system; (Risk range 3-3.2).
- Influence of the immediate and distant environment on the operation of the complete system in the production process of coal production and processing; (Risk range 3.4-3.6).
- Lack of certain goods and services/spare parts on the market for regular/preventive/planned and emergency maintenance of technical systems; (Risk range 3.3-3.8).
- Reduced number and volume of deliveries and suppliers of spare parts for maintenance of technical systems; (Risk range 3.1-3.6).
- Efficient and quality monitoring and controlling compliance with the prescribed procedural measures on the operation of technical systems as well as protection against infection; (Risk range 2.5-2.9).
- Other unpredictable, partially or completely identified or unidentified impacts within the system, outside the system (near and far environment); (Risk range 3.4-3.9).
- Synergy of negative destructions based on difficult to predict, partially or completely identified or unidentified impacts within the system, outside the system (near and far environment); (Risk range 3.6-4).
- Other unknown impacts and consequences arising from them at all levels and in all sectors with the possibility of synergy of negative action. (Risk range 3.5-4).



Figure 1. Technical systems for tailings and surface coal mining, (EPS), Republic of Serbia, (may 2021 wears)

Figure 1., shows the operation of technical systems on tailings and surface coal mining, (EPS), Republic of Serbia, (may 2021 wears)

The health aspect in the mining business has a special significance, interest and treatment. It implies full mobility and engagement of all employees, with an emphasis on the direct production process through the technical treatment of all potential mining resources with their planned maintenance dynamics. It is obvious that this has not been the case since the crisis, and that restrictions in the context in question are present on all sides, both in the production environment and in the near and far health impacts!

The state is responsible for saving every life of an individual and in that sense no one can be privileged in any way and in any challenges. What followed as the first measure was the reduction of the work of employees, of course gradual and harmonized for the development of a pandemic of infection and disease, (I.D. EPS, 2020), (I.D. EPS, 2021), (Amnesty international, 2020) and (La Repubb., 2020).

In mining, it is a big problem if the workforce on technical systems is limited in operation for any reason, since it is organized through system crews that must function as complete, professionally trained to control the work of individual parts of the system in accordance with delegated authority and job responsibilities. Smooth and productive work as a condition for quality work of the complete system.

The high risk of infection and infection has disrupted such a conception, which has resulted in a partial reduction in the volume of work on certain systems. This was followed by regrouping of production crews on the systems according to the degree of priority. Example, (coal mining crews have completed coal mining crews). This was followed by a massive infection, which resulted in some workers with a confirmed infection going to treatment in covid systems and some with milder forms of infection / milder clinical picture for treatment in home isolation. Then follows the first, second and third wave of infection. And it is very difficult to predict how many more waves there will be in total, their scale of influence as the time of their slight calming.

One part of the work that could have been organized in such a way is the work of executors in the administration, through work from home conditions through online opportunities. However, when it comes to direct productive labor, this form of work is excluded!

It is interesting that in recent years, mining has advanced a lot when it comes to robotics and artificial intelligence. Those countries in the world for this activity that had partially or completely robotized systems in operation (usa, china, japan, australia, india, germany, france, poland and others) had room for a well-synchronized organization of work and the ability to minimize risks of infection of employed executors. This could be interpreted as a very positive reference, automation, robotics with the support of artificial intelligence for world mining, but also for other activities whose business is close to or related to mining (mechanical engineering, construction, services, etc.), (I.D. EPS, 2020), (I.D. EPS, 2021), (Arnold, 2020) and (Hassan et al., 2020).

Mining in the Republic of Serbia, however, is not at such a level of development when it comes to previous challenges, and in that sense, not much could be counted on the potential benefits within these development potentials. Nevertheless, the Serbian mining managed to keep the continuity of production slightly below the planned balance, but considering that EPS participates with the production of electricity in the Republic of Serbia with almost 60%, and there were no significant energy turbulences/earthquakes on the domestic electricity market.

Simultaneously with the pandemic, experiences were gradually gained, better knowledge of possible ways of acting was gained, and in the organizational sense, there were gradual procedural changes in work, primarily by eliminating critical places/bottlenecks in system crews for the operation of aggregate units through the formation of reserve crews. Completely to individual jobs for work in system crews.

The fact is that, as in other business activities and mining, there were diseases/infections of workers who were not capable of daily work activities, as well as that a part of them lost the battle with the infection during hospital treatment.

Part of the health problems with the risks of employees, which may arise due to the pandemic crisis can be seen through:

- Unwillingness to act properly at the time of the pandemic; (Risk range 2.9-3.5).
- Lack of procedures for workplace procedures at the time of onset of viral infection; (Risk range 3-3.6).
- Unknown format, content and form of procedures for procedures at the time of onset of viral infection; (Risk range 3.2-4).
- Uncontrolled spread of viral infection among work crews on technical systems; (Risk range 3.3-3.9).
- Insufficient or almost no knowledge about the destructive scope of the viral epidemic at the beginning of its occurrence; (Risk range 3.2-4.1).
- Insufficient knowledge of how infection can occur at the onset of infection; (Risk range 3.5-4.3).
- The extent of health problems and the clinical picture manifested in the infected; (Risk range 3.8-4.3).
- Fear of infection; (Risk range 3.5-4.4).
- Gradual knowledge of the clinical picture of a person infected with a viral infection during the duration of the infection; (Risk range 4.1-4.8).
- Defining procedures for the duration of the infection with all the necessary details, constant updating and updating; (Risk range 3.9-5).
- Problematic monitoring and controlling compliance with prescribed procedural measures for protection against infection; (Risk range 4-5).
- Difficult supply of necessary protective materials and disinfectants during a pandemic. (problem of acting in accordance with the law on public procurement for their procurement/long time of conducting the procurement procedure); (Risk range 4.1-4.8).
- Absence of executors from work on various grounds; (Risk range 3.9-4.7).
- Mass use of sick leave by employees to avoid contacts in larger groups as well as the possibility of infection; (Risk range 3.7-4.8).
- Impossibility to receive new early force in public companies without the approval of the government of the Republic of Serbia; (Risk range 4.2-5.1).
- The problem of social situations in the families of employees; (Risk range 4.7-5).
- Difficult submission of more rigorous protective measures, (locking); (Risk range 4.3-4.9).
- Uncertainty of job security and fear of dismissal or loss in all sectors; (Risk range 4-5.3).
- Confusion about the organization of life and work in the family; (Risk range 4.5-5.5).
- Problem with preschool and school children, students for the entire duration of the pandemic; (Risk range 4.3-4.9).
- Psychological problems in the family as well as individuals, adults and children; (Risk range 4.5-5.1).
- Difficult and gradual recovery of people returning from a covid system; (Risk range 3.9-4.8).
- The problem of quarantine, sick and cured, not having enough living space for isolation/quarantine; (Risk range 4.3-5.1).
- Individuals' fear of vaccination; (Risk range 4.4-5.2).
- The desire of individuals not to be vaccinated at all at the time of available vaccines; (Risk range 4.7-5.5).

- Irresponsibility/misunderstanding of individuals that if they are not vaccinated, they endanger themselves, their family as well as the entire environment and work space, their colleagues in work crews on technical systems; (Risk range 4.1-4.9).
- Fear of the possibility of a difficult financial situation that may arise in the family and in society; (Risk range 4.5-5.6).
- Fear of a major economic recession and crisis in which the world may very realistically fall over a long period of time and its impact on the lives and work of families and individuals. (Risk range 4.7-5.1).
- Reducing market demand for certain types of goods and services at the global, medium, lower and micro levels; (Risk range 4.2-4.9).
- Impossibility of prognosis and knowledge of the profession about the time of the final end of the pandemic; (Risk range 4.4-5.3).
- Fear of a new wave of major viral infection, (the latest danger from the indian virus, which has mutated twice and has already been detected in the world and the countries of the european union; (Risk range 4.8-5.5).
- Raising awareness to a higher threshold for actions in the context of protecting the health of the population at the global level; (Risk range 4.6-5.3).
- Raising the level of awareness to a higher threshold for actions in the context of protecting the health of the population in the republic of serbia and in all companies and all activities. (Risk range 4.9-5.8).
- Consistent application of procedural guidelines for prevention and protection everywhere and in every workplace; (Risk range 5.1-6).
- Efficient and rational monitoring and controlling compliance with the prescribed procedural measures for protection against infection; (Risk range 5.5-6).
- Other unknown pandemic health impacts and their consequences at all levels and in all sectors with the possibility of synergy of negative effects on health and overall health security of the individual, family and nation as a whole. (Risk range 5.3-6).

3. ANALYSIS OF TECHNICAL RISKS DURING THE GREAT PANDEMIC VIRAL CRISIS IN MINING

Technical risks in the production processes of mining during the great pandemic viral crisis are a realistic category for formatting the overall technological readiness to act in these conditions.

Title 2 of the paper lists the most common circumstances that represent a real set of potential threats and pressures, and if we add to that the synergistic effect of acting in a negative connotation, then follows the statement for a fully variable oscillation in the complete system with a priori consideration of the technical aspect of mining.

In accordance with the stated facts, it is possible to present the stated risk through a realistically achievable threat potentials with a risk matrix in a broader and narrower sense.

In a narrower sense, it represents the intersection of the risk thresholds of the current situation in one time interval that must be precisely defined, (I.D. EPS, 2020), (I.D. EPS, 2021), (Radosavljević et al., 2009) and (Kolbert, 2020).

In a broader sense, it is possible to present the risk matrix of risk variation over time from the official announcement of the beginning of a major pandemic infectious crisis until the time of presentation of this paper, given that it is a presentation of risk thresholds over time and how viral infection still lasts without reliable forecasts of its final end, certainly to be followed by the correction of the matrix as needed for a longer period of time.

The authors of this paper monitored this aspect of the technical performance of the system in a period of 300 days, from april 2020 to january 2021 years). The risk matrix provides sufficient flexible space for the required breadth of consideration and for drawing adequate conclusions.

Figure 2., shows the risk matrix in a broader context over time for potential technical impact destruction and oscillations that can be reflected in technical systems in the mining production process over a period of 300 days (April 2020-January 2021). With the prolongation of the pandemic crisis, the matrix can be updated for a longer period of time.

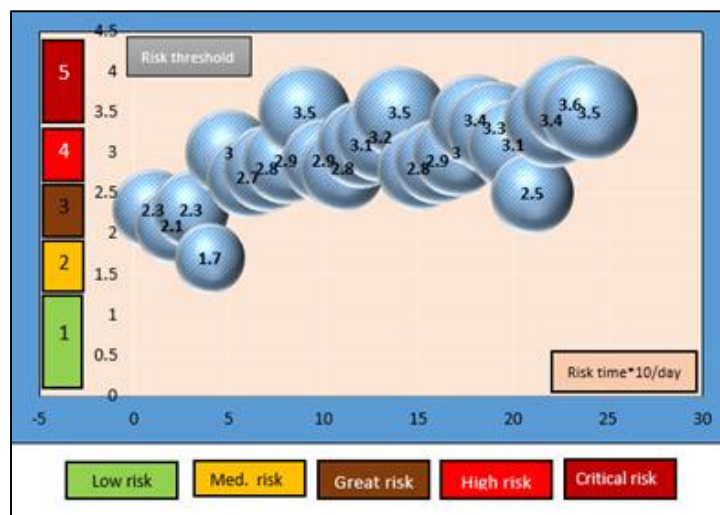


Figure 2. Overview of the risk matrix in a broader context over time for potential technical impact destruction and oscillations on technical systems in the production process of mining in a period of 300 days, (April 2020-January 2021), (Republic of Serbia, May 2021 years)

4. ANALYSIS OF HEALTH RISKS OF EMPLOYEES DURING THE GREAT PANDEMIC VIRAL CRISIS IN MINING

Health risks in mining production processes during the great pandemic viral crisis are a particularly sensitive real category for formatting the overall health safety readiness for preservation when working on technical systems and in the stated conditions.

Previously, only a part of the most common circumstances that represent a real set of potential threats and pressures on human health and safety, and if we add the possible synergistic effect of action in the case of possible joint manifestations in a negative connotation, then follows a statement for a serious assumption and fully variable oscillation.

In the complete health and safety system when analyzing and considering the health and safety format of workers who perform their work duties in mining on a daily basis.

In accordance with the stated facts, it is possible to present the mentioned risks as well as the technical ones through the realistically realizable potentials of threats with a risk matrix in a broader and narrower sense, (I.D. EPS, 2020), (I.D. EPS, 2021), (Radosavljević et al., 2009), (Radosavljević et al., 2011) and (Markz, 2021).

In a narrower sense, as previously stated, it represents the intersection of the risk thresholds of the current situation in one time interval that must be precisely defined.

In a broader sense, it is also possible to present the risk matrix of risk variation over time from the official announcement of the beginning of a major pandemic infectious crisis until the time of presentation of this paper, given that it presents risk thresholds over time and how viral infection still lasts without possibility reliable forecasts of its final end, certainly to be followed by the

correction of the matrix as needed for a longer period of time (the authors of this paper monitored this aspect of the health and safety situation in a period of 300 days, from april 2020 to january 2021). The risk matrix provides sufficient flexible space for the required breadth of consideration and for drawing adequate conclusions, (I.D. EPS, 2020), (I.D. EPS, 2021), (Radosavljević et al., 2009) and (Mattheews, 2020).

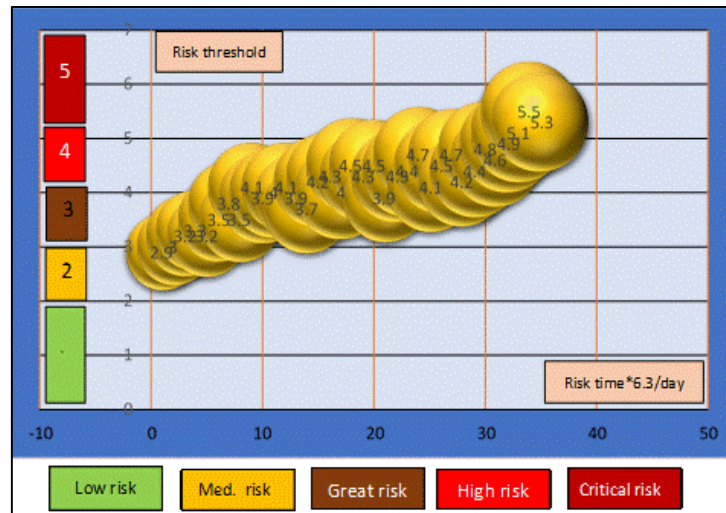


FIGURE 3. OVERVIEW OF THE RISK MATRIX IN A BROADER CONTEXT OVER TIME FOR POTENTIAL HEALTH SAFETY RISKS OF IMPACTFUL DESTRUCTION AND OSCILLATIONS ON EMPLOYED IN THE PRODUCTION PROCESS OF MINING IN THE PERIOD OF 300 ANALYZED DAYS, (APRIL 2020-JANUARY 2021), (REPUBLIC OF SERBIA, MAY 2021., YEARS)

Figure 3., shows the risk matrix in a broader context over time for potential health and safety impacts and oscillations that can be reflected on the workforce and employees in the mining production process in the analysis period of 300 days, (april 2020-january 2021 years). With the prolongation of the pandemic crisis, the matrix for this aspect can be updated, ie its risks for a longer period of time.

5. RISK ANALYSIS AND DISCUSSION OF THE OBTAINED RESULTS

Risk analysis in the context of any relations and activities on the line executor-technical system and the observed problem of connections for the technical aspect would go primarily in the direction of more complex consideration of characteristic cases of direct interaction on the execution executor-technical system and then operationalization of only the execution of activities in the context of the functioning of all technical systems.

In risk analysis, in the conditions of a large infectious pandemic, the first step is to draw a parallel of all interests on the line executor-technical system in operation when it comes to the execution of planned activities. It is then necessary to compare all activities in this process with an assessment of the risk index of each criticality/destruction of the position/activity, which is possibly possible or which is likely to occur due to any problems that are destructive and detected in the previous part. It is very important to note that now it is rare to find an analysis of such a format, scope, type and quality.

Risk analysis is generally perfected for the minimum range of risk formatting. Here we come to a completely new situation where some types of risk analysis are almost unnecessary and some analyzes are limited in scope and character, but the emphasis is on considering all parameters

of application variables of risk types for planned activity, which must be high quality, professional, comprehensive and positioned approaches and ways, with modern tools, which are available to scientists. The risk analysis of the technical aspect of the detected problem range that can be potentially destructive shows a large dispersion in the analytical points, which is a clear signal and indicator of a very high level of risk thresholds for all technical systems in operation for the analyzed time.

A major pandemic viral infection, the end of which almost no one can at least and with the least probability predict. Special attention remains to be paid to the detected components that can potentially cause technical destruction in order to minimize them and overall lower the overall risk thresholds. Here it is necessary to pay special attention to the synergistic complication that can realistically occur due to the combined/simultaneous destructive action of two or more of these components. In such situations, the risk of destruction increases drastically into the zone of critical risk, and destruction can often be fatal to technical systems in mining.

When it comes to risk analysis for the health and safety aspect of employees during a major infectious pandemic crisis, a certain rhythmic increase in risk is noticeable in the analyzed period. So there is no great dispersion but all the detected components have far higher risk potentials compared to the previously considered aspect of the problem.

As health is the basis and the greatest value of every human being, this aspect must be given maximum attention.

Here is a big problem of infection, treatment, recovery and gradual return of every person to a normal, healthy and active quality life. Special emphasis should be placed on the synergy of the action of several detected components, but also on possible new mutant components that have not been identified and which are difficult or almost impossible to detect in the future.

6. CONCLUSION

The problem of increased risk thresholds in the conditions of a major infectious pandemic crisis is evident.

The paper analyzes the risks for the technical and health safety aspect for the time period of 300 days, both for technical systems on surface coal exploitation, and for employees in mining.

Only a part of the problem was detected for both aspects, and the risk analyzes unequivocally confirm both the large risk dispersion for the first and the large but more even increase in the risk potential for the second. In order to fully understand the analyzed processes and aspects, it is very important in areas that interpret the reasons for which rules are generated and that relate to these aspects in specific and extremely complex circumstances in which the world currently lives, and with faster development. It becomes more than a necessity and an inevitability. It can be concluded that in the age of knowledge at this time, medicine as well as other sciences must quickly generate the highest quality responses in situations such as a major infectious pandemic crisis.

It turned out that even the largest and richest countries in the world have very problems during the great pandemic crisis and that almost everyone was late with an adequate response to it. It was not noticed in the opinion of the authors that there are works with multidisciplinary risk analysis for these circumstances, and this is really necessary at this time, then rotation/combining the results of different analytical approaches in risk analysis towards safer and more adequate creation of circumstances and situations for normal life and human labor. In this context, mining is in a similar situation as other branches of economic and non-economic activities, in the republic of serbia, europe and the world. Science and profession, especially medicine, are the most responsible in this segment for generating benefits for humans, and it is obvious that the possibilities are unlimited, both in terms of scope, time, and all other necessary resources.

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SOME OF THE HEALTH RISKS WHEN RELOCATING SETTLEMENTS

Slobodan Radosavljević^{1*}, Nikola Ille², Ivana Radosavljević³, Milan Radosavljević⁴

¹RB "Kolubara" d.o.o., Svetog Save 1., 11550. Lazarevac, R. Serbia; ²The Wolrd Bank, Bulevar Kralja Aleksandra 86-90, 11000, Belgrade, R. Serbia, Washington, United States; ³GO Lazarevac, Karađorđeva 42., 11550. Lazarevac, R. Serbia; ⁴GO Lazarevac, Karađorđeva 42., 11550. Lazarevac, R. Serbia

Abstract: The paper presents an analysis of health risks arising in different circumstances as well as the causes and consequences that occurred in the research conducted in 2020 due to eating disorders for people of different ages, who move from one location to another. It starts from the fact that eating disorder is a fairly broad term, which includes a condition from compulsive overeating to anorexia, and that it is caused by a large number of different conditions, and primarily manifests itself in people who are emotionally and mentally very sensitive, and therefore they also have some other problems (associated diseases) that may be or are related to their general health conditions. What is especially evident is that people of any age are not really spared from this, that is, from newborn children, children over two years of age to the population in the oldest age. If this is compared with the practical problems that the inhabitants of Vreoci have and face, who completely move with their households from the existing location to another, then the problems become more complex and have a special specificity of impact on the overall life and work of the population. The survey was conducted in June and November 2020, and is of the survey type using the SCOFF questionnaire (Developed in England by Morgan and colleagues in 1999). Analysis of health risks to the relevant circumstances of life and work of the population in the new circumstances, there was a need to define proposals for preventive and therapeutic measures for the population of the existing locality Vreoca, a functional scheme that can serve as a model for other settlements in the mining zone or some other works whose residents have started or have yet to start the process of relocating their own households from their existing ones to other locations, at any location in the Republic of Serbia.

Keywords: Relocation, health disorders, cause analysis, risks, SCOFF questionnaire, research

1. INTRODUCTION

Eating Disorder is a broad term that encompasses the condition of compulsive overeating. binge eating disorder is an eating disorder that is recognizable as compulsive consumption of abnormal amounts of food, usually very quickly, with the impression that the person is unable to stop and where he loses control of food (anorexia is a disorder). in the diet

* Corresponding author: drslobodanr@gmail.com

which is manifested in insufficient food intake due to lack of appetite, disgust with food or due to the fixed idea of a person that he is fat, although according to the current norms he is even insufficiently fed).

Eating disorders are characterized by an abnormal attitude towards food that leads to changes in diet and behaviors related to food intake.

A person with an eating disorder is too focused on their weight and body figure, makes bad decisions regarding food intake, which results in a detrimental effect on their own health.

Eating disorders include a number of pathological conditions that can affect one's physical, mental and social functioning. There are several types of eating disorders.

The most common eating disorders are:

- Anorexia nervosa - an eating disorder characterized by low body weight and a disorder of body perception with a constant fear of gaining weight. People maintain their weight by starvation or excessive exercise;
- Bulimia - an eating disorder in which pathologically excessive appetite alternates with episodes of urination - self-induced nausea, laxatives, weight loss pills, etc. ;
- Pathological gluttony - pathological need for food, accompanied by a feeling of insatiable hunger.

Some people, especially younger people, can be diagnosed with an eating disorder that is nonspecific. This means that they have some, but not all, symptoms that are characteristic of anorexia or bulimia, (Morgan et al., 1999).

Eat when you are hungry and stop eating when you are full - although quite clearly and simply formulated the golden rule of nutrition, for most people is a very demanding, and even unattainable formula for a healthy diet. At any given time, five to ten million people suffer from anorexia, bulimia or some other eating disorder. These are serious eating disorders caused by several factors. When we talk about these disorders, we primarily mean anorexia and bulimia, although today compulsive overeating, orthorexia and others are included in this group, (Trebešanin, 1998).

2. COMMON CAUSES OF EATING DISORDERS

The appearance of eating disorders is most often the fault of the social environment, which today intensively forces the ideal of a slim and thin body, especially among young people who want to look a certain way. However, the causes are usually different, there are more of them and they are far more complex.

These are most likely biological (innate factor) and environmental factors, combined with the individual's experience, as well as additional factors that contribute to the consolidation and persistence of the disorder.

It is important to note that this area is being actively researched. There are a lot of scientifically proven or confirmed but also undefined facts regarding the problems of eating disorders, especially in the part of biologically innate factors and environmental factors in their complicated meaning (synergy of several factors).

The most common risk factors that increase the likelihood of developing an eating disorder are:

- That someone in the family has suffered from an eating disorder, depression or addiction;
- Constant exposure to criticism regarding eating habits, body shape and weight;

- Constant care to be lean, especially if it is combined with the pressure of society or work that the person is engaged in (farmers, workers, pupils, students, ballerinas, models, athletes);
- Certain characteristics (obsessive personality, anxiety disorder, low self-esteem and self-esteem, perfectionism);
- Certain experiences, such as sexual or emotional abuse or the death of a loved one;
- Disturbed and difficult relationships with family members or friends;
- Stressful life situations, for example the problem of relocating households, which is the subject of research, the great global pandemic crisis that has affected the whole world and which with its duration with an uncertain end, significantly affects the organization of life and work of the population almost everywhere, at work, college in school, household and more.

In general, it is not easy to determine that the person we are observing has developed an eating disorder. The most common warning signs to pay special attention to are:

- Skipping meals for any reason;
- Constant complaints about one's own obesity even though the person is of normal weight or is thin;
- When people are constantly weighed on a scale and observed in a mirror;
- The person says they have already eaten or will go out and eat outside;
- Observed persons cook rich and complicated meals for others while eating very little or almost nothing on their own;
- People eat only certain low-calorie foods (for example celery and cucumber);
- People feel quite uncomfortable and refuse to eat in public;
- People very often visit websites that promote anorexia, and psychologically create predispositions to the disorder.
- The financial situation in which the persons find themselves;
- Frequent exposure to fear, some stressful situations and more.

The fact that a person suffering from an eating disorder can go unnoticed for years, because the body weight is often within normal limits. Overeating and cleansing are often done in secret and with a great sense of shame, (Tadić, 2010) and (Marinković, 2017).

(Statistics predict that 1 in 250 women and 1 in 2,000 men will develop anorexia at some point in life. The disorder most often develops around the age of 16-17. There is data that, in general, eating disorders affect as much as 5% of the total girl population in puberty).

One of the important questions that can be asked is why are teenagers, young women, young pregnant women so susceptible to eating disorders? The results of scientific research have shown that it is during this period that women usually start following various diets - or experiment with extreme diets, in order to stay lean. Some sports (such as gymnastics) or jobs (such as modeling) are especially risky because they force the need to maintain a slim figure.

Bulimia is as much as 5 times more common than anorexia and 90% of them are females.

Pathological gluttony affects both males and females equally. It usually occurs later in life between the ages of 30 and 40. Since it is not easy to diagnose pathological gluttony, it is not known exactly how widespread this disorder is.

There are several types of eating disorders. In the most frequent number of cases, and in the analysis of the research, three are considered (Anorexia nervosa, Bulimia and Pathological gluttony).

According to the dictionary of psychological terms: Anorexia is an eating disorder that manifests itself in insufficient food intake due to lack of appetite, disgust with food or due to a person's fixed idea that he is fat, although according to current norms he is even undernourished. It first appears in infants at the time of weaning. In adults, most often in younger women (from the middle and upper class), who are pathologically afraid that they will gain weight and therefore try to achieve a slim line with a drastic diet. Anorexia can be the result of a bad relationship with parents, peers, as well as failure in heterosexual relationships and difficulties in accepting one's sexual role, which then leads to depression and feelings of guilt that cause a relatively permanent lack of appetite. The symptom of anorexia can occur as part of hysteria, forced neurosis, melancholy and schizophrenia, (Tadić, 2010), Marinković, 2017) and (Doc. collected, 2020).

Bulimia, although often associated with a person's "life choice," is a very serious, potentially life-threatening condition. Bulimia is a disorder that disrupts the normal diet, bringing with it a chaotic change of excessive food intake and the so-called "cleansing" of the body from food. After the phase of excessive food intake, there is an almost panicky need to get rid of everything that was ingested during the meal. By forcing vomiting or using laxatives, a person really throws out what he has eaten. Similar to anorexia, the pattern of "cleansing" can be carried out by sufferers by excessive exercise and starvation. Unlike anorexia, which is more often associated with younger ages, bulimia can also occur in adulthood. A large number of cases were not diagnosed and did not receive adequate, necessary treatment. Both sexes, both men and women, can get bulimia.

Pathological gluttony is actually a pathological need for food, accompanied by a feeling of insatiable hunger. Pathological gluttony affects both males and females equally. Overeating disorder involves frequent consumption of large amounts of food and the feeling that you cannot stop eating.

It usually occurs later in life between the ages of 30 and 40. Since it is not easy to diagnose pathological gluttony, it is not known exactly how widespread this disorder is.

All people sometimes overeat due to certain social events, such as during Christmas, Easter or other holidays, but in some people overeating creates a feeling of losing control and becomes daily, and it can be said that such a person has an overeating disorder.

If a person has an overeating disorder, he may feel ashamed about overeating and every time that period ends the person promises himself that he will stop, even though it does not happen. A person cannot stop eating because he feels forced, and he cannot resist food and continues to eat, (Tadić, 2010), Marinković, 2017) and (Doc. Collected, 2020).

3. BASIC DATA ON THE SETTLEMENT OF VREOCI THAT IS BEING EVICTED

The settlement of Vreoci is located in the Municipality of Lazarevac, which is the area of the city of Belgrade. Vreoci is located north of Lazarevac.

In the settlement of Vreoci, according to the census of the Republic of Serbia, from 1-15. In October 2011, there were 2575 adult inhabitants, and the average age of the population was 39.5 years (38.4 for men and 40.5 for women). There were 1088 households in the settlement, and the average number of members per household was 2.95.

Due to the expansion of EPS mining works, 793 households were relocated from the village by the end of 2018, and another 294 households remained for relocation. The relocation process itself involves a large number of technical and psycho-physiological, social, health and other problems. This was the reason for the subject research to be done in methodologically

defined ways, in one such place with an industrial environment in the system of the mining complex of coal production and processing of the Electric Power Industry of the Republic of Serbia (EPS), (I.D. EPS, 2019), (I.D. EPS, 2020) and (I.D. EPS, 2021).

4. RESEARCH GOAL AND METHOD OF WORK

The main goal of the research was that in the target group of citizens of one settlement (in this case Vreoci), through a well-defined sample, the researcher uses randomly selected phone numbers or e-mail addresses of households and their members. randomly selected addresses and names from household databases for the settlement are visited, such as electoral registers of surveys, and then surveys of respondents in direct contact and conversation are conducted), establish, record, analyze and define causes that manifest in the context of eating disorders .

The first research in June 2020 includes the analysis of a sample of 139 randomly selected adults (over 18 years of age) of the inhabitants of the settlement of Vreoci (by the method of simple random sampling), of different ages, by filling out a questionnaire.

The second research conducted at the end of September 2020 includes the analysis of a sample of 121 randomly selected adults (over 18 years old) of the inhabitants of Vreoci, (by the method of simple random sampling), of different ages by filling out a questionnaire including the circumstances of a major pandemic crisis caused by Kovid virus19.

During this research with the help of a questionnaire, about 35% of the population of the settlement of Vreoci were interviewed and interviewed during the first research conducted in June 2020. This is in order to maintain the continuity of the research in order to determine possible changes that occurred in the period between these two researches.

The research was done using the SCOFF questionnaire.

The SCOFF questionnaire was developed at the Institute of Psychiatry, Department of Eating Disorders in London in 1999 by John Morgan of Leeds and co-authors (Reid, F. and Lacey, J.), with the aim of early detection of disorders in patients with unexplained weight loss. to improve prognosis and make it easier to identify ways and types of eating disorders. (The questionnaire uses five simple screening questions designed / validated in specialist and primary health care facilities for eating disorders. It has a sensitivity of 100% and a specificity of 90% for anorexia nervosa. Although not a diagnostic questionnaire, a score of 2 or more positive answers should increase suspicion index in the case of an eating disorder, emphasizing the mandatory need for a more detailed history of the examination of the anamnesis of the disorder.), (Morgan et al., 1999), (Torvald et al., 2012) and (Jašović et al., 2014).

The SCOFF survey questionnaire is a screening tool that can be used in the general population to identify people who may be at risk or already have an eating disorder.

The SCOFF questionnaire is a five-question screening tool designed to clarify the suspicion that an eating disorder may exist, and is not based on a diagnosis. Research questions can be submitted orally or in writing, (Morgan et al., 1999) and (Đurović, 2020).

The SCOFF survey questionnaire was applied in the research as follows:

Answer the following five questions by circling the answers:

1. Do you sometimes cause nausea and vomiting because you feel overeating? (YES, NO, I DON'T KNOW).
2. Do you worry that you have lost control of the amount of food you eat? (YES, NO, I DON'T KNOW).
3. Have you lost more than 6kg in the last 3 months? (YES, NO, I DON'T KNOW).

4. Do you think you are obese even though your surroundings tell you that you are thin?
(YES, NO, I DON'T KNOW).
5. Could it be said that food dominates your life?
(YES, NO, I DON'T KNOW).

The criteria of the author of the questionnaire for the concluded are the following:

Answering (yes) to two or more questions requires further examination and a more comprehensive assessment. The next two questions showed that they indicate high sensitivity and specificity for bulimia nervosa. These questions indicate the need for further examination and discussion. Each answer with yes to five questions yes / no on SCOFF is summarized for the total score. The results of two or more positive answers to the questions were originally set as the cut-off point for maximum sensitivity for detecting anorexia and bulimia nervosa (Morgan et al, 1999). The intersection point of the three was proposed as the best compromise between sensitivity and specificity, (Morgan et al., 1999) and (Đurović, 2003).

An analysis of 15 studies examining the usefulness of SCOFF found that the five SCOFF questions represent a highly effective means of detecting eating disorders, even by non-specialist experts, in several languages. Its use as a screening tool is recommended.

Its advantages are: readability, ease of use, efficient use of time, which is available and confirmed in other languages.

Some of the limitations of this questionnaire are: SCOFF is a self-reporting measure, may be less effective for men and older people who may present with different symptoms / more associated diseases in addition to eating disorders, does not prescribe excessive exercise for weight loss.

This questionnaire is free and easily available. SCOFF was developed in the United Kingdom, but has been adapted for use in the United States (Morgan et al., 1999; Parker, Lions, & Bonner, 2005). SCOFF translations have also been developed for use in Germany, Finland, Spain, Japan and other countries around the world, (Nikolić et al., 2003), (Ivanović, 2009) and (Main, 2005).

Table 1. Presentation of the defined criterion of the suspicion index with the indication of the risk index of suspicion for eating disorder by the authors of the research and according to (Morgan, J., Reid, F. and Lacey, J.)

Doubt index criterion (defined by the author of the paper)			
Value of index points	Index rating	Suspicion index mark	Suspicion index risk
To the 2.	Low	1	
From the 3 to the 10.	Middle	2	
From the 11 to the 30.	Hanging	3	
From the 31 to the 50.	High	4	
Pcross 50.	Extremely higt	5	

Table 1., shows the defined criteria of the suspicion index and the risk index for eating disorders by the authors of the research, according to (Morgan, J., Reid, F. and Lacey, J.).

Data collection by filling out a questionnaire by the population of different ages of the settlement Vreoci was done twice:

- For the first time in June 2020;
- Second time in late September and early October 2020.

During the second research, in addition to the targeted problems, the circumstances of eating disorders were observed, and especially the impact of the great pandemic crisis caused by the viral infection kovid19., (Main, 2015), (Radosavljević et al., 2009), (Radosavljević et al., 2009), (Radosavljević et al., 2010) and (Radosavljević et al., 2011).

5. RESEARCH RESULTS, ANALYSIS AND DISCUSSION

Table 2. Overview of the answers obtained during the survey of the population of the settlement Vreoci by age groups and the number of respondents by gender, (June 2020)

Age (years) and Number respondents		Question 1 (Answers)			Question 2 (Answers)			Question 3 (Answers)			Question 4 (Answers)			Question 5 (Answers)			In total answers		
		yes	no	i	yes	no	i	yes	no	i	yes	no	i	yes	no	i	yes	no	i
20-30 (26)	m 17	7	9	1	8	8	1	9	7	1	7	9	1	10	6	1	41	39	5
	w 9	5	3	1	6	3	0	4	5	0	8	1	0	7	2	0	30	14	1
31-40 (24)	m 11	6	5	0	7	4	0	5	6	0	9	1	1	7	4	0	34	20	1
	w 13	8	4	1	8	5	0	7	5	1	9	4	0	8	5	0	40	23	2
41-50 (26)	m 15	9	6	0	10	5	0	11	4	0	9	5	1	11	4	0	50	24	1
	w 11	6	5	0	7	4	0	6	4	1	8	3	0	9	2	0	36	18	1
51-60 (31)	m 14	6	7	1	8	6	0	9	4	1	7	7	0	8	5	1	38	29	3
	w 17	8	9	0	9	7	1	10	6	1	10	7	0	9	8	0	46	37	2
61-70 (19)	m 10	3	7	0	7	3	0	6	4	0	6	3	1	8	2	0	30	19	1
	w 9	4	5	0	5	4	0	7	2	0	6	3	0	7	1	1	29	15	1
71> (13)	m 8	5	3	0	6	2	0	5	3	0	4	4	0	5	2	1	25	14	1
	w 5	3	2	0	4	1	0	5	0	0	4	1	0	5	0	0	21	4	0
In total: (139)	m 68	36	37	2	46	28	1	45	28	2	42	29	4	49	23	3	420	256	19
	w 71	34	28	2	39	24	1	39	22	3	45	19	0	45	18	1	695		

Number of respondents 139, (m-68 male, female 71 female). Age groups of Respondents 20-30 g - 26; 31-40 g - 24; 41-50 g - 26; 51-60 g - 31; 61-70 g - 19; 71 g> - 13;

Table 3. Overview of the obtained summary answers to all questions during the survey of the population of the settlement Vreoci for all population groups, (June 2020)

Age (years) and Number respondents		Question 1 (Collective answers)			Question 1 (Collective answers)			Question 1 (Collective answers)			Question 1 (Collective answers)			Question 1 (Collective answers)			In total (Collective answers)		
		Da	Ne	N	Da	Ne	N	Da	Ne	N	Da	Ne	N	Da	Ne	N	Da	Ne	N
20 - 71>	M 68	36	37	2	46	28	1	45	28	2	42	29	4	49	23	3	218	145	12
	w 71	34	28	2	39	24	1	39	22	3	45	19	0	45	18	1	202	111	7
In total	m	70	65	4	85	52	2	84	40	5	87	48	4	94	41	4	420	256	19
	w																		

Number of respondents 139, (m-68 male, female 71 female). Age groups of respondents: 20-30 g - 26; 31-40 g - 24; 41-50 g - 26; 51-60 g - 31; 61-70 g - 19; 71 g> - 13.

Table 2., shows the answers obtained during the survey of the population of the settlement of Vreoci by age groups and sex from the SCOFF survey conducted in June 2020.

Table 3., shows the summary answers obtained during the survey of the population of the settlement Vreoci for all population groups and genders in the group, from the survey conducted in June 2020.

Table 4. Overview of the obtained summary answers during the population survey of the settlement of Vreoci for all population groups, (September 2020)

Age (years) and Number respondents		Question 1 (Collective answers)			Question 2 (Collective answers)			Question 3 (Collective answers)			Question 4 (Collective answers)			Question 5 (Collective answers)			In total (Collective answers)		
		Da	Ne	N	Da	Ne	N	Da	Ne	N	Da	Ne	N	Da	Ne	N	Da	Ne	N
20 - 71>	M 57	31	24	2	38	18	1	38	18	1	38	17	2	40	14	3	185	95	9
	W 64	38	24	2	39	23	2	40	22	2	41	22	2	43	20	1	201	111	9
Ukupno	m	69	48	4	77	41	3	78	40	3	79	39	4	83	34	4	386	206	18
	ž																610		

Number of respondents 121, (m-57 male, female-64 female). Age groups of respondents 20-30 g - 21; 31-40 g - 23; 41-50 g - 24; 51-60 g - 28; 61-70 g - 16; 71 g> - 9.

Table 4., shows the summary answers obtained during the survey of the population of the settlement Vreoci for all population groups and genders in the group, from the survey conducted in late September and early October 2020.

The total number of answers to all questions of all respondents and all population groups with yes in the first survey is 94 or 67.6%, with no is 41 or 29.5%, in the second survey is 83 or 68.6%, with no 34 or 28.1%. Given that there are several positive responses in both studies, there is a high suspicion index of eating disorders (above 2) with a high risk of destructive potentials and it could be expressed from the value of the suspicion index for the first study 38.1 and for the second 40.5. (according to Morgan, J., Reid, F. and Lacey, J.) and (index criteria of the research author).

A very high percentage of positive responses shows that the surveyed population is largely in the zone of eating disorders and that they should definitely change their habits in cooperation with professional medical workers. As it is known that this is a long-term process, that indicates the fact that changes should start as soon as possible. The participants in the research were able to personally see that there are people who have some form of eating disorder (anorexia, bulimia, pathological gluttony) at an advanced stage, which needs to be treated. Some of the respondents are being treated, but mostly from other associated diseases, but not from eating disorders, except for a small number in which conditions of pathological changes in the body inevitably require it.

As the critical age groups of both sexes is the population in the first study are from 41-50 years and 51-60 years, and in the second study as the critical age groups of both sexes in addition to the populations of 41-50 years and 51-60 years is the population of 20-30 and 31-40 years.

In other groups, there are indications for early or moderately advanced eating disorders. This is especially indicative for the population aged 20 to 30 years.

Part of the problems that were identified in both researches for the population of the settlement Vreoci, which were reached in a direct conversation based on their personal suggestions and confirmations and the desire to publish them, fully knowing the specifics of

the situation and circumstances in which they now (2020/21 years) findings, in addition to those identified in previous research and which largely contribute to the real risks, can affect eating disorders are:

- The relocation process in which all surveyed family households are almost stopped, slowed down at all levels, which causes great concern and anxiety of the owners and which is directly reflected in the manner and regularity of healthy eating in all household members (personal statement of respondents);
- Great fear and already visible great consequences (in the remaining non-eviction households there are a lot of infected people, even whole families, a lot of residents under treatment in covid centers and there are many deaths), caused by the Pandemic crisis that brought many restrictions. Extremely uncertain future of household relocation at this time but in 2021, (personal statement of respondents);
- The number of stressful situations and circumstances in which the population finds itself has increased (personal statement of the respondents);
- The economic situation of households directly affects the quality and discipline of nutrition.
- A large number of family members in households are in a state of nervousness every day for most of the day due to various circumstances and influences (personal statement of the respondents);
- The trend of improper diet has continued, (fast unhealthy food in places where one finds oneself because there is no time for a regular meal and regular healthy diet), (personal statement of the respondents);
- Increased skipping of regular meals, (personal statement of the respondents);
- Great fear for one's own capital, which will be tomorrow and neglect of one's own health condition (personal statement of the respondents);
- Postponement of preventive examinations, regularly scheduled examinations due to various diseases and groups of associated diseases (personal statement of the respondents);
- Drastic increase in air pollution in the winter and greater pneumological problems of the respiratory system, in the population of all ages in Vreoci, (personal statement of the respondents, available data on air pollution);
- High pollution of land, especially heavy metals, unhealthy agricultural products in Vreoci. A special problem is that these products are sold on the markets in Veliki Crljeni and Lazarevac (personal statement of the respondents);
- A large number of cancerous diseases and the inability to provide adequate nutrition for such conditions (personal statement of the respondents);
- A large number of cardiovascular diseases and inadequate nutrition for such conditions (personal statement of the respondents);
- A large number of other associated diseases as well as personal, emotional, psychophysiological and sociological problems related to the conditions and circumstances in which the surveyed population now finds itself as well as fear of events in the near future regarding relocation of their households- (personal statement of respondents of both sexes almost all age groups);

The identified problems indicate the fact that there was a need to conduct a more detailed survey for the population of the settlement of Vreoci, because the assumptions are in the new circumstances that another part of the problem that is very important regarding eating disorders will be identified.

It was stated that at the time of the first and second research, the surveyed citizens had almost no educational initiative by health workers that would direct the population to overcome, treat and recover from the already caused consequences of eating disorders. Medical assistance is mainly provided to the population (patients) after the occurrence of other and more complex health problems caused by eating disorders together with other associated disorders in the outpatient health care institution in Veliki Crljeni and Rudovci as well as the Health Center "Dr. Djordje Kovacevic" in Lazarevac. In both conducted researches, it was not possible to find data on whether there is and how many are the remaining population who did not move out of the settlement of Vreoci and are in outpatient and inpatient treatment and where they are being treated for the consequences caused by eating disorders.

6. PROPOSED SCHEME OF FUNCTIONING OF THE PROCESS OF TREATMENT OF EATING DISORDERS

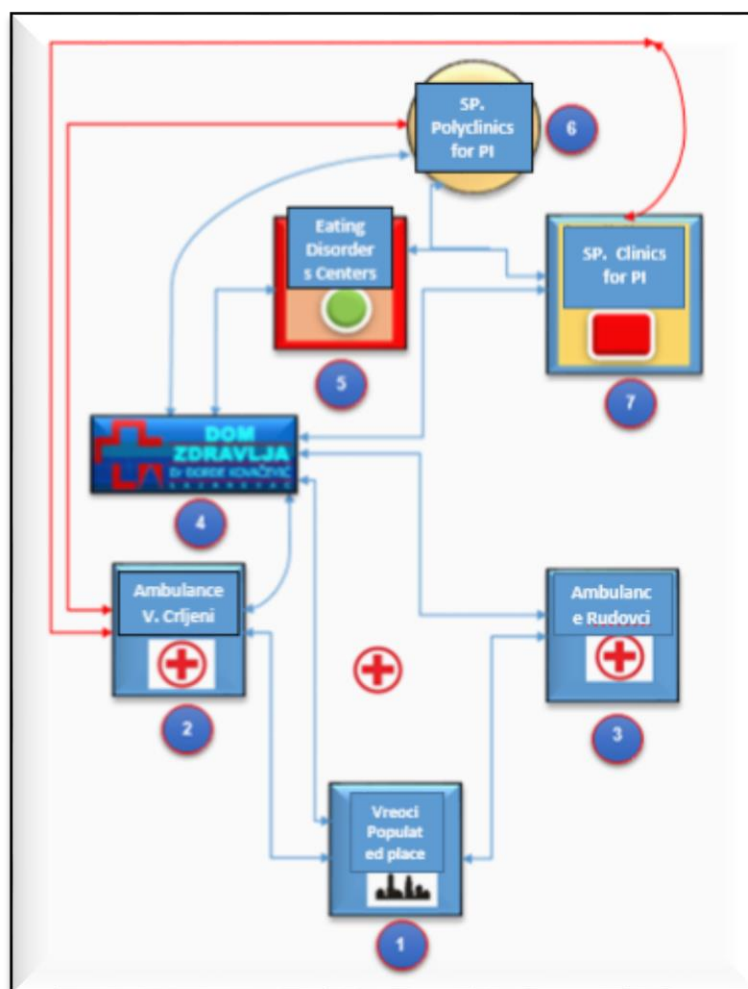


Figure 1. Proposed scheme of functioning of the process of treatment of eating disorders for the settlement of Vreoci, (1. Settlement of Vreoci, 2. Ambulance Veliki Crljeni, 3. Ambulance Rudovci, 4. Health Center, Lazarevac, 5. Centers for treatment of disorders nutrition, 6. Specialized Polyclinics for the treatment of eating disorders, 7. Specialized Clinics for the treatment of eating disorders), (April 2021)

In Figure 1., that one of the possible proposals of the functional scheme of the process of treatment of eating disorders for the settlement of Vreoci is shown.

7. CONCLUSION

The paper discusses the characteristics of eating disorders and explains the need for faster establishment of health, and especially nutritional culture of nutrition in the population of the settlement Vreoci. In developed countries, this is a standard and part of health culture that is promoted in various ways. The goal is to provide everyone with the necessary educational approaches and content, as well as the necessary medical services, .

It can be concluded that, generally observed in the practice of not only the settlement of Vreoci, Lazarevac and beyond, there are no preventive programs for eating disorders, which are really necessary and necessary for the population of not only the mentioned settlements.

The paper gives only some parts of the review of eating disorders for part of the population of one settlement (Vreoci), as well as the part that causes such conditions, and the need for research and other settlements in this way that are in a similar situation in near mining operations. It should be noted that research of this type and in this way on the mentioned areas of eating disorders, has not been done so far, at least not on the population of populated places in the Municipality of Lazarevac. There is a need for new more complex research on eating disorders in other localities, both in the zone of mining works and in the zones of performing works of other / different activities.

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EVALUATION OF ERGONOMIC CHARACTERISTICS OF CRANE CABIN SEAT

Vesna Spasojević Brkić^{1*}, Zorica Veljković¹, Aleksandar Brkić², Martina Perišić¹

¹ University of Belgrade - Faculty of Mechanical Engineering, Belgrade, Serbia, ² Innovation center of the Faculty of Mechanical Engineering, Belgrade, Serbia

Abstract: Cranes are amongst of the most dangerous equipment used in both the industry and construction sites. Despite contemporary the risk awareness, incidents in crane's operations have not substantially decreased, crane operators still work long hours in constrained workspaces requiring awkward postures and using unadequate seats. The aim of this paper is to check if application of Kittusamy's checklist on crane cabin seat characteristics is possible and to conclude possible improvement actions according to its application. Likert scale from 1 to 5 has been used. This analysis has covered few crane cabins producers such as Liebherr, Metalna, MIN, Litostroj, Goša, Clark i Ivo Lola Ribar, which are operated by 28 crane operators. Descriptive statistics and Pareto analysis show that: a) all examined characteristics have room for improvement, b) horizontal and vertical seat adjustment and hand support existence, adjustment and height should be significantly improved, c) the best characteristics are lumbar support and seat connection to floor, d) slight improvement is expected on other items, too. Proposal for further research is sample enlargement and multivariate statistics analysis application.

Keywords: crane, cabin, seat, checklist, operator

1. INTRODUCTION

Cranes are amongst of the most dangerous equipment used in both the industry and construction sites (Marques et al. 2014; Milazzo et al., 2015; Spasojevic Brkic et al., 2015). Despite contemporary the risk awareness, incidents in crane's operations have not substantially decreased (Brkic et al., 2020; Lingard et al., 2021). Crane operators still work long hours in constrained workspaces requiring awkward postures (Brkic et al., 2015). Their neck extension, trunk flexion and repetitive arm movement are associated with an increased risk of developing neck and shoulder pain that leads to reduced working capacity, quality and safety (Eger et al., 2008; Darabad et al., 2017). Exposure to awkward positions, repetitive movements in an uncomfortable working position or overtime are factors that can lead to various other musculoskeletal disorders on operators, too (Ray & Tewari, 2012; Spasojevic Brkic et al., 2015). To further improve those aspects, there is the need of a more integrated approach, where design safety and safety in the use fields, quality and productivity should be

* Corresponding author: vspasojevic@mas.bg.ac.rs

considered as one entity, with special attention paid to human error issues (Häkkinen, 1993; Milazzo et al., 2015; Brkic et al., 2020).

The aim of this paper is to check if application of Kittusamy's check list (Kittusamy, 2003) on crane cabin seat characteristics is possible and to conclude possible improvement actions according to its application.

2. LITERATURE REVIEW

The crane operators had previously indicated that discomfort was mainly contributed by a forward flexed sitting position that happened during lifts close to the crane (Kittusamy & Buchholz, 2004). Wang et al. (2000), Kushwaha and Kane (2016), Ray & Tawari (2012) and Spasojevic Brkic et al. (2015) notice necessity to minimize the anthropometric mismatch in crane cabins to solve human error issues that bring very high occupational risks.

Crane operators need to lean forward and look down through the clear floor of the cab in order to lift and lower containers in the yard (Milazzo et al., 2021). They are required to maintain a forward, trunk-flexed position (23.9 ± 2.9 degrees) of forward flexion to adequately view the workspace for 70% of their workday (Munro, 2014). Trunk angles during the maneuvering tasks averaged 30.7 ± 0.4 degrees and the highest workload experienced by the operators (Munro, 2014). The crane operators had previously indicated that discomfort was mainly contributed by a forward flexed sitting position that happened during lifts close to the crane (Kittusamy & Buchholz, 2004). Kushwaha, & Kane (2016) have noticed that, in their sample of 27 operators, 100% of them continuously suffer from some kind of musculoskeletal disorder. Hamaoui et al. (2016) have confirmed that, but put into question undesirable over activity of upper and lower limbs muscles to prevent the body from sliding. Tall crane operators are probably the most vulnerable workers, as Carragee et al. (2008) synthesized the literature and presented the fact that among workers in manual occupations, the annual prevalence of neck pain varied from 16.5% in spinning industry production line workers in Lithuania to 74% in Swedish crane operators, who are among the tallest in Europe, together with Serbian. Bovenzi, Pinto & Stacchini (2002) have found 40-60% of operators with 12-month prevalence of low back pain.

Previous research shows that the cabin shall be equipped with a chair/seat suitable for operating the crane that minimizes operator fatigue and permits visual, reach, and communications access so the intended work tasks can be performed efficiently and safely, but more survey on that topic is needed. It is evident that control and check lists would be usable to evaluate contemporary crane cabin seats designs.

But, checklists for cabin design evaluation are very difficult to find in the available literature. As follows, one, recently adopted scientifically designed checklist will be presented, with an application for evaluating the design of construction equipment cabins. The first one checklist is developed by Kittusamy (2003) and it consists of 31 questions. It has been applied to 7 types of construction equipment and 7 operators which use those equipment by Kittusamy (2003), and later on proved by Jorgensen, Kittusamy, and Aedla (2007). Fourteen of those questions are focused to seat design and will be the subject of further analysis.

3. METHODOLOGY AND RESULTS

The Kitussamy's check list (2003) parts, which are concerned with crane cabin seat design, namely the following 14 questions have been applied:

- Q1. Is the seat height adjustable?
- Q2. Can the seat be adjusted horizontally?
- Q3. Is the seat set at the appropriate height?
- Q4. Does the seat have back support?
- Q5. Does the seat have lumbar support?
- Q6. Are there armrests?
- Q7. Are the armrests adjustable?
- Q8. Are the armrests set at the proper height?
- Q9. Do you feel any vibrations from the equipment over the seat?
- Q10. Do you feel any vibrations from the equipment across the floor?
- Q11. Do you feel any vibrations from the equipment through the controls?
- Q12. Is the seat firmly attached to the cabins floor?
- Q13. Can the seat be tilted back?
- Q14. Can the seat rotate?

Likert scale from 1 to 5 has been used. This analysis has covered few producedrs such as Liebherr, Metalna, MIN, Litostroj, Gosa, Clark i Ivo Lola Ribar, which are operated by 28 crane operators, with characteristics as in Table 1. Descriptive statistics show sample sizes, means, medians, minimum and maximum, range, variance, standard deviation, and coefficient of variation (Montgomery, Runger, 2010). Only 2 of 28 examined crane operators had previous experience in accidental situations.

Table 1. Cranes and operators chacteristics

Statistic	Age	Height	Weight	Years of experiance	Age of crane
Nbr. of observations	28	28	28	28	28
Minimum	33,000	165,000	70,000	12,000	0,120
Maximum	55,000	182,000	102,000	32,000	40,000
Range	22,000	17,000	32,000	20,000	39,880
Median	50,000	176,000	83,000	22,000	40,000
Mean	46,393	173,679	87,786	20,964	35,301
Variance	65,739	34,504	125,811	45,177	86,043
Standard deviation	8,108	5,874	11,217	6,721	9,276
Variation coefficient	0,175	0,034	0,128	0,321	0,263

Table 2. Descriptive statistics on questions Q1-14

Statistic	Minimum	Maximum	Range	Median	Mean	Variance	Standard deviation	Variation coefficient
Q1	1,000	5,000	4,000	1,000	1,148	0,571	0,755	0,658
Q2	1,000	5,000	4,000	1,000	1,185	0,595	0,772	0,651
Q3	1,000	5,000	4,000	2,000	2,519	1,805	1,344	0,533

Q4	4,000	5,000	1,000	5,000	4,667	0,222	0,471	0,101
Q5	1,000	5,000	4,000	1,000	1,778	2,395	1,548	0,871
Q6	1,000	1,000	0,000	1,000	1,000	0,000	0,000	0,000
Q7	1,000	2,000	1,000	1,000	1,037	0,036	0,189	0,182
Q8	1,000	2,000	1,000	1,000	1,037	0,036	0,189	0,182
Q9	1,000	5,000	4,000	4,000	3,889	1,802	1,343	0,345
Q10	1,000	5,000	4,000	5,000	4,074	1,920	1,386	0,340
Q11	1,000	5,000	4,000	5,000	4,037	1,739	1,319	0,327
Q12	2,000	5,000	3,000	5,000	4,185	1,262	1,123	0,268
Q13	1,000	5,000	4,000	1,000	1,704	1,023	1,012	0,594
Q14	1,000	5,000	4,000	1,000	2,037	2,776	1,666	0,818

Also, Pareto principle (Grosfeld-Nir et al., 2007) is applied to summed scores obtained for all 14 questions, as in Figure 1.

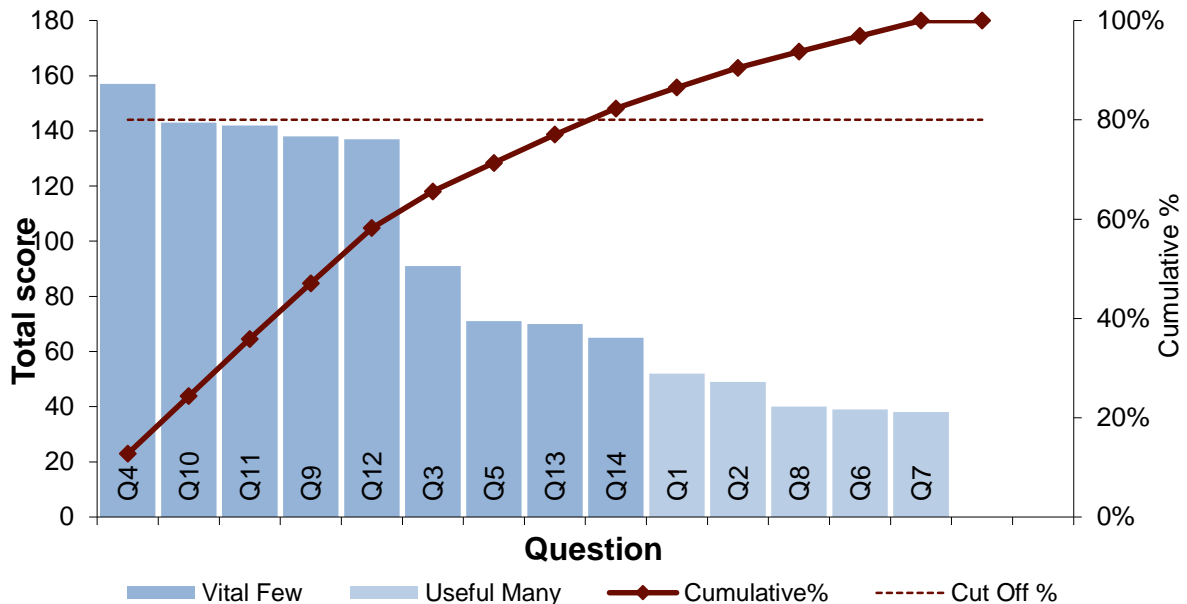


Figure 1. Pareto analysis applied to total scores obtained for questions Q1-Q14

4. DISCUSSION AND CONCLUSIONS

The aim of this paper is to check if application of Kittusamy's checklist (Kittusamy, 2003), originated for other construction equipment but cranes, is applicable to crane cabin seat characteristics. Data have been collected for 7 crane producers and 28 crane operators have participated in the survey.

Crane operators in the sample had 46.4 years, height 176 cm and 83 kg and 22 years of experience in average. Crane cabins examined were around 35 years old in average.

The highest values of mean, over 4, have Q4, Q12, Q10 and Q11, respectively, which means that observed seats have back support, that they are firmly connected to floor, and that operators feel high levels of vibration across the floor and commands. Value close to 4 on Q9

points out to the fact that operators feel vibrations also across the seat. Value a little bit above 2.5 has Q3 – about seat height. Other questions have mean values below 2.5.

The highest standard deviation has question Q14, about seat rotation, while the lowest value standard deviation is on Q6, about hand support.

Pareto analysis shows that 80% of points obtained in the check list counts on Q4, Q10, Q11, Q9, Q12, Q3, Q5, Q13 and Q14. The resting 20% include horizontal and vertical seat adjustment and hand support existence, adjustment and height.

Conclusion is that it is possible to apply Kittusamy's checklist (Kittusamy, 2003), originated for other construction equipment in aim to improve crane seats design and to conclude possible improvement actions according to its application. Other recommendations for crane cabin seats used in Serbia are as follows: a) all examined characteristics have room for improvement, b) horizontal and vertical seat adjustment and hand support existence, adjustment and height should be significantly improved, c) the best characteristics are lumbar support and seat connection to floor, d) slight improvement is expected on other items, too.

Limitation of this survey for sure is the sample size. Proposal for further research is sample enlargement and multivariate statistics analysis application.

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CUSTOMERS LOYALTY AND RISK MANAGEMENT PRACTICE IN SERBIAN COMPANIES

**Nuri Mohamed Saad Alheriani, Vesna Spasojević Brkić*, Mirjana Misita, Martina
Perišić, Neda Papić**

University of Belgrade - Faculty of Mechanical Engineering, Belgrade, Serbia

Abstract: Many organizations globally, although aimed to meet customers' needs, neglect relationship between customer loyalty and their risk management practice. Namely, there are limited studies which have conducted risk management implementation and analyzed how it could influence organizations' performance indicators. According to those facts, the main aim of this paper is to empirically analyze influence of risk management practice in Serbian companies on customers' loyalty as important performance indicator. The empirical survey intended to survey the influence of risk management practice on order fulfillment is very important dimension of operational performance. The survey containing a cover letter and a questionnaire has been sent to 200 Serbian companies certified to few management standards and 30 companies have responded. After data collection, factor and reliability analysis and regression modeling has been done to explore relationship between risk management practice and its influence on order fulfillment. According to obtained results, it is evident that it's recommended to domestic companies which are aimed to retain their customers to include in their practice risk-based policies/objectives, risk treatment plans and to pay attention to participation commitment, organizational structure, roles, powers and responsibilities for risk management, providing regular training and stakeholders at all stages of risk management.

Keywords: Customer Loyalty, Risk Management, Performance, Factor and Reliability analysis, Regression

1. INTRODUCTION

In a modern environment when the competition is intensifying, customer relationship management concept gives possibilities to reducing business risk, increasing competitiveness and profits (Cockalo et al., 2012; Tomic and Spasojevic Brkic, 2019; Siddiqi et al., 2018). Anyhow, many organizations globally although aimed to meet customers' needs, neglect relationship between customer loyalty and their risk management practice. On other side, there are many potential biases in risk management models and theories with strong separation of human and organizational factors from technical, undermining the holistic view, which can lead to an approach where people are treated as isolated and independent actors who make bad decisions in a social vacuum and who pose a threat to business and safety (de Almeida et al., 2017). Also, in risk management the available methods still dictate what to

* Corresponding author: vspasojevic@mas.bg.ac.rs

analyse, instead of the phenomena dictating which methods should be utilized. New risk management paradigm that takes into account contingencies, such as people, technology and organization and their interaction is immediately necessary.

The aim of this paper is to empirically check if risk management practice modeled in manner to support integration of management standards based on risk is related to customer loyalty and to describe that relationship.

2. LITERATURE REVIEW

Risks are managed by everyone daily through our daily activities and some of them are consciously aware and fully understood and others are not. Thus, risk management in an organization should include identifying all risks that have an impact on their objectives with understanding them fully and then establishing and implementing an effective plan to prevent these risks and thereby reduce financial losses or impacts. There are many risks explicit in health and safety, environment, quality, information security...etc., which can affect the performance of the organization. Therefore it's necessary to implement several standards such as ISO 45001, ISO 14001, ISO 9001, and ISO 27001 which are built on a risk management framework (Mayernik et al., 2017). Therefore, it remains an integral part of the management of any project and an essential component in the methodology of its management, and it does not represent a function independent of the rest of the project or the functions of the company. Consequently, the risk management approach is always holistic in relation to risk, as seen as a mixture of several environmental, programmatic and situational concerns issues, despite the primary sources of risks are often technical (Golubovic et al., 2018).

The concept of an IMS according to Benyettou et al. (2018) began to appear to industrial organizations within the past fifteen years, i.e. with the publication of the environmental management standard in the management of the organization as a first step and then one of the main requirements for the organization's survival in the production, ensuring cost-effectiveness and additionally to achieving the framework of the organization's policy and strategic decisions. Thus, integrating these standards with each other to implement the integrated management system (IMS) is gaining momentum in a rational and logical manner in order to achieve multiple advantages such as the reduction of risks and improvement of internal and external efficiency, reducing the cost of production, reduction in documentation, increasing operational efficiency, and motivating employees to increase production through the optimal use of resources and reducing duplication of tasks, which in turn are considered one of the most important factors in achieving sustainable development. On the other hand, there are various obstacles in the implementation of the integrated management system (IMS) that companies should take into accounts such as insufficient resources, lack of motivation for employees, the participation of top management and their commitment, insufficient training, the inadequacy of guidance for integration, attitudes that lead to negative results and lack of skilled auditors and consultants.

Moreover, Hamidi et al. (2012) clarify that the integrated management system IMS is used in many organizations today with the aim of leaving traditional management routines and replacing them with advanced management schemes. So in 2012, Hamidi et al. conducted a research study in Iran concerning event analysis and verification of the impact of IMSs on health and safety performance indicators for workers in power plants. The study was conducted by analyzing the data and knowing the percentage of victims' accidents before and after applying the international monitoring system and forecasting the future to show these results to us the extent to which the use of IMSs greatly contributed to reducing accident

indicators and thus improving safety in this industry during the test period and therefore recommended that this be applied an approach in other industries.

Although previous literature in the field of management systems integration (Bernardo et al., 2015; Alemida et al., 2014; Domingues et al., 2017; Hernandez-Vivanco et al., 2018) indicates that there are many strategies, processes, models, and frameworks that provide insight into the integration of management standards and implementation of the integrated management system (IMS), there exists an inadequacy in finding a methodology to design and implement risk models in these various standards in which risk management is considered one of the most integrated aspects of management systems, especially since it is important to many industrial organizations today. Therefore, there is a need to develop a risk management integrated model in standardized management systems which include ISO 9001:2015 for a QMS, ISO 14001: 2015 for an EMS, ISO/IEC 27001: 2013 for ISMS, ISO45001:2018 for occupational and safety management system, and ISO 22000:2018 for FSMS, as given in Algeriani et al. (2019). This model of risk management assists the organization in managing its various risks by identifying and treating risk factors and covering the entire organization by choosing its scope and thus assisting top management in obtaining a clear narration of the entire risk profile and then the actual contribution to the strategic and operational decision-making processes of the organization which in turn will provide adequate results of the organization's operation. Since all guidelines utilized PDCA approach with good to one another to be proceeded with progress of their presentation, and the risk appraisal strategy is in line with this cycle too, together with utilizing process approach as a far reaching extension for all procedures and frameworks in the association and various cooperation between strategies, goals and assets to control and relieve various types of undesired events in the best and proficient manner so as to address all significant risks (La Verde et al., 2019). Model proposed in Algeriani et al. (2019) can be implemented in any organization regardless of type, size, and product in many fields and levels.

Both loyalty and the company's profitability are strongly related to the process of the creation and delivery of customer value and numerous risks are encountered to reach desired results (Scridon et al., 2019; Menet&Szarucki, 2020). Risk is one of very important factors in the perception of a value, close to classical benefits and sacrifices (Woodall, 2003). Mwencha(2014) emphasises that the perceived risk has a negative influence on purchase behaviour. Kothandaraman and Wilson (2001) add that an ideal business partner is one which is able to offer significant value to the client with a low level of risk. Yee and San (2011) define perceived risk as a being the most important antecedent to consumer behaviour.

So, it is evident that connection between risk and perceived value by the customer and their loyalty exist, although it has not been surveyed enough till now.

3. METHODOLOGY AND RESULTS

The empirical survey intended to survey the influence of risk management practice as modelled in Algeriani et al. (2019) on customers' loyalty. The survey containing a cover letter and a questionnaire has been sent via email to 200 Serbian companies certified to at least three management standards – ISO 9001, 14001, 45001. The questionnaire contained four parts - the first part included demographic data on the surveyed companies, the second included information on the standards of management systems applied by company, the third part contained questions about the integration of management systems, while the fourth part included integration based on risk and its influence on companies' performance. Likert scale from 1-5 has been used on questions about risk management. Customer loyalty as

performance indicator has been indicated, with answers 0 and 1. After three months, and two reminders sent to companies in the sample, 30 companies have replied, which gives response rate of 15%. Companies in the sample have 276 employees in average and belong to ten different industrial sectors. After data collection, regression modelling has been done to explore relationship between risk management practice and its influence on customer loyalty.

Table 1. Descriptive statistics on collected data

Dimensions/ Descriptive statistics	Mean	Standard deviation	Variance	Coefficient of variation	Median
1. Goals - risk based policies/objectives	4,133333	1,041661	1,085057	0,247779	4
2. Purpose and context - risk based policies/objectives	4,1	1,268994	1,610345	0,304308	4,5
3. Continual improvement commitment - risk based policies	3,9	1,241523	1,541379	0,312989	4
4. Legal and legislation commitment - risk based policies	3,733333	0,980265	0,96092	0,258158	4
5. Policies/objectives that are based on risk	4,166667	1,116748	1,247126	0,263515	4
6. Participation commitment	4,366667	1,0662	1,136782	0,240064	5
7. Reward employees	4	1,286535	1,655172	0,316228	4,5
8. Processes and procedures necessary to address risk	4,433333	1,165106	1,357471	0,258389	5
9. Plan resources to address risks	4,366667	1,033352	1,067816	0,232668	5
10. Plan to determine the rmpes	4,166667	1,205829	1,454023	0,284535	4,5
11. Organizational structure, roles, powers and responsibilities for risk management	4,133333	1,105888	1,222989	0,263057	4
12. Provide regularly training	4,166667	1,261727	1,591954	0,297725	5
13. Stakeholders at all stages of the risk management	3,6	1,132589	1,282759	0,30932	4
14. Identification of risks with their likelihoods and consequences	4,166667	1,234094	1,522989	0,291204	5
15. Document the results of the monitoring and review of the risk	4,366667	0,999425	0,998851	0,225029	5
16. Compare the magnitude of risk	3,666667	1,184187	1,402299	0,317532	4

17. The priorities of risks that need to be treated	4,433333	0,935261	0,874713	0,207415	5
18. Implement corrective and preventive actions	4,166667	1,234094	1,522989	0,291204	5
19. Implement internal and external audit program	4,266667	1,172481	1,374713	0,270182	5
20. Implement a management review	3,933333	0,691492	0,478161	0,172848	4
21. Implement risk treatment for all risks	3,8	0,924755	0,855172	0,239266	4
22. Should select the options for risk treatment	4,1	1,241523	1,541379	0,297721	4,5
23. Prepare and implement risk treatment plans	3,933333	0,868345	0,754023	0,217055	4
24. Customers Loyalty	0,758621	0,435494	0,189655	0,564076	1

Table 2. Factor loadings after Varimax rotation on risk management practice

	D1	D2
Goals - risk based policies/objectives	0,774	0,385
Purpose and context - risk based policies/objectives	0,515	0,953
Continual improvement commitment - risk based policies	0,898	0,437
Legal and legislation commitment - risk based policies	0,577	0,489
Policies/objectives that are based on risk	0,530	0,801
Participation commitment	0,896	0,289
Reward employees	0,937	0,684
Processes and procedures necessary to address risk	0,925	0,407
Plan resources to address risks	0,784	0,302
Plan to determine the RMPes	0,511	0,893
Organizational structure, roles, powers and responsibilities for risk management	0,703	0,603
Provide regularly training	0,836	0,493
Stakeholders at all stages of the risk management	0,053	1,013
Identification of risks with their likelihoods and consequences	0,773	0,683
Document the results of the monitoring and review of the risk	0,761	0,172
Compare the magnitude of risk	0,446	0,673
The priorities of risks that need to be treated	0,541	0,435
Implement corrective and preventive actions	0,885	0,589
Implement internal and external audit program	0,522	0,711
Implement a management review	0,148	0,332
Implement risk treatment for all risks	0,043	0,624
Should select the options for risk treatment	0,797	0,726
Prepare and implement risk treatment plans	0,512	-0,044

Table3. Reliability analysis of risk management practice

Cronbach's alpha statistics :

Cronbach's alpha	Standardized Cronbach's Alpha
0,967	0,966

Guttman statistics:

Guttman L1	L2	L3	L4	L5	L6
0,925	0,970	0,967	0,996	0,950	0,925

Table 4. Model parameters (Loyalty)

Source	Value	Standard error	T	Pr> t	Lower bound (95%)	Upper bound (95%)
Intercept	3,554	0,316	11,235	<0,0001	2,858	4,250
Goals - risk based policies/objectives	-0,400	0,067	-5,968	<0,0001	-0,547	-0,252
Purpose and context - risk based policies/objectives	-0,677	0,091	-7,413	<0,0001	-0,878	-0,476
Continual improvement commitment - risk based policies	-0,105	0,046	-2,294	0,042	-0,206	-0,004
Legal and legislation commitment - risk based policies	-0,473	0,064	-7,392	<0,0001	-0,614	-0,332
Policies/objectives that are based on risk	0,160	0,053	3,005	0,012	0,043	0,277
Participation commitment	0,199	0,061	3,266	0,008	0,065	0,333
Reward employees	0,643	0,071	9,035	<0,0001	0,487	0,800
Processes and procedures necessary to address risk	-0,078	0,065	-1,194	0,258	-0,222	0,066
Plan resources to address risks	-1,011	0,126	-8,043	<0,0001	-1,287	-0,734
Plan to determine the rmpes	0,227	0,060	3,754	0,003	0,094	0,360
Organizational structure, roles, powers and responsibilities for risk management	0,197	0,075	2,644	0,023	0,033	0,362
Provide regularly training	0,956	0,124	7,714	<0,0001	0,683	1,229
Stakeholders at all stages of the risk management	0,000	0,000				
Identification of risks with their likelihoods and consequences	-0,405	0,080	-5,062	0,000	-0,581	-0,229
Document the results of the monitoring and review of the risk	0,000	0,000				
Compare the magnitude of risk	0,234	0,045	5,239	0,000	0,136	0,333
The priorities of risks that need to be treated	0,000	0,000				

Implement corrective and preventive actions	0,105	0,056	1,890	0,085	-0,017	0,227
Implement internal and external audit program	0,000	0,000				
Implement a management review	-0,435	0,070	-6,194	<0,0001	-0,590	-0,280
Implement risk treatment for all risks	0,000	0,000				
Should select the options for risk treatment	0,195	0,051	3,846	0,003	0,083	0,306
Prepare and implement risk treatment plans	0,000	0,000				

Loyalty depends on all dimensions but processes and procedures necessary to address risk and implementing corrective and preventive actions.

4. DISCUSSION AND CONCLUSIONS

The main purpose of this paper is to show relation between risk management practice and its influence on customer loyalty. Reliability analysis of collected data related to the risk management shows that there is some redundancy in the data due to the fact that the reliability values calculated by both the Cronbach Alpha and the Guttman are above 0,9. As for factor analysis, it shows that all variables can be grouped into two factors. As the minimum factor loading value for the sample of 276 respondents, factor loading is 0,35 (Hair et al., 2014) none of 25 questions is excluded from any of two emerging factors.

After the reliability analysis and factor analysis, a regression model was created and shows that the loyalty depends of all dimensions of risk management practice except procedures necessary to address risk and implementing corrective and preventive actions.

There are more than one propositions for the further research. Firstly, it is necessary to check how other factors in the survey affect the different performance of the companies and secondly, it is necessary to monitor how proposed model will prove in practice.

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PARASITE COMMUNITIES AND A CONTENT OF COPPER IN *CHONDROSTOMA NASUS* AND *ALBURNUS ALBURNUS* FROM THE DANUBE RIVER, BULGARIA

Petya Zaharieva*, Radoslava Zaharieva

Agricultural University-Plovdiv, Department of Agroecology and Environmental Protection,
Mendeleev 12, Plovdiv, 4000, Bulgaria

Abstract: The object of study in the present research were two species of freshwater fish (*Chondrostoma nasus* (Linnaeus, 1758) and *Alburnus alburnus* (Linnaeus, 1758)) from the ecosystem of Danube River (Kudelin village), Bulgaria. Tissues and organs (liver, skin and muscles) of common nase and bleak and water and sediments were analyzed for copper content. The copper concentrations decreased in the same order (liver > skin > muscles) in both fish species. The highest and the lowest mean concentrations of copper were found in common nase, respectively in liver samples ($C_{\text{Liver}} = 30.31 \pm 6.29 \text{ mg.kg}^{-1}$ wet weight; $79.65 \pm 17.70 \text{ mg.kg}^{-1}$ dry weight) and muscles samples ($C_{\text{Muscles}} = 0.54 \pm 0.21 \text{ mg.kg}^{-1}$ wet weight; $2.23 \pm 0.84 \text{ mg.kg}^{-1}$ dry weight). The mean copper concentrations in water and sediments samples were $0.18 \pm 0.15 \text{ mg.l}^{-1}$ and $315.41 \pm 284.01 \text{ mg.kg}^{-1}$ dry weight, respectively. All collected fish specimens were subjected to coparasitological examination. The isolated parasites from *C. nasus* belong to the class Cestoda and class Nematoda, while the parasites from *A. alburnus* belong to the class Trematoda and class Acanthocephala. The main ecological terms of parasite communities were discussed.

Keywords: *Alburnus alburnus*, *Chondrostoma nasus*, copper, Danube River, parasites

1. INTRODUCTION

The Danube River basin occupies ten percent of Europe's territory, divided between nineteen countries. The river basin covers more than 90% of the territory of five European countries – Serbia (92.6%), Slovakia (96%), Austria (96.1%), Romania (97.4%) and Hungary (100%) (www.icpdr.org). Numerous cities, industrial and agricultural buildings, agricultural lands, etc., are located along the river, leading to pollution, including heavy metals (Gasparotti, 2014; Jaishankar et al., 2014; Simionov et al., 2020). Fish is directly exposed to pollutants in the aquatic environment (Authman et al., 2015). As part of the human diet, fish is a subject of study for the presence of heavy metals (Pradit et al., 2010; Afshan et al., 2014). Water and sediments, tissues and organs of freshwater fish species from the Danube River, and rivers and lakes falling into its basin, have been studied for heavy metal content by various authors on the territory of Bulgaria (Hristov, 2014; Hristov & Kirin, 2014; Chunchukova et al., 2016; Chunchukova & Kirin 2017; Chunchukova et al., 2017; Kirin & Chunchukova, 2017; Shukerova et al., 2017; Chunchukova et al., 2020; Zaharieva & Zaharieva, 2020a, 2020b,

* Corresponding author: petya.zaharieva3@gmail.com

2020c; etc.), as well as on the territory of other European countries (Lenhardt et al., 2011; Andreji et al., 2012; Lenhardt et al., 2012; Skoric et al., 2012; Subotić et al., 2013; Štrbac et al., 2015; Subotić et al., 2015; Djikanović et al., 2016; Milanov et al., 2016; Jovanović et al., 2017; Kostić et al., 2017; Pavlović et al., 2019; Zuliani et al., 2019; etc.). However, investigations on copper in the Bulgarian section of the Danube River are few (Kirin et al., 2013; Kirin et al., 2014; Zaharieva & Kirin 2020a, 2020b; Zaharieva & Zaharieva, 2020d).

The present study aims to provide data on the concentrations of copper in tissues and organs of common nase and bleak, water and sediments, and data on parasites of both fish species from the Bulgarian upper section of the Danube River.

2. MATERIALS AND METHODS

In 2020, water, sediments and a total of 75 fish species belonging to two species – common nase (*Chondrostoma nasus* (Linnaeus, 1758)) and bleak (*Alburnus alburnus* (Linnaeus, 1758)) from the Danube River, Kudelin village were collected. The village of Kudelin falls in the district of Vidin, the northwestern part of the Republic of Bulgaria.

The fish were caught with a permit to catch fish for research purposes. The species of the studied fish was identified by Karapetkova & Zhivkov (2006), Kottelat & Freyhof (2007). All fish specimens of both species were measured and weighed. Basic metric data – L (maximum body length), H (maximum body height) and G (weight) were recorded, for both fish species. Mean values for L (cm), H (cm) and G (g) of *Chondrostoma nasus* and *Alburnus alburnus* were 33.45 ± 1.96 , 8.09 ± 0.75 , 369.33 ± 55.04 and 10.70 ± 0.82 , 2.25 ± 0.24 , 6.51 ± 1.53 , respectively.

Biological samples (liver, skin, muscles), three water samples and three sediments samples from the Danube River, Kudelin were investigated for copper content. The chemical analysis of the collected samples was performed in an accredited laboratory at the Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences (BAS), Sofia. The results of the chemical analysis for copper content are presented in mg.kg^{-1} wet weight and mg.kg^{-1} dry weight (biological samples); mg.l^{-1} (water samples) and mg.kg^{-1} dry weight (sediments samples). Immediately after their capture, the fish were examined for parasite presence by standard methods (Petrochenko, 1956; Zashev & Margaritov, 1966; Kakacheva-Avramova, 1983; Bauer (Ed.), 1987; Moravec, 2013). The main ecological terms of the parasite communities of the two studied fish species were presented.

3. RESULTS AND DISCUSSIONS

3.1. ECOPARASITOLOGICAL EXAMINATIONS OF *CHONDROSTOMA NASUS* AND *ALBURNUS ALBURNUS* FROM THE DANUBE RIVER

Two cyprinid fish species are selected as model fish species – common nase, *Chondrostoma nasus* and bleak, *Alburnus alburnus*. Both studied species are freshwater, gregarious fish. They are found in the Danube River and its tributaries but inhabit different water layers – the common nase inhabits the bottom layers while the bleak upper ones. The two fish species differ in their eating habits. The common nase is herbivorous, and the bleak is an omnivorous species. Both fish species are subject to sport fishing. *A. alburnus* is a small fish (with a maximum body length of up to 25 cm and up to 60 g weight), while *C. nasus* is larger (with a maximum body length up to 50 cm and up to 1.5 kg weight) (Karapetkova & Zhivkov, 2006; www.fishbase.in).

The two model fish species *Chondrostoma nasus* and *Alburnus alburnus* were subjected to ecoparasitological examination. A total of 75 fish specimens (30 specimens of *C. nasus* and 45 specimens of *A. alburnus*) were studied. It was found that the parasite communities of common nase and bleak from the Danube River (Kudelin) included two and five parasite species, respectively. The isolated parasite species of *C. nasus* belong to the classes Cestoda (1) and Nematoda (1), while of *A. alburnus* – to the classes Trematoda (4) and Acanthocephala (1). Common parasite species was not detected for the two studied fish species. In the parasite community of common nase with the highest prevalence (P%) and the highest mean intensity (MI) was the nematode *Contracaecum* sp., larvae. While in the parasite community of bleak with the highest prevalence were *Asymphyiodora imitans*, *Nicolla skrjabini* and *Postodiplostomum cuticola*, and with the highest MI was the trematode *Postodiplostomum cuticola* (Figure 1).

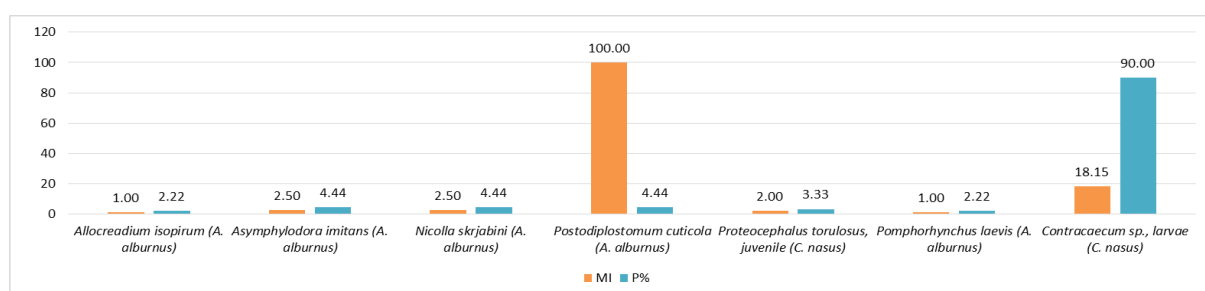


Figure 1. Mean intensity (MI) and the prevalence (P%) of parasites of *Chondrostoma nasus* and *Alburnus alburnus* from the Danube River

In the last few years, studies on parasites and parasite communities of different freshwater fish species have been performed by Chunchukova et al. (2016), Chunchukova & Kirin (2017), Chunchukova et al. (2017), Chunchukova & Kirin (2018), Chunchukova et al. (2018), Chunchukova & Kirin (2020), Chunchukova et al. (2020) for the lower part of the Danube River in Bulgaria, as well as from Zaharieva & Kirin (2020c, 2020d), Zaharieva & Zaharieva (2020a, 2020b, 2020c, 2020d) for the upper course of the river on Bulgarian territory. Kirin et al. (2013) studied fish (including common nase and bleak) from the lower part of the Danube River (Vetren biotope) for parasites. The authors did not detect parasites on common nase. In the parasite community of bleak *Pomphorhynchus tereticollis* was with the highest prevalence (P% = 75), while the parasite *Hysterothylacium aduncum* had the highest mean intensity (MI = 7.5). Chunchukova et al. (2018) analyzed the parasite fauna of 91 specimens of *A. alburnus* (Vetren biotope) and reported the highest prevalence for acanthocephalan *Pomphorhynchus laevis* (P% = 20.88) and the highest mean intensity for cestode *Ligula intestinalis* (MI = 30.22). Zaharieva & Kirin (2020c) studied 165 specimens of *A. alburnus* from the Danube River (Kudelin, Novo selo and Koshava biotopes). In the parasite community of bleak from Kudelin with the highest prevalence and mean intensity (P% = 9.52; MI = 100.00) was the trematode *P. cuticola*; of bleak from Novo selo – with the highest P% = 10.00 was *Sphaerostomum brahamae*, and with the highest MI = 100.00 was *P. cuticola*; while in the parasite community of bleak from Koshava with the highest P% = 29.03 and MI = 4.11 was the trematode *Allocreadium isoporum*. Zaharieva & Kirin (2020d) investigated 155 specimens of *C. nasus* from the Danube River (Koshava and Kudelin biotopes) for parasites. In the parasite community of common nase (Kudelin) the nematode *Contracaecum* sp., larvae had the highest P% and MI, respectively 66.37% and 22.68. In Koshava with the highest P% = 40.48 was again

the nematode *Contracaecum* sp., larvae, while with the highest MI = 8.69 was the nematode *Raphidascaris acus*, larvae.

Jirsa et al. (2007) reported the *Caryophyllaeus laticeps* on common nase from rivers in Austria, was reported with prevalence from 48.2% to 78.2% and with mean intensity from 8.8 to 17.2. Jirsa et al. (2011) announced the cestode *Caryophyllaeus laticeps* and the acanthocephalan *Pomphorhynchus laevis* in intestines of common nase from the Danube River in Austria. Djikanović et al. (2013) studied the parasite fauna of 22 fish species (including common nase) from the Danube River (Serbia) and reported cestode *Proteocephalus torulosus* with prevalence $P\% = 0.12$. Marković & Novakov (2015) announced trematode *Posthodiplostomum cuticola* on *C. nasus* from Zapadna Morava River (Danube basin, Serbia).

3.2. COPPER CONTENT IN TISSUES AND ORGANS OF *CHONDROSTOMA NASUS* AND *ALBURNUS ALBURNUS*, WATER AND SEDIMENTS FROM THE DANUBE RIVER

Tissues and organs of *Chondrostoma nasus* and *Alburnus alburnus*, water and sediments from the Danube River were studied for a copper (Cu) content. In both fish species, the Cu concentrations decreased as follows: liver > skin > muscles. Higher copper content was found in liver samples of common nase ($C_{\text{Liver}} = 30.31 \pm 6.29 \text{ mg.kg}^{-1}$ wet weight) than those in liver samples of bleak ($C_{\text{Liver}} = 5.54 \pm 1.30 \text{ mg.kg}^{-1}$ wet weight). While in the skin and muscles samples of bleak (mg.kg^{-1} wet weight, $C_{\text{Skin}} = 3.44 \pm 0.33$ and $C_{\text{Muscles}} = 1.13 \pm 0.18$, respectively) there were higher copper concentrations compared to those found in skin and muscles samples of common nase (mg.kg^{-1} wet weight, $C_{\text{Skin}} = 1.00 \pm 0.21$ and $C_{\text{Muscles}} = 0.54 \pm 0.21$, respectively). The mean concentrations of Cu in water and sediments were $C_{\text{Water}} = 0.18 \pm 0.15 \text{ mg.l}^{-1}$ and $C_{\text{Sediments}} = 315.41 \pm 284.01 \text{ mg.kg}^{-1}$ dry weight, respectively (Table 1).

Table 1. Copper concentrations in tissues and organs of *C. nasus* and *A. alburnus* (mg.kg^{-1} wet weight; mg.kg^{-1} dry weight), water (mg.l^{-1}) and sediments (mg.kg^{-1} dry weight)

Danube River		mg.kg^{-1} wet weight		mg.kg^{-1} dry weight	
		Min – Max	Mean \pm SD	Min – Max	Mean \pm SD
<i>Chondrostoma nasus</i>	Liver	23.57 – 38.11	30.31 ± 6.29	62.21 – 106.25	79.65 ± 17.70
	Skin	0.74 – 1.27	1.00 ± 0.21	1.85 – 2.67	2.38 ± 0.39
	Muscles	0.31 – 0.82	0.54 ± 0.21	1.25 – 3.31	2.23 ± 0.84
<i>Alburnus alburnus</i>	Liver	4.68 – 7.03	5.54 ± 1.30	11.58 – 20.45	16.63 ± 4.56
	Skin	3.13 – 3.78	3.44 ± 0.33	3.92 – 4.67	4.22 ± 0.39
	Muscles	0.95 – 1.31	1.13 ± 0.18	2.44 – 3.19	2.78 ± 0.38
Water		$0.18 \pm 0.15 \text{ mg.l}^{-1}$			
Sediments		$315.41 \pm 284.01 \text{ mg.kg}^{-1}$ dry weight			

Few authors studied the content of copper in common nase and bleak from the Danube River section in Bulgaria. Zaharieva & Kirin (2020a) examined liver, skin and muscles of common nase, water and sediments from the Danube River, Kudelin biotope. The authors reported higher concentrations of Cu only in skin samples of common nase ($C_{\text{Skin}} = 1.64 \pm 0.75 \text{ mg.kg}^{-1}$ wet weight) compared to the present study ($C_{\text{Skin}} = 1.00 \pm 0.21 \text{ mg.kg}^{-1}$ wet weight). Zaharieva & Kirin (2020b) also examined the liver, skin and muscles of bleak from the Danube River (Kudelin) for heavy metal content, including copper. The authors announced higher concentrations of Cu in the studied tissues and organs of *A. alburnus* ($C_{\text{Liver}} = 7.32 \pm 2.39 \text{ mg.kg}^{-1}$ wet weight).

¹ wet weight; $C_{\text{Skin}} = 3.78 \pm 2.24 \text{ mg.kg}^{-1}$ wet weight and $C_{\text{Muscles}} = 1.29 \pm 1.03 \text{ mg.kg}^{-1}$ wet weight) compared to those in the present study. While the copper concentrations in water and sediments were lower than those found in this study.

Various authors studied the content of copper in tissues and organs of common nase and bleak from rivers that fall into the Danube River basin. Andreji et al. (2012) analyzed for heavy metals muscles of five fish species from the Nitra River (in Slovakia). The established copper concentrations in common nase were $21.95 \pm 0.84 \text{ mg/kg}$ wet weight. Subotic et al. (2015) examined muscles of two fish species – *Alburnus alburnus* and *Esox lucius* caught at the confluence of the Sava River and the Danube River in Serbian territory. The authors found the following mean copper concentrations in bleak: $1.71 \pm 0.25 \text{ }\mu\text{g/g}$ dry weight. Djikanović et al. (2016) examined nine fish species from Međuvršje Reservoir (part of the Danube River basin, Serbia) for the content of 16 elements (including copper). The authors analyzed liver, muscle and gill samples, and reported the following Cu concentrations in samples of common nase: $C_{\text{Liver}} = 269.36 \pm 128.37$, $C_{\text{Muscle}} = 2.29 \pm 1.16$ and $C_{\text{Gills}} = 5.74 \pm 5.23 \text{ }\mu\text{g.g}^{-1}$ dry weight.

3.3. EXCEEDANCES OF COPPER IN TISSUES AND ORGANS OF *CHONDROSTOMA NASUS* AND *ALBURNUS ALBURNUS*, WATER AND SEDIMENTS FROM THE DANUBE RIVER

The copper content in the examined tissues and organs of both fish species in the present study was compared with the norms for Cu given by the Food and Agriculture Organization (FAO) and the World Health Organization (WHO), as well as in Ordinance No. 31 of 2004 on the maximum levels of contaminants in foodstuffs from the Bulgarian legislation, namely 30 mg/kg, 20 mg/kg and 10 mg/kg. The concentrations of copper in the investigated tissues and organs of bleak did not exceed these norms. In the case of common nase, only in liver, the Cu content exceeded the norms of FAO, WHO and Ordinance No. 31 by 1.01, 1.52 and 3.03 times, respectively (Figure 2). Zaharieva & Kirin (2020a) examined liver, skin and muscles of *Chondrostoma nasus* from the same biotope along the Danube River and reported an excess of Cu again only in liver, but only compared to the norms specified by WHO and Ordinance No. 31, 1.15 and 2.30 times respectively. The authors did not indicate exceedances according to the norm pointed by the FAO. Zaharieva & Kirin (2020b) also examined the liver, skin and muscles of *Alburnus alburnus* from the Danube River (Kudelin) and did not establish exceedances against the norms by FAO, WHO and Ordinance No. 31, which is similar to the current study of bleak.

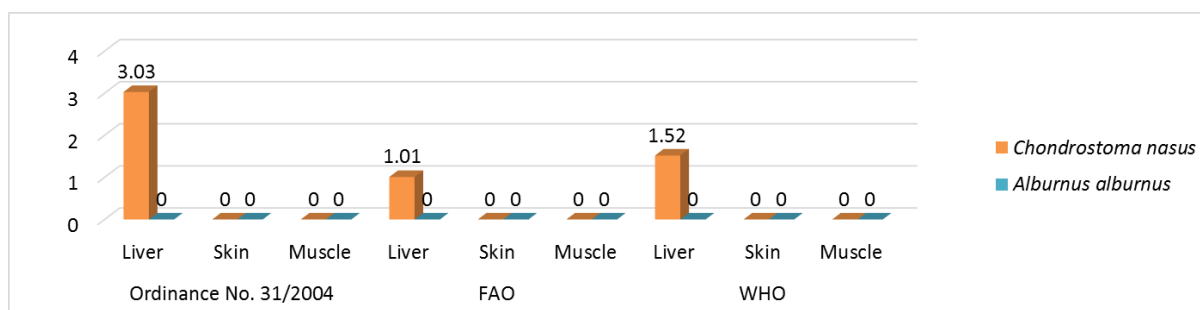


Figure 2. Exceedances of Cu in tissues and organs of *C. nasus* and *A. alburnus*

The copper concentrations in water samples from the investigated section of the Danube River were compared with the norm for Cu specified in Ordinance No. 18 of 2009 on the quality

of water for irrigation of crops (from the national legislation) – 0.2 mg/dm³. It was found that the copper concentration in the water samples did not exceed this norm.

The copper content in sediments samples was considered in relation to the Dutch Target Values – 36 mg/kg, and the norm in Ordinance No. 3 of 2008 on the norms for the permissible content of harmful substances in soils (from the Bulgarian legislation) – 150 mg/kg, at pH 6.0-7.4. The reported Cu content in sediments exceeded 8.76 times the Dutch Target Values and 2.1 times the norm in Ordinance No. 3 of 2008 (Figure 3).

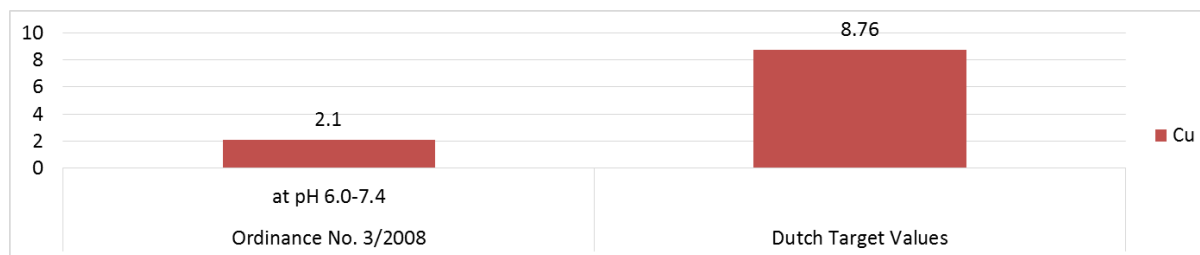


Figure 3. Exceedances of Cu in sediments

Very significant correlations between the Cu content in the biological samples from both fish species and those in the water and sediments samples ($p < 0.001$; $r_s = 1.0$) were found.

The bioconcentration factor (BCF) relative to water and sediments was presented. The values of bioconcentration factor are the highest for the liver samples of common nase/ water. In general, the bioconcentration of Cu is the highest both from water and from sediments in both fish species, and is the lowest in the muscles samples (Table 2).

Table 2. $BCF_{Cu} = [C_{\text{host tissues}}]/[C_{\text{water}}]$ and $BCF_{Cu} = [C_{\text{host tissues}}]/[C_{\text{sediments}}]$ for both fish species

<i>Chondrostoma nasus</i> / Water	BCF_{Cu}	<i>Alburnus alburnus</i> / Water	BCF_{Cu}
$C_{\text{Liver}}/C_{\text{Water}}$	168.39	$C_{\text{Liver}}/C_{\text{Water}}$	30.78
$C_{\text{Skin}}/C_{\text{Water}}$	5.56	$C_{\text{Skin}}/C_{\text{Water}}$	19.11
$C_{\text{Muscle}}/C_{\text{Water}}$	3.00	$C_{\text{Muscle}}/C_{\text{Water}}$	6.28
<i>Chondrostoma nasus</i> / Sediments	BCF_{Cu}	<i>Alburnus alburnus</i> / Sediments	BCF_{Cu}
$C_{\text{Liver}}/C_{\text{Sediments}}$	0.25	$C_{\text{Liver}}/C_{\text{Sediments}}$	0.05
$C_{\text{Skin}}/C_{\text{Sediments}}$	0.01	$C_{\text{Skin}}/C_{\text{Sediments}}$	0.01
$C_{\text{Muscle}}/C_{\text{Sediments}}$	0.01	$C_{\text{Muscle}}/C_{\text{Sediments}}$	0.01

4. CONCLUSION

In 2020, 30 specimens of *Chondrostoma nasus* and 45 specimens of *Alburnus alburnus* from the Danube River (Kudelin village) were investigated for the presence of parasites and Cu content. A total of seven species of parasites belonging to the classes Trematoda, Cestoda, Acanthocephala and Nematoda were identified. The chemical analysis showed a decrease in the Cu concentrations in the order: liver > skin > muscles. This trend was observed in both fish species, and the liver of common nase contained the highest mean copper concentrations ($C_{\text{Liver}} = 30.31 \pm 6.29 \text{ mg.kg}^{-1}$ wet weight), while the muscles of the same species – had the lowest mean concentrations ($C_{\text{Muscles}} = 0.54 \pm 0.21 \text{ mg.kg}^{-1}$ wet weight). The content of copper in water and sediments was also analyzed. The concentrations of the tested element in all samples were compared with the norms for Cu, specified in the national and international legislation.

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PARASITE COMMUNITIES AND A CONTENT OF ARSENIC IN *ALBURNUS ALBURNUS* AND *ABRAMIS BRAMA* FROM THE DANUBE RIVER, BULGARIA

Radoslava Zaharieva*, Petya Zaharieva

Agricultural University-Plovdiv, Department of Agroecology and Environmental Protection,
Mendeleev 12, Plovdiv, 4000, Bulgaria

Abstract: In the spring of 2020, the parasites and parasite communities of two species and 85 specimens of freshwater fish (bleak, *Alburnus alburnus* (Linnaeus, 1758) and freshwater bream, *Abramis brama* (Linnaeus, 1758)) from the Danube River (Kudelin biotope) were studied. Five parasite species of bleak were identified: four trematode species – *Allocreadium isopirum* (Looss, 1894), *Asymphyiodora imitans* (Mühling, 1898), *Nicolla skrjabini* (Iwanitzky, 1928), *Postodiplostomum cuticola* (von Nordmann, 1832) and one acanthocephalan species – *Pomphorhynchus laevis* (Müller, 1776). Five parasite species of freshwater bream were also found: two trematode species – *Asymphyiodora imitans* (Mühling, 1898), *Nicolla skrjabini* (Iwanitzky, 1928); one cestode species – *Caryophyllaeus laticeps* (Pallas, 1781); one acanthocephalan species – *Pomphorhynchus laevis* (Müller, 1776) and one nematode species – *Contracaecum* sp., larvae. The study also discussed the research results on the arsenic (As) content in samples of fish species, water, and sediments from the upper section of the Danube River (Kudelin biotope) Bulgaria. The highest As concentrations were found in the liver samples and the lowest – in the muscles samples in both studied fish species. Data on arsenic concentrations in tissues and organs of freshwater bream from the Danube River, Kudelin biotope, were provided for the first time.

Keywords: *Abramis brama*, *Alburnus alburnus*, arsenic, Danube River, parasites

1. INTRODUCTION

The Danube River (2857 km) is among the three longest rivers in Europe, along with the Volga River (3700 km) and the Ural River (2428 km) (Sidorchuk et al., 2009; Ramazanov & Dzhanaileyeva, 2012; Ilie et al., 2016). The rivers are subject to anthropogenic pollution, including heavy metals and metalloids contamination flowing through vast areas (Ilie et al., 2017). In general, the lower sections of the rivers are more polluted (Simionov et al., 2016). Fish, including the species *Alburnus alburnus* and *Abramis brama*, as well as water and sediments from the Danube River, have been studied for heavy metals/ metalloids by a number of authors from different European countries through which the river flows (Diaconescu et al., 2008; Urdeş et al., 2010; Lenhardt et al., 2012; Mititelu et al., 2012; Zrnčić et al., 2012; Ioniță et al., 2014; Milošković et al., 2016; Tudor et al., 2016; Burada et al., 2017; Jovanović et al., 2017; etc.). However, few authors study the ichthyofauna of the Bulgarian section of the

* Corresponding author: radoslava.zaharieva7@gmail.com

Danube River, both for heavy metal content and for the presence of parasites (Kirin et al., 2013; Kirin et al., 2014; Chunchukova et al., 2016; Chunchukova et al., 2017; Chunchukova & Kirin, 2020; Chunchukova et al., 2020; Zaharieva & Kirin 2020a, 2020b, 2020c, 2020d; Zaharieva & Zaharieva 2020a, 2020b, 2020c, 2020d; etc.).

The purpose of the present study is to provide new information on parasites and parasite communities of two fish species – *Alburnus alburnus* and *Abramis brama*, as well as to trace arsenic (As) accumulation in fish tissues and organs, water and sediments from the Bulgarian section of the Danube River (Kudelin biotope).

2. MATERIALS AND METHODS

A total of 45 specimens of bleak (*Alburnus alburnus*) and 40 specimens of freshwater bream (*Abramis brama*) were caught from the upper Bulgarian section of the Danube River, northwestern Bulgaria, during the 2020 spring season. Samples of water, sediments and fish were collected from the Danube River in the vicinities of Kudelin village, designated as Kudelin biotope (Figure 1).

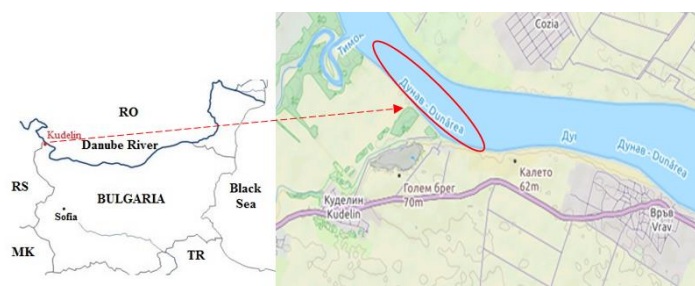


Figure 1. Danube River, Kudelin biotope, northwestern Bulgaria [ViewRanger]

The collected fish species were identified (Karapetkova & Zhivkov, 2006). All caught specimens from both fish species were weighed and measured (Table 1).

Table 1. Maximum body length (L), maximum body height (H) and weight (G) of the studied specimens of *A. alburnus* and *A. brama*, the Danube River

Danube River / Kudelin Spring, 2020		L (cm)	H (cm)	G (g)
<i>Alburnus alburnus</i> N = 45	min – max	9.1 – 12.5	1.7 – 2.9	4 – 12
	Mean ± SD	10.70 ± 0.82	2.25 ± 0.24	6.51 ± 1.53
<i>Abramis brama</i> N = 40	min – max	17.5 – 40	5 – 13	61 – 873
	Mean ± SD	22.94 ± 4.55	7.11 ± 1.51	156.48 ± 140.01

All specimens of bleak and freshwater bream were investigated for parasites (Petrochenko, 1956; Zashev & Margaritov, 1966; Kakacheva-Avramova, 1983; Bauer (Ed.), 1987; Moravec, 2013). Temporary and permanent microscopic slides were prepared from the isolated parasites (Zashev & Margaritov, 1966; Georgiev et al., 1986; Scholz & Hanzelova, 1998; Moravec, 2013). The prevalence; mean intensity; mean abundance and the Brillouin's diversity index (HB) were discussed (Magurran, 1988; Bush et. al., 1997).

Liver, skin and muscles samples of bleak and freshwater bream and water and sediments samples were analyzed for arsenic content by ICP "OPTIMA 7000" Perkin-Elmer at an

accredited laboratory at the Institute of Biodiversity and Ecosystem Research (IBER), Bulgarian Academy of Sciences (BAS), Sofia. The bioconcentration factor and the linear correlation coefficient of Spearman were also presented. Statistical data analysis were performed using Statistica 10 (StatSoft Inc., 2011) and MS Excel (Microsoft 2010).

3. RESULTS AND DISCUSSIONS

3.1. PARASITE COMMUNITIES STRUCTURE OF *ALBURNUS ALBURNUS* AND *ABRAMIS BRAMA* FROM THE DANUBE RIVER

The subjects of this study are two fish species from the family Cyprinidae – bleak (*Alburnus alburnus*) and freshwater bream (*Abramis brama*), which inhabit different water layers. The bleak is found in the upper water layers and is a carnivorous species that uses mainly zooplankton and insects for food. The freshwater bream prefers the lower water layers and is an omnivorous species that use zooplankton, algae, and other food sources. *A. alburnus* is a small fish and up to 19 cm in length, while *A. brama* is up to 80 cm in length (Karapetkova & Zhivkov, 2006).

As a result of this ecoparasitological study of the 45 specimens of *A. alburnus* and the 40 specimens of *A. brama* from the Danube River's freshwater ecosystem, Kudelin biotope, five parasite species were found in 7 bleak specimens (*Allocreadium isopirum* (Looss, 1894), *Asymphylogora imitans* (Mühling, 1898), *Nicolla skrjabini* (Iwanitzky, 1928), *Postodiplostomum cuticola* (von Nordmann, 1832) and *Pomphorhynchus laevis* (Müller, 1776)) and five parasite species – were found in 12 freshwater bream specimens (*Asymphylogora imitans* (Mühling, 1898), *Nicolla skrjabini* (Iwanitzky, 1928), *Caryophyllaeus laticeps* (Pallas, 1781), *Pomphorhynchus laevis* (Müller, 1776) and *Contracaecum* sp., larvae). Common parasite species for the parasite communities of *Alburnus alburnus* and *Abramis brama* were *A. imitans*, *N. skrjabini* and *P. laevis*.

In comparison with previous studies (Zaharieva & Kirin, 2020c), the current study identified the highest number of parasite species on bleak (5 species) in one season. Zaharieva & Kirin (2020c) reported three parasite species on *A. alburnus* (for Kudelin biotope) during each of the three studied seasons (*N. cheilancristrotus*, *P. laevis* and *Contracaecum* sp., larvae (spring); *P. cuticola*, *Sph. bramae* and *P. laevis* (summer) and *P. cuticola*, *Sph. bramae* and *Contracaecum* sp., larvae (autumn)). The lowest number of parasites (2 species – *Sph. bramae* and *N. cheilancristrotus*) were reported for bleak from Novo selo biotope during the summer season of 2019. The following parasites on *A. alburnus* from the lower section of the Danube River (Vetren biotope) in Bulgaria *Pomphorhynchus tereticollis* and *Hysterothylacium aduncum* (Kirin et al., 2013); as well as *Nicolla skrjabini*, *Ligula intestinalis*, *Acanthocephalus lucii*, *Pomphorhynchus laevis* and *Contracaecum microcephalum*, larvae (Chunchukova et al., 2018) were reported.

In the present study, five parasite species on freshwater bream were identified, while in a previous study of *A. brama* from Kudelin biotope (Zaharieva & Zaharieva, 2020c), six parasite species were reported. Zaharieva & Zaharieva (2020c) also studied specimens of freshwater bream from the 805-810 river km along the Danube River, finding five parasite species. Various authors provide data on parasites and parasite communities of freshwater bream from the lower section of the Danube River on the territory of Bulgaria (Vetren and Silistra biotopes). The following parasites on *A. brama* from Vetren biotope have been reported: *Gyrodactylus elegans*, *Diplozoon paradoxum*, *Paradiplozoon homoion*, *Dactylogyrus yinwenyingae*, *Asymphylogora imitans*, *Asymphylogora tincae*, *Caryophyllaeus fimbriceps*,

Acanthocephalus lucii, *Acanthocephalus anguillae*, *Pomphorhynchus laevis*, *Pomphorhynchus tereticollis*, *Contracaecum microcephalum*, larvae and *Raphidascaris acus*, larvae (Kirin et al., 2013; Churchukova et al., 2016; Churchukova et al., 2017; Churchukova et al., 2020). For Siliistra biotope, the following parasite fauna of *A. brama* have been reported: *Gyrodactylus elegans*, *Diplozoon paradoxum*, *Asymphyllodora imitans*, *Palaeorchis incognitus*, *Caryophyllaeus laticeps*, *Pomphorhynchus laevis*, *Pomphorhynchus tereticollis* and *Rhabdochona denudata* (Kirin et al., 2014; Churchukova & Kirin, 2020).

3.2. COMPONENT COMMUNITIES OF *ALBURNUS ALBURNUS* AND *ABRAMIS BRAMA* FROM THE DANUBE RIVER

Parasites were found in 19 specimens (22.35%) of the 85 examined bleaks and freshwater breams. Four trematode species (with more than 211 specimens) and one acanthocephalan species (with 1 specimen) were found in the component community of bleak. The component community of freshwater bream was also dominated by trematodes (two species with 17 specimens), followed by cestodes, acanthocephalans, and nematodes represented by only one species. In the parasite community of *A. alburnus*, all parasite species were accidental ($P\% < 10$). The trematode *P. cuticola* has the highest mean intensity and the highest mean abundance ($MI = 100.00$ and $MA = 4.44$). In the parasite community of *A. brama*, the trematode *A. imitans* and the acanthocephalan *P. laevis* were component parasite species with a prevalence of 17.50% and 10.00%, respectively. The other three parasite species were accidental. *Contracaecum* sp. was distinguished with the highest mean intensity ($MI = 5.00$), while *A. imitans* was distinguished with the highest mean abundance ($MA = 0.40$) (Table 2).

Table 2. Basic ecological terms of the parasites and the parasite communities of *A. alburnus* and *A. brama* (N – number of investigated fish, n – number of infected fish, p – number of fish parasites, MI – mean intensity, MA – mean abundance, P% – prevalence)

Parasite species	<i>Alburnus alburnus</i> (N = 45)					
	n	p	MI	MA	P%	Range
<i>Allocreadium isopirum</i>	1	1	1.00	0.02	2.22	1
<i>Asymphyllodora imitans</i>	2	5	2.50	0.11	4.44	2-3
<i>Nicolla skrjabini</i>	2	5	2.50	0.11	4.44	1-4
<i>Postodiplostomum cuticola</i>	2	> 200	100.00	4.44	4.44	> 100
<i>Pomphorhynchus laevis</i>	1	1	1.00	0.02	2.22	1
Parasite species	<i>Abramis brama</i> (N = 40)					
	n	p	MI	MA	P%	Range
<i>Asymphyllodora imitans</i>	7	16	2.28	0.40	17.50	1-7
<i>Nicolla skrjabini</i>	1	1	1.00	0.02	2.50	1
<i>Caryophyllaeus laticeps</i>	1	1	1.00	0.02	2.50	1
<i>Pomphorhynchus laevis</i>	4	7	1.75	0.18	10.00	1-3
<i>Contracaecum</i> sp.	1	5	5.00	0.13	2.50	5

Zaharieva & Kirin (2020c) studied *Alburnus alburnus* from three biotopes (Koshava, Kudelin and Novo selo) along the Danube River and reported a total of seven parasite species. In the parasite communities of bleak, with the highest mean intensity were *P. cuticola* ($MI = 100.00$) from Kudelin and Novo selo biotopes, and *A. isopirum* ($MI = 4.11$) from Koshava biotope.

Zaharieva & Zaharieva (2020c) investigated the parasites and the parasite communities of *Abramis brama* from the Danube River (Kudelin) and identified six parasite species, and *P. cuticola* was with the highest mean intensity (MI = 100.00), followed by *A. imitans* (MI = 77.10). In another previous study (Zaharieva & Zaharieva, 2020d) on freshwater bream from the Danube River (805-810 river km), five parasite species were reported, and again *P. cuticola* was with the highest mean intensity (MI = 100.00), followed by *A. imitans* (MI = 58.67).

3.3. INFRACOMMUNITIES OF *ALBURNUS ALBURNUS* AND *ABRAMIS BRAMA* FROM THE DANUBE RIVER

Two species and 85 specimens of fish were caught and examined for the presence of parasites, of which 16 fish specimens were infected with one parasite species, 3 fish specimens were infected with two parasite species. Sixty-six specimens of fish were not infected (Figure 2; Table 3).

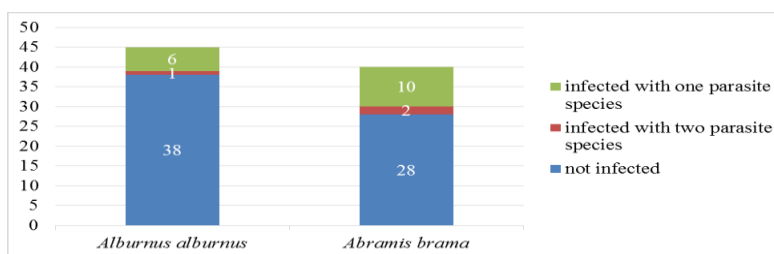


Figure 2. Infection of *A. alburnus* and *A. brama*

In the infracommunities of *Alburnus alburnus* and *Abramis brama* from the Danube River (Kudelin biotope), the number of the detected parasites in one specimens was >100 and 7, respectively. More than 242 parasite specimens were studied. Brillouin's diversity index (HB) was much higher for the infracommunities of *A. alburnus* (HB=2.64±3.34) compared to those for the infracommunities of *A. brama* (HB=0.31±0.38). This is due to the significantly higher number of specimens associated with the established invasion with *P. cuticola* (> 200 specimens). Both host species were invaded with five parasite species.

Table 3. Infracommunities of *A. alburnus* and *A. brama*

Number of specimens <i>Alburnus alburnus</i>	Number of parasite species		
	0	1	2
38	38	6	1
Total number of species (Mean number of species ± SD)	5(0.12±0.32)		
Total number of specimens (Mean number of specimens ± SD)	>212(1.20±3.51)		
Brillouin's diversity index (HB)	2.64±3.34		
Number of specimens <i>Abramis brama</i>	Number of parasite species		
	0	1	2
28	28	10	2
Total number of species (Mean number of species ± SD)	5(0.29±0.79)		
Total number of specimens (Mean number of specimens ± SD)	30(6.41±34.25)		
Brillouin's diversity index (HB)	0.31±0.38		

3.4. CONCENTRATIONS OF ARSENIC IN *ALBURNUS ALBURNUS* AND *ABRAMIS BRAMA*, WATER AND SEDIMENTS FROM THE DANUBE RIVER

This study presents the arsenic concentrations in liver, skin and muscles of *Alburnus alburnus* and *Abramis brama*, in water and sediments from the Danube River. In fish samples, the As content is given in mg.kg⁻¹ wet weight and mg.kg⁻¹ dry weight, and in water and sediments samples in mg.l⁻¹ and mg.kg⁻¹ dry weight, respectively (Table 4).

Table 4. Arsenic concentrations (C_{As}) in fish, water and sediments from the Danube River

C _{As}		Mean ± SD mg.kg ⁻¹ wet weight	Mean ± SD mg.kg ⁻¹ dry weight
<i>A. alburnus</i>	Liver	12.18±1.55	37.15±11.83
	Skin	2.42±0.35	3.03±0.47
	Muscles	1.65±0.61	2.99±0.31
<i>A. brama</i>	Liver	9.44±6.97	31.89±24.59
	Skin	7.13±6.87	18.13±15.89
	Muscles	3.41±2.67	14.40±11.60
Water		6.07±3.18 mg.l ⁻¹	
Sediments		583.85±39.82 mg.kg ⁻¹ dry weight	

Of the examined tissues and organs of bleak and freshwater bream, the highest content of arsenic (As) was found in the liver samples (C_{As/A.alburnus} = 12.18±1.55 mg.kg⁻¹ and C_{As/A.brama} = 9.44±6.97 mg.kg⁻¹; wet weight), followed by those in skin samples (C_{As/A.alburnus} = 2.42±0.35 mg.kg⁻¹ and C_{As/A.brama} = 7.13±6.87 mg.kg⁻¹; wet weight) and muscle samples (C_{As/A.alburnus} = 1.65±0.61 mg.kg⁻¹ and C_{As/A.brama} = 3.41±2.67 mg.kg⁻¹; wet weight). Arsenic concentrations in liver samples of bleak were higher than those found in liver samples of freshwater bream, but As concentrations in skin and muscle samples of freshwater bream were higher than those in skin and muscle samples of bleak. In both fish species (*A. alburnus* and *A. brama*), the arsenic content decreased in the following order: liver > skin > muscles. In the samples of water and sediments from the Danube River (Kudelin biotope), the As concentration was 6.07±3.18 mg.l⁻¹ and 583.85±39.82 mg.kg⁻¹ dry weight, respectively (Table 4). The established differences are statistically significant (p<0.05), and there is a very significant correlation, both between biological samples and those from water and between biological samples and those from sediments (r_s=1; p<0.001).

Zaharieva & Kirin (2020b) studied liver, skin and muscles of bleak from the Danube River (Kudelin biotope) and reported 2.31, 5.93 and 1.3 times higher As concentrations than the mean concentrations of arsenic found in the present study. However, the authors' concentrations in water and sediments were 86.71 and 29.91 times lower than the mean concentrations presented in the current study. Zaharieva & Zaharieva (2020d) investigated freshwater bream, water and sediments from the Bulgarian section of the Danube River (between 805-810 river km) for a presence of As. The authors reported that arsenic concentrations decreased in the following order: liver (4.31±1.53 mg.kg⁻¹ wet weight) > skin (2.22±0.52 mg.kg⁻¹ wet weight) > muscles (0.46±0.14 mg.kg⁻¹ wet weight). These reported arsenic concentrations in fish and water samples (0.06±0.05 mg.l⁻¹) and in sediments samples (22.71±14.58 mg.kg⁻¹ dry weight) were lower than those found in the present study.

Chunchukova & Kuzmanova (2017) studied tissues and organs of bleak, water and sediments from the Bulgarian section of the Danube River (Vetren biotope) for arsenic content.

The authors reported the highest As concentrations in liver ($0.600 \pm 0.690 \text{ mg.kg}^{-1}$), followed by those in muscles ($0.073 \pm 0.029 \text{ mg.kg}^{-1}$) and skin ($0.066 \pm 0.037 \text{ mg.kg}^{-1}$). The reported mean concentrations of As in water and sediments were 0.013 mg.l^{-1} and 5.74 mg.kg^{-1} , respectively. The mean concentrations of arsenic in fish, water and sediments from the upper part of the Danube River (Kudelin biotope) found in the present study were several times higher than those established by Chunchukova & Kuzmanova (2017) for the lower section of the river (Vetren biotope).

In the current study, the bioconcentration factor (BCF) was calculated to determine the extent to which the studied tissues and organs of both fish species accumulated arsenic from the surrounding environment (water and sediments) (Table 5). BCF is the highest for liver, both regarding the As content in the water and regarding the content in the sediments samples, such as the factor values for both fish species are much higher than the As content in the water samples.

Table 5. $BCF_{As} = [C_{\text{host tissues}}]/[C_{\text{water}}]$ and $BCF_{As} = [C_{\text{host tissues}}]/[C_{\text{sediments}}]$

Fish tissues and organs / Water	BCF_{As}	Fish tissues and organs / Sediments	BCF_{As}
$C_{A.alburnus}/\text{Liver}/C_{\text{water}}$	2.01	$C_{A.alburnus}/\text{Liver}/C_{\text{sediments}}$	0.06
$C_{A.alburnus}/\text{Skin}/C_{\text{water}}$	0.40	$C_{A.alburnus}/\text{Skin}/C_{\text{sediments}}$	0.01
$C_{A.alburnus}/\text{Muscle}/C_{\text{water}}$	0.27	$C_{A.alburnus}/\text{Muscle}/C_{\text{sediments}}$	0.01
$C_{A.brama}/\text{Liver}/C_{\text{water}}$	1.56	$C_{A.brama}/\text{Liver}/C_{\text{sediments}}$	0.05
$C_{A.brama}/\text{Skin}/C_{\text{water}}$	1.17	$C_{A.brama}/\text{Skin}/C_{\text{sediments}}$	0.03
$C_{A.brama}/\text{Muscle}/C_{\text{water}}$	0.56	$C_{A.brama}/\text{Muscle}/C_{\text{sediments}}$	0.02

4. CONCLUSIONS

In the spring of 2020, two species and a total of 85 specimens of freshwater fish from the Danube River (Kudelin biotope) were studied for the presence of parasites. Sixty-six of them were not infected, and in 19 fish specimens a total of seven parasite species were found – four species of trematodes (*Allocreadium isopirum*, *Asymphyloglora imitans*, *Nicolla skrjabini*, *Postodiplostomum cuticola*); one species of cestodes (*Caryophyllaeus laticeps*); one species of acanthocephalans (*Pomphorhynchus laevis*) and one species of nematodes (*Contracaecum* sp.). From them, five parasite species were reported for each host species. Common parasite species for the parasite communities of *Alburnus alburnus* and *Abramis brama* were *A. imitans*, *N. skrjabini* and *P. laevis*. Data on arsenic content in biological samples of *A. alburnus* and *A. brama* (liver, skin and muscles) in water and sediments were also presented. The highest mean concentrations of arsenic were found in the liver samples of bleak ($C_{As/A.alburnus} = 12.18 \pm 1.55 \text{ mg.kg}^{-1}$ wet weight; $37.15 \pm 11.83 \text{ mg.kg}^{-1}$ dry weight), and the lowest – in the muscle samples, again of bleak ($C_{As/A.alburnus} = 1.65 \pm 0.61 \text{ mg.kg}^{-1}$ wet weight; $2.99 \pm 0.31 \text{ mg.kg}^{-1}$ dry weight). In general, the arsenic content in the fish samples decreased in the order: liver > skin > muscles. The established differences for the As content in the biological samples of both species are statistically significant ($p < 0.05$). The correlations between this content and the As content in water and sediments are very significant ($r_s = 1$; $p < 0.001$). BCF is the highest for the liver, both regarding the As content in water and sediments.

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CUSTOMER INTERACTION STRATEGY IN DIGITAL PLATFORMS AND NEW RISKS

Yulia Syaglova^{*}, Tatiana Maslevich, Natalia Safronova

*Russian Presidential Academy of National Economy and Public Administration (RANEPA);
Moscow State University of Civil Engineering (MGSU), Russian Federation.*

Abstract: In the context of economy digital transformation most companies faced with the task of forming, adapting or adjusting the strategy of interaction with customers. This task is determined by global trends which affect to the client behavior in the digital environment and the formation of a successful business model for the organization.

The most significant trends in business processes transformation are technological trends, as well as socio-cultural trends. In the context of Internet technologies, new digital platforms are being formed. An example of such platforms are marketplaces of global, national or niche coverage, as well as ecosystems which create an integrated effective business model. That circumstances help clients to realize their requirements in the field of forming a new customer experience. The company's stakeholders are able to form an omnichannel customer experience by organizing a special CJM, including offline and online points of interaction. Therefore, the global task of such digital platforms is to form an effective strategy for managing all customer contact points in order to achieve the best customer experience and the highest profitability of the company. An omnichannel strategy for managing the customer experience should be based on the requirements of "seamless", regardless of the type of interaction point with the platform. The consequence business process changing is the emergence of new "digital" risks. The most significant risks today are the risks of customer identification, information loss, cyberattacks, fraud risks in the digital environment. Their organization of risk management create challenges to the global risk management system.

Keywords: digital platform, customer journey map (CJM), seamless client interaction, business processes, digital risks, omnichannel.

1. INTRODUCTION

In the context of digital transformation, most businesses in various industries and business areas face the task of shaping, adapting, "customizing" or adjusting the strategy for interacting with their customers. This task is due to global trends that influence, on the one hand, the behavior of the client in the digital environment, and, on the other hand, the formation of an optimal, effective business model for an organization.

Digital transformations of business environment within the company in various fields of activity, in general, develop under the influence of a comprehensive program for the digital transformation of the Russian Federation. According to a KPMG study, 63 % of Russian companies have a digital transformation program (KPMG Analytical report, 2019). In world

^{*} Corresponding author: syaglova-yv@ranepa.ru

practice, about 70 % of companies are involving in such a program. At the same time, about 68 % of Russian companies have already implemented certain elements of digital technologies. The implemented digital technologies include Big Data and predictive analytics tools which substantiate the possibility of obtaining additional efficiency and effectiveness in business processes due to the expedient collection, storage, decryption and use of data which is the main resource of digital transformations.

Within the framework of the KPMG study, the following data was obtained: 77 % of Russian companies expect to increase operational efficiency and reduce costs due to the effectiveness of individual business processes. At the same time, digitalization of office business processes is part of the introduced digital technologies and transformation strategy. About 50 % of companies use this solution to improve efficiency and save company resources.

The KPMG analytical report also presented the barriers to implementing a digital transformation strategy: the insufficient maturity of existing business processes (for 64 % of companies); the lack of required competencies (for 58 % of companies); the lack of the necessary infrastructure (for 35 % of companies) and lack of budget (32 % of companies).

The barriers, according to the authors, indicate that the implementation of a digital transformation strategy as a whole is a prerequisite for the further successful functioning of a company in the digital economy. However, the digitalization of individual business processes requires a budget for digital transformations, competencies within the personnel of a company, the optimal amount of data for analysis, processing and further business decisions, as well as additional preparation of business processes for the possibility of “digitization” and / or digitalization.

One of the tools for improving the efficiency of the company's interaction with customers and building a new business model is the construction of a customer travel map (CJM). This approach to the study of the company's points of contact with the client is the most popular today and requires further improvement. There are also scientific studies devoted to the search for optimal services at points of contact with the client to improve the interaction experience (Azzin Shiratori et al., 2021), the ways of customers in the context of buyers of different age categories, in particular, melilnials, whose customer experience is given special attention (Mele et al., in the press), separate works are devoted to the study of risks in the cyber environment that buyers face as part of their customer experience in cyberspace (Boletsis et al., 2021). In the future, the authors of the publication will focus on the digital transformation of the process of forming an effective CJM, the possibilities of managing it to increase its effectiveness, as well as on digital threats and risks in the formation of an effective CJM.

2. TECHNOLOGICAL AND SOCIOCULTURAL TRENDS

Having analyzed the analytical material of global research and consulting companies such as Deloitte, Gartner, PWC and others, the authors systematized the information and formulated the main types of trends that influence the formation and effective functioning of digital business processes in companies.

The first type is a group of technological trends.

Technological trends are developing under the influence of such digital technologies as: neurotechnology and artificial intelligence technologies, distributed ledgers and quantum technologies, Big Data technologies and the Internet of Things (IoT), robotics and sensorics and technologies of virtual and augmented reality (AR, VR), cloud technologies storage and new production technologies (Digital twin, Smart manufacturing). This group of technologies allows companies to shape and digitalize their business processes, while ensuring the security

of the functioning of data and the "digital footprint" left by stakeholders. In addition, the authors are confident that the list of technologies is not finalized, it is constantly expanding, since the conditions for the formation and functioning of companies in the digital environment are also subject to rather rapid changes and require adaptation and adjustment to socio-cultural trends which will be discussed below.

The second type is a group of socio-cultural trends.

This group is associated with changes in the requirements and needs of the client that acquires new experience of interaction with companies in the modern digital space and forms new channels of contact in its route (CJM). In the context of the analysis of socio-cultural trends, modern companies in the digital economy are represented by the following types. These are completely digital companies - platforms that do not have a physical presence; omnichannel companies, in which part of the client's CJM is formed and proceeds in a digital environment, and partly through physical contacts with the company; integrated business models such as marketplaces which are represented by partnerships of a number of companies, united by a single customer CJM, represented by digital and physical contact channels.

Returning to the categorization of socio-cultural trends, the authors consider it important to dwell on the mandatory presence of customer-centricity and customer-centricity in the business model of companies which are aimed at taking into account the interests of either the entire target audience of the company or its individual segments in order to form a more significant value chain for the client and the company. In addition, when building a CJM business process, the parameter of transparency and traceability of all interactions with the company (elements of distributed ledgers and blockchain technologies) is important, which allows real-time monitoring of the current channel of contact in CJM, identifying problems and imperfections and implementing them in a real-time mode in order to avoid "breaks" in the customer's journey and the subsequent flow of CJM. An important socio-cultural parameter is the perfection of the customer experience when moving between separate points of contact in CJM. Perfection in this case is assumed that neither the client nor the company sees significant difference in the value chain when the client moves from one channels of contact to another, taking into account both the "digital" ways and the physical ones. The client can freely move between these groups and, if desired, replace the physical way with a "digital" one or vice versa, at will or need, without affecting the decrease in value in the chain of relationships with the company. Next, it should be emphasized the importance of speed and accuracy when interacting with channels of contact in the client's CJM. In the digital environment, the speed of communications in general is significantly increased and does not allow to decrease, the client receives information much faster, selects and compares goods or services, makes a purchase, and so on. In case of a decrease in the speed of operations within the framework of CJM, the client can quite easily, in the absence of additional motivation, for example, within the framework of a loyalty program, switch to a competitor company that will offer the client the highest speed, accuracy and efficiency of operations within the framework of CJM.

3. DIGITAL PLATFORMS AND CJM STRATEGY

Thus, the technological and socio-cultural trends formulated above allow the authors to come to the general conclusion that in the context of the increasing penetration of Internet technologies, both in Russia and in international economic spaces (according to research data, the penetration rate is about 60-85 % depending on the business area), as well as the increasing willingness of customers to make an increasing number of transactions using e-commerce (from 50 % to 80 % depending on the geographic location of the customer, the type of product

purchased, generational changes and trends in customer behavior, the availability of a technical opportunity to enter Internet and so on), in the digital economic system, preconditions are formed for the formation of new digital platforms which enable the client to implement all the above requirements in the field of forming a new customer experience as part of the CJM (Internet World Stats).

We are talking about such digital platforms as marketplaces and general economic trend. Among the formed marketplaces, one should highlight: global digital platforms operating within the global economic and trade space, implementing, as a rule, the widest range of goods and / or services, for example, such as Amazon, Walmart, Alibaba and others; marketplaces at a national level of coverage, operating within one country which, as a rule, sell a wide range of goods and / or services, for example, in Russia, such as Sbermegamarket, Ozon, Wildberries; as well as niche-level platforms operating within a limited range of models, for example, in Russia, such as the Fair of Masters, Leroy Merlin, Profi.ru, and so on.

In addition to the highlighted types of marketplaces in terms of coverage and assortment presented, integrated business models called ecosystems are also distinguished in the new digital economic system which include many stakeholders from various spheres of economy. These stakeholders are united by a single space and create an integrated effective business model. Successful digital ecosystems include Alibaba, Amazon, Sberbank, Yandex.

In such digital spaces, the clients of the ecosystem which, according to the parameters of client-centricity and client-centricity, are represented by two types: external - the final consumers of products or goods, and internal - the team, personnel, suppliers within the company. These types of customers in the ecosystem have a unique opportunity to form a special value chain with the highest impact for each individual group. Typically, the generated CJM is represented by an omnichannel customer experience model that includes "digital" and physical touchpoints.

Based on the foregoing, the global goal of digital platforms is to form an optimal and effective strategy for managing all channels of contact for all types of customers in order to achieve the best experience in the framework of CJM, on the one hand, and the highest efficiency in carrying out the company's business processes, on the other.

Such a strategy for managing customer experience in a digital environment should be based on the above-mentioned requirements of socio-cultural and technological trends, such as:

- "perfection", regardless of the type of interaction with the platform;
- the speed and accuracy of performing the required operations when placing an order, organizing logistics, marketing operations, and so on;
- convenience and comfort in interaction with the platform, which are realized through high-quality usability and design of the site and / or mobile application as channels of contact;
- availability of technically advanced digital spaces - a website and / or a mobile application with the ability to quickly load content;
- availability of diverse and fast delivery and payment options for goods;
- availability of a relevant stock, confirmed by the warehouse, suitable for placing an order;
- availability of customer support and service that is able to quickly solve emerging problems for the client;
- availability of opportunities for monitoring and controlling "digital" risks arising in the infrastructure of the platform;

- taking into account the requirements of metrics and KPIs in order to maintain the effectiveness of the digital business.

The authors of the publication believe that the strategy for managing customer experience in new digital platforms can be successful, while ensuring effectiveness for all stakeholder groups along the entire chain of origin of touchpoints in CJM:

- manufacturers and suppliers of products and goods to the platform;
- teams and talents within different departments and divisions of the digital platform which are the internal links of the system;
- providers of logistics and marketing services, if they are implemented on the basis of outsourcing technologies;
- end consumers;
- the digital platform itself as an intermediary providing the opportunity to establish relationships between the specified stakeholders.

4. DIGITAL RISKS

Having defined the main parameters of the client experience management strategy in the context of digital business transformation, the authors of the publication consider it necessary and appropriate to dwell on the risks generated in the digital environment. The authors of the publication believe that a lack of understanding of the emerging barriers and risks can have a negative impact, and in some cases even provoke a “failure” or bankruptcy of the digital business model due to untimely response, lack of control mechanisms and management of emerging risks.

The fourth stage of the industrial revolution (Industry 4.0) brings significant economic and social benefits to participants in economic processes, allows them to expand the coverage areas of users, offer new services, and reduce, in some cases, operating costs. At the same time, a radical restructuring of the business model gives impetus to the emergence of new risks, most of which arise in the digital environment.

By now the digitalization of business processes has already allowed the risk management to adapt to the new model of work with a client and the conditions for the functioning of digital platforms in a remote format of work, without the presence of physical contact with the client.

At the same time, the creation of a business ecosystem model, the transition from digital processes of an individual enterprise to digital platforms for their joint interaction, prepares a new challenge for the risk management.

Formation of a strategy for managing customer experience in digital platforms in a seamless entry, focus on customer-centricity, the use of cloud technologies and artificial intelligence capabilities to analyze a significant amount of information, identify technological risks as the most significant threats to the implementation of enterprise strategy.

The risk management community agrees that the most significant of these are identification risks, risks of information loss, “cyber attacks” and risks of fraudulent activities. Among these risks, one can single out a group that is objectively related to the novelty of the development process and the use of the latest technologies, and a group of risks, the source of which are deliberately performed unauthorized operations in the digital space, ranging from

data theft and extortion to planned large-scale attacks on the information systems of organizations which potential consequences can become significant.

Currently, a client getting on a digital platform to interact with an enterprise, simultaneously via a blockchain system and / or a distributed ledger, becomes both a client of the organization and a full participant in the entire business ecosystem. In these conditions, he is forced to take on the function of a risk manager and be responsible for managing his own risks in full.

A separate group of risks is the possibility of gaining access to private information and user data on social networks, as well as its distribution and unauthorized use. As of the beginning of 2021, about 66.6 % of the world's population (5.22 billion people) use mobile devices, about 60 % of people worldwide (4.66 billion people) use the Internet, in 2021 the number of users increased by 7.3% (Digital world & Russian statistics, 2021).

In these conditions, the importance of the risk management function in the enterprise management system increases, as a guarantor of the protection of assets of all participants in economic interaction.

When building a risk management system in the context of an increasing rate of change in the internal and external environment of the organization's functioning, one should pay attention to the following features:

1. The growth of variations in the implementation of risks due to the different nature of their occurrence, manifestation and impact on business. The same process, performed using online and offline technologies, can lead to consequences that differ significantly in the nature and degree of impact. This leads to an increase in the register of enterprise risks and the complication of building a control system over them.

2. The presence of "blind" zones of the business process without coverage by risk control measures, when the nature of development and the speed of introduction of new technologies into the production process do not allow the risk manager, due to the limited human consciousness, to fully realize the presence of current risks and predict the occurrence of potential risks. Consequently, their identification in most cases is possible only upon implementation in the practice of economic activity, which, in turn, can lead to reputation losses and direct financial losses.

3. High correlation between operational and strategic risks, due to the complication of execution and an increase in the scale of the impact of business process procedures when a single operation performed in violation of risk management recommendations or due to the presence of a "human factor", may exceed the level of risk tolerance.

In the coming years, the speed of changes and implementation of scientific and technological progress in business processes will increase. According to forecasts, by 2025 significant financial funds are planned to be invested in the development and improvement of cloud services technologies - about 623 billion US dollars, automobile unmanned vehicles - 416 billion US dollars, unmanned aerial vehicles - 52 billion US dollars (WEF Global Risk Report, 2020).

Potential risks of use of these and other technologies in the production process remains to be studied and the extent of their possible impact on the activities of organizations to be assessed.

5. NEW COMPETENCIES

In the context of the digital nature of new risks, managers are required to have new “digital” competencies, their willingness to manage potential risks during the period of business transformation.

Leaders must have critical thinking and analytical mindset to predict and assess possible risks, the ability to control in the field of cybersecurity, knowledge in the field of change management and project management.

According to the authors of the publication, professional “digital” management competencies in the field of risk management include:

- special theoretical knowledge and practical skills in the use of new tools to identify, assess and forecast risks, built on Big Data and artificial intelligence technologies using methods of statistical analysis and mathematical modeling;
- competence in the analysis of the architecture of the organization's business processes, as well as digital platforms and ecosystems for the presence of existing and forecasting potential risk events when the model of interaction with the organization's stakeholders changes;
- the ability to see the relationship of risk events, their cause-and-effect relationship and build a reliable line of defense, avoid "blind" areas open to control-centered procedures;
- the ability to develop and provide new services to all interested parties in the field of forming approaches and choosing methods of protection against the existing and potential risks in the digital environment for the implementation of business processes;
- the use of digital analytics to identify patterns in the course of the process in order to further automate activities using the capabilities of artificial intelligence based on IT systems;
- skills in the formation of the internal environment of the organization with a focus on risk culture in which both business participants and customers of the organization may not come into direct contact but be present as channels of contact on the organization's IT platform or signals on CJM.

When working with risks today, special attention should be paid to the collection and analysis of relevant information to make management decisions. According to the annual survey of CEOs of the largest companies in the world, conducted by PWC specialists, only 22 % of them believe that they receive sufficiently complete data on risks to make strategic decisions, while this indicator has not shown positive dynamics over the past ten years (PWC Analytical report, 2019).

A significant part of the respondents not only lacks knowledge about risks, but also lacks the formed risk-oriented thinking necessary to work in the new conditions of total risk. In addition, risk management must be integrated into the strategic decision-making process and into the enterprise's digital transformation plan. When building a three-level protection system which includes departments that accept risk when interacting with customers, develop a risk management policy and management structures of the organization, special attention should be paid to the interaction of all functional divisions of the organization to involve them in an integrated risk management process with the aim of retaining and increasing the value of the business.

When examining the issue of the organization's readiness to manage risks in the new environment, it should be noted that readiness for management should be understood as the presence of a clear roadmap for the process of business transformation and the use of new technologies, the possibility of using digital methods of identification and assessment in

working with risks, the integration of the risk management in the development processes and making strategic decisions in the organization, using the capabilities of artificial intelligence to optimize the operational activities of the organization. There is no unambiguous answer about the readiness of the risk management function to adapt to new conditions due to the lack of reliably significant information. According to estimates from the PWC report, out of 1,000 surveyed respondents and risk management specialists, only one fourth is ready to build a risk management system in practice fully.

In the activities of the rest of the respondents, the readiness to manage risks in the new conditions is partially present, in the form of separate elements of the system. At the same time, the current stage of development requires the transformation of the competence of the risk manager into digital skills which will contribute to the formation of an adequate approach to risk management in the new reality, accelerate the digitalization of enterprise business processes, as well as increase the efficiency of investments in the development and application of new technologies.

6. CONCLUSIONS

After conducting a systematic analysis of analytical materials from research and consulting companies, as well as on the basis of the above material, the authors of this publication came to the following conclusions:

1. In the emerging new digital economic environment, a significant part of organizations are inclined to implement a comprehensive digital transformation strategy or to include elements of digitalization in individual business processes.
2. The formation and implementation of basic and auxiliary business processes in organizations are influenced by technological and socio-cultural trends.
3. The formation of CJM customers in the digital environment is due to the emergence of digital business models, namely marketplaces and digital ecosystems.
4. The strategy for the formation and management of CJM is based on the principles of omnichannel “perfection” and reflects both the interests and needs of customers, as well as the goals of the effectiveness and marginality of the business model.
5. The creation of a business ecosystem model and the transition from digital processes of an individual company to digital platforms prepares a new challenge for the risk management and is due to the presence of new "digital" risks.
6. In the context of the digital nature of new risks, managers are required to have new “digital” competencies, their willingness to manage potential risks during the period of business transformation.

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APPLICATION OF E-BUSINESS IN THE COUNTRIES OF SOUTHEAST EUROPE DURING THE COVID PANDEMIC

Sanela Arsić*, Ivan Jovanović, Isidora Milošević, Milena Jevtić, Anđelka Stojanović

*University of Belgrade, Technical Faculty in Bor, Engineering Management Department,
Bor, Serbia*

Abstract: The COVID-19 pandemic has gripped all EU countries and has significantly shaken up all enterprises' business. The effects of pandemic also were reflected on electronic business (e-business). Hence, the purpose of this research is to determine the level of e-business development in the ten states of Southeast Europe (SEE), based on the data collected from the Eurostat Data for 2020. This research used the PROMETHEE-GAIA method to rank countries according to key indicators of e-business based on five different criteria. The obtained results indicate that the best-ranking country is Croatia, while in Serbia, e-business development is at the lowest level. Additionally, the sensitivity analysis shows considerable stability in the result. The findings can be beneficial for policymakers in analysed countries and managers of enterprises to evaluate strategies and policies designed to foster a conducive environment for e-business at both the national and international level.

Keywords: E-business, Information communication technologies, Enterprises, PROMETHEE method

1. INTRODUCTION

The growing use of the Internet and information and communication technologies (ICT) significantly impact the way enterprises conduct business nowadays. Electronic business (E-business) and IKT provide opportunities for enterprises to compete in the world market and have a vital role in the global economy (Moriset, 2020), especially in the COVID-19 period, which has covered the whole world and reflects on all type of industries. Therefore, the pandemic has led to a much better understanding of the importance of E-business. During the pandemic period, in order to place their products and services on the market, many companies recognised the chance to come to the users using the online environment. This business trend has also spread to enterprises that did not use this type of business before the pandemic. E-business has provided customers with safe and secure access to products and services and has enabled companies to continue to operate despite limited contacts and other confinement measures.

When it comes to E-business, very often are identified the term E-business and E-commerce. However, E-commerce is limited only to purchases and sales of goods or services, while E-business captures many elements of the value chain where used ICT.

E-business integrates the human resource management systems, supply chain management systems, enterprise resource planning systems, customer relationship

* Corresponding author: saarsic@tfbor.bg.ac.rs

management systems, knowledge management systems, as well as trust mechanisms to provide the capability of transforming business operations (Lai & Chen, 2009; Chan, 2010; Chung et al., 2011). E-business is a business model where the business takes place in a network environment through the Internet (Pilinkiene et al., 2013; Moriset, 2020). Also, this business model transforms traditional business processes between stakeholders such as customers, suppliers, employees, and communities, by allowing them to operate businesses in a network environment (Lai & Chen, 2009). Pilinkiene et al. (2013) E-business defines as a set of processes and tools that allows companies to use the Internet, i.e., it's based on applying information technologies to conduct business internally and externally. On the other hand, Troshani and Rao (2007) consider that E-business providing organisations new opportunities to deliver goods and services and add value through improvements in supply chain efficiency and effectiveness.

E-business is composed of compact systems requiring skilful, professional employees who will effectively exploit the functionalities of systems and enable the enterprises to realise benefits. Therefore, the dependability of the functions and services delivered by E-businesses will affect employee fulfilment of business tasks (Lai & Chen, 2009; Hadi Putra & Santoso, 2020).

The potential of E-business came to the fore, especially during the pandemic COVID-19, because it was shown how important this segment of the business is for enterprises. Therefore, the research question in this paper deals with the analysis of the level of development of key indicators that affect E-business in the countries of Southeast Europe (SEE). The PROMETHEE method of multi-criteria decision-making was used to rank alternatives (SEE countries). Taking into account that the level and effects of development E-business are not the same in all states of SEE, the paper has analysed the differences between EU member states (Croatia, Slovenia, Greece, Turkey, Bulgaria, and Romania) and states which not EU members (Montenegro, North Macedonia, Bosnia and Herzegovina, and Serbia). Considered alternatives are ranked according to the crucial functionalities of E-business (3D printing and robotics, artificial intelligence, big data analysis, cloud computing services, supply chain management). Simultaneously, the GAIA plane was used for graphical interpretation of the obtained results.

The rest of this paper, through the following sections, is organised. Section 2 presents the literature review of the key functionalities of E-business. Section 3 shows a used methodology based on the PROMETHEE method. Section 4 related to the obtained results and includes a discussion of the findings. Finally, the conclusion section (Section 5) considers the limitations and recommendations for improvements.

2. THEORETICAL BACKGROUND

New networking capabilities and advanced information and communication technologies allow enterprises to communicate, transact, and collaborate with business partners with greater ease and more flexibility than ever before at a lower cost. The key indicators of E-business development that companies use in their daily business are 3D printing and robotics, artificial intelligence, big data analysis, cloud computing services, integration of supply chain management.

2.1. 3D PRINTING AND ROBOTICS

3D printing and robotics are a growing field of research. To form objects with complex structures straight from a digital design presents 3D printing of soft robotics (Keneth et al., 2020). The fabrication of soft robots is currently challenging and highly time and labour-intensive. Recent advancements in three-dimensional (3D) printing of soft materials and multi-materials have become the key to enable the direct manufacturing of soft robots with sophisticated designs and functions (Yap et al., 2020). Soft robots have received increasing attention due to their numbers of advantages, such as safety for human operators, high flexibility and increased design freedom. This technology allows engineers and designers to devise unique products manufactured cost-effectively at low volumes (Gul et al., 2018). Another advantage of 3D printing technology is that it is ecologically convenient. 3D printing technologies and soft robotics have a high potential for applications in various fields such as multiple manufacturing divisions, robotics, motorised, health and aerospace, and it is expected that this substantial growth will continue over the following years (Yu et al., 2017, Keneth et al., 2020).

2.2. ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) is a technology that supports and facilitates economic activities and the daily social life of the people (Lu et al., 2018). The application of artificial intelligence in business has emerged as a response to one of the constant challenges in the industry, reducing business costs (Agrawal et al., 2017). Leading world companies, it is considered that the usage of artificial intelligence has set specific standards for productivity, utility, and accuracy in enterprises (Kumar & Kalse, 2021). The condition of the market and business for AI technologies are changing rapidly. Many Internet giants and start-up companies are racing to invest in AI technologies. Given that in the new industry based on the application of artificial intelligence, the so-called „Industry 4.0“, large amounts of data are continuously processed, must pay special attention to the protection of personal data (Helmold, 2019).

Artificial intelligence is applied in a lot of segments of life. The combination of a neural network, giant data banks and learning abilities enables the imitation of some human skills. Artificial intelligence is used to recognise images and languages draw logical conclusions, for E-commerce prediction algorithms, for managing robots with human-like characteristics and for others purposes (Lu et al., 2018).

The usages of the following issues of artificial intelligence contribute to the enhancement of production during covid-19: QR code; sales prioritisation; identification, verification and surveillance (bank) (Lu et al., 2018; Jablonska & Polkowski, 2020). These issues show that artificial intelligence can be beneficial for the development of SMEs in financial, marketing, accounting information systems, supply chain management, avoiding commercial risks, improving production and improving foreign market expansion. Adopting new technologies in any form is a requirement of SMEs, and it will take enterprises towards sustainability (Kumar & Aggarwal, 2018).

2.3. BIG DATA ANALYSIS

Big Data has gained enormous attention in recent years. In the era of Big Data, that term refers to the considerable quantity of available information. The purpose of this approach is that large quantities of data are continuously produced and stored at lower cost (Stein, 2010), i.e., the data can be made and stored more massively and economically. This trend has a significant impact on all pillars of society, especially on science, engineering and business (Fan et al., 2014). Science is a serious consumer of big data because scientific advances depend on the adequate processing of large amounts of data. This analysis brings new challenges and opportunities to explore high-dimensional data.

To handle the challenges of Big Data, it is necessary computational methods and new statistical thinking. In the last years, numerous companies have adopted the data-driven approach to improve business performance and reduce risks, especially in E-business. Companies are implementing specialised data analytics programs to gather, store, manage and analyse massive datasets from various sources to identify key business challenges that can be useful for decision-makers to make a better decision (Zhao, 2020, in press).

2.4. CLOUD COMPUTING SERVICES

In computing technologies cloud computing is one of the fastest growing. Cloud computing supports virtualisation technologies and provides an opportunity for end-user to deploy virtual resources at negligible cost without having any added infrastructure (Shiju & Pramila, 2021, in press). It empowers users to share lots of configurable framework assets over the Internet. This technology is one of the evolving areas where distributed services are requested without the physical networks at the customer end. The physical tools of cloud computing are mounted at remote locations and use (Revuri et al., 2021, in press). A cloud is a place of substantial infrastructural possessions which offers multiple diverse amenities for the end-users. Cloud providers control all resources available to the customers. The user does not need to know where the computer requirement is discovered and how the cloud works. The National Institute of Standards and Technology cloud computing defined as a “Model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort and or service provider interaction” (Ravi Kumar et al., 2018).

Cloud technology offers to lease and utilising manufacturing possessions whenever the needed resources are based on demand to promote elasticity (Brintha et al., 2021, in press). Many people are using cloud computing in day-to-day life in some form without being aware of it. Industries use cloud-based technologies to achieve mass production in reduced time, provide customer satisfaction, dynamic management of customer orders and cope with limited time to market the product.

The cloud computing has many advantages, such as anytime-anywhere accessibility, better geographic coverage with the fastest time, less investment in infrastructure, etc. (Ravi Kumar et al., 2018). On the other side, in cloud computing exists number challenges that appear like data security, lack of resources and expertise etc.

2.5. INTEGRATION SUPPLY CHAIN MANAGEMENT

Information technologies and E-businesses have contributed to the development of supply chain operations. Companies' ability to work successfully in today's competitive and fast-moving business environment depends on integrating with other supply chain members.

The E-commerce industry includes product configuration, suitable infrastructure, logistics, secured payment gateway, and supply chain management. Therefore, an efficient supply chain accelerates E-commerce processes to meet customers' expectations. To improve the business level and reduce cost, companies link their internal process to external suppliers and customers with different levels of integration (Mozafari & Tafazzoli, 2012). In supply chain management, the management of information flows has always been one of the key aspects influencing the fast growth of web-based information transfer between companies and their suppliers (Johnson & Whang, 2002). Basu and Siems (2004) found that the impact of E-business technologies on supply chain operations lead to the reduced logistics costs, lower inventory, and streamlined procurement processes.

3. METHODOLOGY

The methods used for the ranking and classification of the SEE countries according to the level of implementation of the key indicators of E-business are considered in this section. E-business data were retrieved from EUROSTAT open database, considering components related to the E-business. The analysis has involved all enterprises, without financial sector (10 persons employed or more) whose total number at the country level is shown as a percentage for each analysed components. The final dataset includes data from 10 SEE countries gathered during 2020 in the COVID-19 period. The surveyed countries were: Croatia, Montenegro, Slovenia, North Macedonia, Greece, Turkey, Bulgaria, Bosnia and Herzegovina, Romania and Serbia. These countries were ranked according to the level of usage of the following indicators (criteria) during the COVID-19 period: 3D printing and robotics, artificial intelligence big data analysis, cloud computing services and supply chain management based on integration with customers and/or suppliers. The PROMETHEE II method (Preference Ranking Organisation Method for Enrichment Evaluations) was employed for ranking SEE countries while using the Shannon Entropy method to weigh the criteria.

3.1. PROMETHEE AND GAIA METHODS

PROMETHEE method is observed to an effective multi-criteria decision-making (MCDM) tool often applied to deal with complex problems in the manufacturing and service sectors (Athawale et al., 2012; Safari et al., 2012). This preference function-based outranking method developed by Brans et al. (Brans et al., 1984) is a particular type of MCDM technique that can provide a ranking order of the decision options. Firstly was developed PROMETHEE I method that can give only the partial ordering of the decision alternatives. Later, this method is expanded. Therefore, the PROMETHEE II method was originated, which can perform the full ranking of the alternatives. The advantages of this method reflected in dealing with decision-making problems with multiple conflicting criteria and alternative (Maity & Chakraborty, 2015) as is the case this in this research. The PROMETHEE method is based on determining the positive (ϕ^+) and negative flow (ϕ^-) for each alternative. The positive flow of

preference shows how much a particular alternative dominates other alternatives. If the value is higher ($\phi^+ \rightarrow 1$), the alternative is more significant. The negative preference flow shows how much other alternatives prefer a particular alternative. The alternative is more significant if the current value is lower ($\phi^- \rightarrow 0$). According to PROMETHEE II, the complete ranking is based on calculating the net flow (ϕ). The net flow represents the difference between the positive and negative preference flow. The alternative that has the highest net flow value is the best ranked (Athawale et al., 2012; Abdullah et al., 2019). This paper employed the PROMETHEE II method to obtain the full ranking of the evaluated countries according to the level of usage of indicators of E-business. The applied steps of the PROMETHEE II method are represented below.

Step 1. Creating a decision matrix/table. The decision matrix for defined criteria and alternatives can be formed based on cardinal (quantitative) or ordinal (quantitative data).

Step 2. Assigning a preference function P (a, b) for each criterion. The selected preference function P (a, b) is defined to decide how much alternative *a* is preferable to alternative *b*. The Promethee method has six forms of preference functions available (Usual, U-shape, V-shape, Level, Linear, Gaussian) - each of them has two thresholds, Q and P.

Step 3. Calculation of the preference index $\pi(a, b)$ represents the intensity of preference *a* concerning *b*.

$$\pi(a, b) = \sum_{j=1}^n w_j \cdot P_j(a, b); \left(\sum_{j=1}^n w_j = 1 \right) \quad (1)$$

Step 4. Determine the leaving and the entering outranking flows as follows:

- Leaving positive ϕ^+ flow for the alternative:

$$\Phi^+(a) = \frac{1}{m-1} \sum_{x \in A} \pi(a, x) \quad (2)$$

- Entering negative ϕ^- flow for the alternative:

$$\Phi^-(a) = \frac{1}{m-1} \sum_{x \in A} \pi(x, a) \quad (3)$$

- Calculate the net outranking flow for each alternative:

$$\Phi(a) = \Phi^+(a) - \Phi^-(a) \quad (4)$$

3.2. SHANNON'S ENTROPY METHOD

An entropy algorithm is a helpful tool to acquire weights of criteria. Consider P_{ij} in the decision matrix for alternatives' evaluation. In the decision matrix, there are *n* alternatives and *K* criteria. The element of this matrix for *j*th criteria is as below (Safari et al., 2012; Haddadha et al., 2017):

$$P_{ij} = \frac{f_j(a_i)}{\sum_{j=1}^n f_j(a_i)}; \quad j = 1, 2, \dots, k; \quad \forall j \quad (5)$$

- Entropy is calculated as below:

$$E_j = -M \sum_{i=1}^n P_{ij} \ln P_{ij}; \quad \forall j \quad (6)$$

- In the next step *M* is a constant calculated as a constant value:

$$M = \frac{1}{\ln(n)} \quad (7)$$

The next step is to calculate deviation degree (d_i), which shows that the *j*th criterion has helpful information for the decision-maker. If exist a difference between one criteria

values, this indicates the alternatives are indifferent according to this criteria. Deviation degree is calculated as below:

$$d_i = 1 - E_i; \quad \forall j \quad (8)$$

The last step in Shanon entropy is to obtain weights based on the following equation:

$$w_j = \frac{d_i}{\sum_{i=1}^k d_i}; \quad \forall j \quad (9)$$

4. RESULTS AND DISCUSSION

Data collected from the EUROSTAT open database during 2020 were used as a basis for the analysis of the application of E-business in business operations of companies. Ten SEE countries were analysed, which represent alternatives in the model. These alternatives were explored based on five criteria: 3D printing and robotics, artificial intelligence, big data analysis, cloud computing services, supply chain management. Following the steps for calculating the PROMETHEE method in section 3.1 for each analysed country, the weighting coefficients for each criterion are determined, which are shown in Table 1.

Table 1. Input parameters of decision table

<i>Criteria</i>	<u>Criteria 1</u> 3D printing and robotics	<u>Criteria 2</u> Artificial intelligence	<u>Criteria 3</u> Big data analysis	<u>Criteria 4</u> Cloud computing services	<u>Criteria 5</u> Integration with customers/suppliers (supply chain management)
<i>Alternatives</i>	Objective entropy weights				
Weight	0.12	0.16	0.20	0.22	0.23
min/max	max	max	max	max	max
Preference Function	Linear	Linear	Linear	Linear	Linear
Indifference threshold (Q)	0.05	0.05	0.05	0.05	0.05
Preference threshold (P)	0.30	0.30	0.30	0.30	0.30
Bulgaria	3	2	6	11	10
Greece	/	/	12	17	/
Croatia	5	3	13	39	43
Romania	2	1	4	16	17
Slovenia	5	1	5	39	58
Montenegro	8	0	12	53	/
North Macedonia	5	6	12	/	7
Serbia	2	1	2	14	19
Turkey	3	1	9	19	/
Bosnia and Herzegovina	3	1	5	14	13

The weighting coefficients represent indicators of the relative importance of each selected criteria in the conducted analysis for the calculation of which the Entropy method was used, which is explained in detail in section 3.2. The goal of applying the Shannon entropy method is to obtain as few values as possible that describe the alternatives of a given set. The criteria with a lower entropy value provide more information related to the result of the alternative according to the given criteria. In this way, the criteria have greater significance in the defined model. When determining the weight parameters, it starts from the defined decision matrix (Table 1). Then, each criterion's entropy value is calculated, where the degree of divergence of the own average information carried by each criterion is further defined. The degree of divergence represents a significant strength of the diversity of criteria. Finally, the entropy weights of all criteria are determined (Safari et al., 2012). The linear preference function shown in Figure 1 was used in the analysis. The indifference threshold (Q) and preference threshold (P) are determined with a 5% and 30% difference between the highest and lowest value according to each given criteria. The type of criteria is defined with max to determine the most developed country in terms of the application of E-business according to all the analysed criteria.

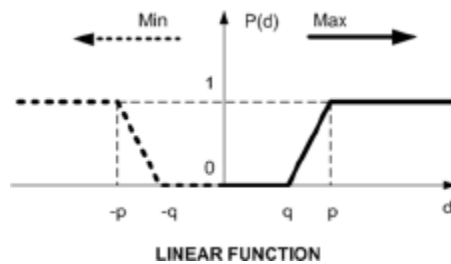


Figure 1. The preference function

Using the data obtained by calculating the preference index, the calculation of „outranking flows“ was performed, i.e., positive (Φ^+) and negative flow (Φ^-) and complete net flow $\Phi(a)$, i.e. the final rank of analysed alternatives was shown in Table 2 and Figure 2. For ranking alternatives, the Visual PROMETHEE software package was used.

Table 2. Results of the complete ranking of the countries of SEE according to the level of use of E-business

<i>Alternatives</i>	Φ^+	Φ^-	Φ	Rang
Croatia	0.7145	0.0877	0.6268	1
Montenegro	0.4676	0.1772	0.2904	2
Slovenia	0.4627	0.2391	0.2236	3
North Macedonia	0.3650	0.2030	0.1620	4
Greece	0.2476	0.1305	0.1171	5
Turkey	0.2984	0.2882	0.0103	6
Bulgaria	0.2649	0.5641	-0.2992	7
Bosnia and Herzegovina	0.1762	0.5256	-0.3494	8
Romania	0.2057	0.5605	-0.3548	9
Serbia	0.1563	0.5831	-0.4268	10

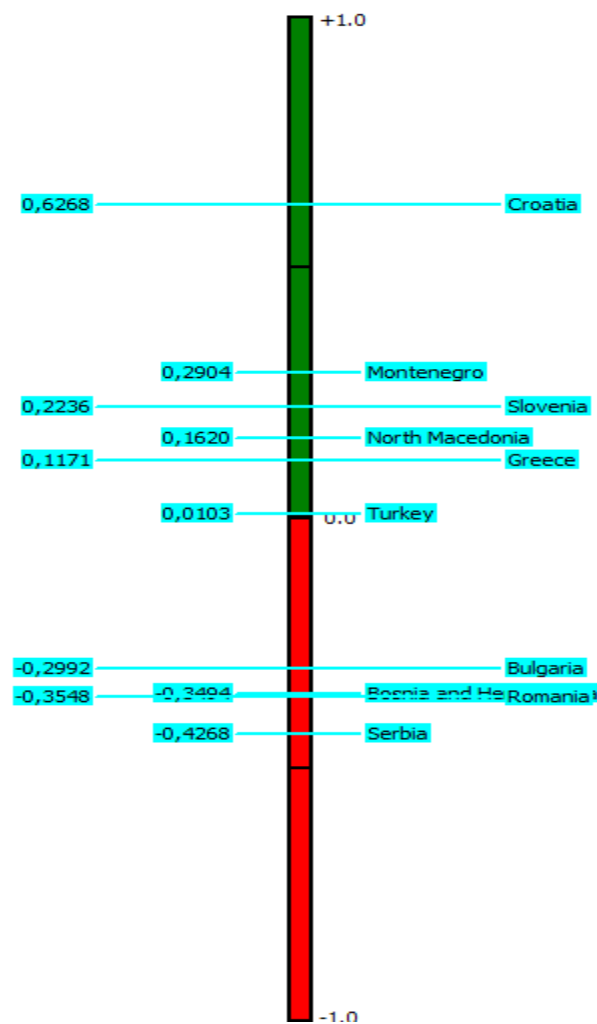


Figure 2. PROMETHEE II complete ranking of countries

The application of the Visual PROMETHEE software package and the calculation also enable visualisation of the obtained results using the GAIA (Geometrical Analysis for Interactive Aid) plane. The GAIA plane enables a graphical presentation of the obtained solutions. It provides ranking information in two-dimensional space, based on which the interpretation of the significance of individual criteria can be reported. Hence, it is possible to present the problems of ranking graphically, determine the specific characteristics of the relationship between the selected alternatives, and finally, get essential information about the nature and significance of the criteria and the impact of weight parameters on the final results of the analysis. The positions of the considered alternatives shown in Figure 3 (squares) represent the strengths or weaknesses of the alternatives in terms of the selected criteria, which determines the future result of the final decision. If the alternative is closer to the direction of the criterion vector, that alternative is better based on those criteria (Brans & Mareschal, 1994).



Figure 3. GAIA level of selection of the best-ranked country according to E-business indicators

The percentage of data collection at the GAIA plane, i.e. the reliability of the given graphical interpretation, is higher than 60% ($\Delta: 85.50\%$), which is considered highly acceptable (Brans & Mareschal, 1994). It observing the distance of criteria from the coordinate origin (axes ending in rhombuses in Figure 3), it can be noticed that the most influential is criteria 1. They are then followed by criteria 4 and criteria 5, which are more significant regarding the other two criteria (criteria 5 and criteria 2). Their influence is also confirmed by the proximity of the p_i decision stick. The vector p_i (decision stick) is represented by an axis ending in a circle representing the optimal solution by the given weighting criteria.

The alternatives (squares on the GAIA plane) determines their strength or weakness concerning the analysed criteria. If the alternative is closer to the axis of criteria, that alternative is better according to that criterion. The best-ranked country considering analysed criteria is Croatia. Croatia as a member of the EU has made significant efforts in recent years and directed investments in Internet technologies, both in the public and private sectors. This

was also contributed by the proactive policy of the state, which encourages the application of the ICT in business operations, thus contributing to economic growth and development.

According to the application of big data analysis in companies, Greece has shown that it has the best performance. In this SEE country, companies invest a lot of effort to gain helpful insight into processed data, i.e., to manage large amounts of different data at a reasonable speed and in an appropriate time frame to allow rapid analysis of this data real-time. Taking into account criteria 5, which refers to the application of integration with customers/suppliers (supply chain management), Turkey is the best-ranked country. Considering these criteria, companies in Turkey have highlighted d their business to the integration of interaction with their suppliers and customers.

On the other hand, the worst positioned countries are Bulgaria, Bosnia and Herzegovina, Romania and Serbia. These countries are not suitable by any criteria and located opposite the direction of the p_i decision. This fact is somewhat expected, given that these are the less developed countries. Bulgaria and Romania have been members of the EU since 2007, but they are still at the bottom of economic development compared to other member states. Consequently, they must continue to encourage investment in ICT development in enterprises. One of the critical reasons for the insufficient growth of E-commerce in Serbia and Bosnia and Herzegovina is mistrust of citizens and the economy. Interestingly, this problem has been identified in many other economies (Beldad et al., 2010; Choon Ling et al., 2011).

4.1. SENSITIVITY ANALYSIS

Any MCDM framework is based on reducing bias and ensuring the solution's reliability (Pamučar at al., 2017). To determine the size of the preferred relationships with the obtained ranking, the sensitivity analysis of the weighting coefficients of the criteria was performed, which is shown in Table 3. Criteria weights contribute significantly to finding out the final ranking. With this analysis, it is possible to determine stability intervals for each criterion. The stability interval defines the limits within which the range of weight coefficients of the given criteria can move without influencing the previously obtained ranking solution. On that occasion, the weight of only one criterion changes, while the relative weights of the remaining criteria remain unchanged (Doan & De Smet, 2018).

Table 3. Weight stability intervals of E-business indicator

Indicators	The initial weights (%)	Stability interval (%)	
		Min	Max
3D printing and robotics	13	11.84	50.31
Artificial intelligence	17	12.91	21.65
Big data analysis	21	19.77	25.67
Cloud computing services	24	14.62	25.31
Integration with customers/suppliers, supply chain management	25	21.17	26.62

Sensitivity analysis showed that criterion 1 (3D printing and robotics) has the largest stability interval since the value of this weighting factor can be significantly increased without

affecting the obtained ranking solution (up to 37.31%). In comparison, the change of results would occur after reducing the weighting factor by more than 1.16%.

5. CONCLUSION

It is indisputable that the transition to digital business is accelerated and necessary, especially during the COVID-19 pandemic. The paper analysed the development of SEE countries according to essential indicators of E-business. Although E-business shows significant potential in Southeast Europe, there is still a lot of space for expansion. It is necessary to encourage positive trends in this area, especially in countries that are worst-ranked according to E-business indicators, such as Bosnia and Herzegovina, Romania, and Serbia. Interestingly, there is no significant difference between EU member states and non-member countries, as evidenced by the rank of the first three countries, where they are: Croatia, Montenegro and Slovenia.

By promoting and developing the E-business services analysed in this paper, reforming the education system and tailor it to the demand of the contemporary business environment can create conditions for raising the level of E-business development in the considered countries. The best way to strengthen the E-business development of the analysed countries is the digitalisation of the economy, public administration, and society.

In addition, to meet the needs of existing and new generation of digitally advanced consumers, companies should improve managerial knowledge and skills in the field of E-business. Also, companies need to train employees to use tools in E-business, work on raising awareness of the advantages of using E-business, and adopt the banking business of the company to the needs of E-business. On the other hand, the state administration must improve the implementation of legal regulation in E-business, i.e., electronic commerce, electronic documents, electronic signatures, protection of personal data, information security, safety, and protection of data secrecy.

In addition to all the above recommendations, this study has some limitations. Namely, the data analysed in the paper represent the current situation that reflects the condition of the period of the COVID-19 pandemic during 2020. Considering the level of development of E-business, it would be good to analyse the period before the pandemic and compared the results. In the analysis, only the SEE countries are included. Hence, it would be interesting for future study to extend the sample to other regions of Europe. Also, ranking can be done by applying some other MCDM methods to confirm the validity of the used method.

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THE NETWORK SCIENCE APPROACH IN DETERMINING THE INTELLECTUAL STRUCTURE, EMERGING TRENDS AND FUTURE RESEARCH OPPORTUNITIES: AN APPLICATION TO TAI CHI FOR OLDER ADULTS

Maria Helena Pestana¹, Margarida Sobral², Wan-Chen Wang^{3*}, Artur Parreira⁴

¹*Department of Quantitative Methods, ISCTE-IUL, Lisbon University, Portugal;*

²*Psychogeriatrics Service, Hospital Magalhães Lemos, Porto, Portugal;* ³*Department of Marketing, Feng Chia University, Taiwan;* ⁴*Research Center on Politics, Economy and Societies (ULHT, Lisbon), and Complex Systems Research Group (GESC) at University Santa Úrsula, Brazil*

Abstract: This article focuses on the geriatric market segment which is becoming increasingly important as a result of demographic trends and aging populations. Using network science approach, this study maps the structure of knowledge, its changes over time and research opportunities in Tai-chi. Data collected from Web-of-Science and Scopus between 1996-2019 was used to build a network of 2,202 articles and 6,820 authors. The results show Tai-chi represents a small-world network as the majority of the articles were produced among universities and medical schools, displaying a connection between theoretical knowledge and pragmatic applications. The scientific achievements mainly emerge from the USA, China, and UK. The collaborative efforts focused on a giant component and converge on a small area of research. Future opportunities at the intersection of Tai-chi and geriatrics include mindfulness-meditation, osteoarthritis, sleep quality, cardio-respiratory function and pain management. This article provides contributes to the literature on Tai-chi and offers insights into the capabilities of CiteSpace, Vosviewer, Gephi, and Python.

Keywords: Tai-chi, older adults, network science approach, intellectual structure, emerging trends.

1. INTRODUCTION

The progressive aging of the population and increased life expectancy demand strategies to improve the quality of life for older adults. Tai-chi has attracted several researchers for whom this field has a role in promoting health for this important segment (Behere et al., 2019; Lan et al., 2013; Gillespie et al., 2012). It is therefore important to understand how knowledge acquisition and information dissemination occurred in the subject field of Tai-chi for older adults.

Tai-chi is an effective body-mind exercise program that benefits and promotes health (Behere et al., 2019), including physical and mental activity, psychological well-being (Blake

* Corresponding author: wancwang@fcu.edu.tw

& Hawley, 2012), and a better quality of life (Lan et al., 2013). The multifaceted characteristics of Tai-chi can enhance balance and confidence of older adults (Blake & Hawley, 2012), strengthen muscles (Lan et al., 2013), and prevent falls (Gillespie et al., 2012). In fact, injuries resulting from falls are the cause of more than half of hospital admissions for older adults (El-Khoury et al., 2013; Wayne, et al., 2011). It is also documented that Tai-chi can enhance cognition and brain health in older adults (Chang et al., 2014). For example, Tai-chi has positive effects in people with Parkinson's disease (Lee et al., 2008; Amano et al., 2013), depression (Liu et al., 2019), and sleep problems (Si et al., 2019). In addition to its brain benefits, Tai-chi research has touched the fields of rheumatology (Wang, 2012), chronic pain (Peng, 2012), osteoporosis and cancer (Drake, 2013), cardiovascular disease (Pan, 2016), and cardiopulmonary function (Sun et al., 2019), and therefore can have positive effects on older adults' health.

The complexity of scientific research of Tai-chi as geriatric therapy required a network science approach. Most studies on Tai-chi are descriptive and cross-sectional, and just a very few include a bibliometric analysis. Consequently, in-depth bibliometric studies are needed for Tai-chi. In the current study, the collaborative network was analyzed from 1996 until 2019 through the perspective of social network analysis (SNA), whereby authors and areas of research are represented as nodes, and their inter-relationships present as edges in a graph which employs several centrality metrics. Data were collected from Web-of-Science (WoS) and Scopus, considered the most widespread and best quality databases for literature searches in different scientific fields (Guz & Rushchitsky, 2009). The objectives of this study were: (i) to analyze whether or not Tai-chi is evolving as a collaborative network; (ii) to determine whether or not Tai-chi is similar to most SNA as small-world, identified by a giant component of interconnected authors, allowing the information to be easily accessed and updated; (iii) to evaluate and identify critical researchers using centrality metrics (iv) to analyze the occurrence of a positive association between authors' centrality metrics and their productivity and degree of collaboration; (v) to know the institutions and countries from where the knowledge derives; (vi) to determine the presence of an internal cohesion among the research topics and to identify the hot spots and research opportunities.

2. METHODS

In this paper, we analyze a community structure by examining not only modularity but also the following attributes of the network: density, average clustering coefficient, average path length, and diameter. At micro level we assessed the performance of both networks adding the following centrality measures: degree centrality, closeness centrality, betweenness centrality, and eigenvector centrality. Various free Java software tools were used in our research to proceed with our SNA analysis: CiteSpace(<http://cluster.cis.drexel.edu/~cchen/citespace>), was used to convert Scopus data in WoS data and to obtain bursts of keywords used to identify research opportunities; Vosviewer (<https://www.vosviewer.com/>), was used as input to create files of nodes and edges needed to be analyzed and visualized through Gephi (<https://gephi.org/>). Gephi was used to measure both co-authorship networks and co-occurring keyword network networks, using centrality metrics; and Python (<https://www.python.org/downloads/windows/>), was used to clean the data, to eliminate duplicates and synonyms, and to obtain the files by authors, institutions, countries and keywords. The harmonization or disambiguation of institutions, author names and country names are key to attribute articles to their correct authors, institutions, and countries.

The current research focuses on a longitudinal data set from January 1996 to December 2019 with the aim of studying the evolutionary dynamics of scientific collaboration networks

and Tai-chi research areas. Data were collected from Web-of-Sciences (WoS) and Scopus. The dimensions chosen as a basis for selecting the documents were keywords, English language, and years of publication. To obtain more scientific and accurate data, only the following keywords included in the title, abstract or keywords were extracted (Fu et al., 2012): “Tai-chi” OR “tai-chi” OR “t'ai chi” OR “tai ji” OR “tai-ji” OR “Tai-chi chuan” OR “taijiquan” OR “tai ji quan” OR “shadow boxing.” OR “aging” OR “Older” OR “senior”. Among the published documents, the analysis relates only to articles considered to be responsible for the advancements within and among disciplines (Pestana & Sobral, 2019).

3. RESULTS

After merging synonyms and eliminating duplicates records, we obtained a net sample of 2,202 articles, reflecting the contribution of 6,820 authors with 28,855 collaborations (links), from 3,215 institutes in 61 countries. Research in Tai-chi for older adults is essentially approached through co-authorship (86.4%). There are 296 single articles, and 262 isolated authors. On average there are 4.4 authors per article, with emphasis on 32.2% of articles made by three and four authors. The distribution of articles per author indicates a large co-authorship participation in Tai-chi research. The cohesiveness of Tai-chi collaboration network is analysed on one hand by the attributes of a node (degree, average path coefficients, averaged clustering coefficients), and on another hand by the study of Tai-chi components. Results show that the average distance between two authors across the network is 4.8, which means that information only needs to flow using four or five intermediaries to be transferred from one author to another. The high average clustering coefficient 0.813, suggests a highly clustered network with close relationships between researchers.

In the study of the collaborative network, we eliminated from the analysis isolated authors and those with few connections. These peripheral authors, with no connections or just with a single link to the entire network, could distort the understanding of our collaborative network through weak or widely dispersed nodes (Pestana, Wang, & Parreira, 2020). This pruning procedure resulted in a more simplified co-authoring network decreasing from 6,820 authors to 2,206 authors who have the highest link strength. The used of metrics shows Tai-chi network with 205 components, with a giant component containing 1,336 authors and representing 60.56% of the whole pruned network. Of the remaining 204 small components, the largest one has 18 authors. Most small components have only two, three or four authors.

Tai-chi is a small-world network, where most nodes have relative low degree collaboration, with very few having a high degree collaboration (Barabási & Alber, 1999). The spread and dissemination of Tai-chi information is therefore an easy process, where researchers can be easily updated on the progress of Tai-chi research to improve health or prevent health problems for older adults.

Figure 1 visualize the distributions of countries of the pruned network, where most connections are located at the center. The size of the characters displays the countries with the highest degree, where the China, USA, and United Kingdom stands out. The connections among countries show the international nature of Tai-chi research. Collaboration between different countries in research is likely to result in a further increase in knowledge, which may have a positive impact on the prevention of health problems among the older adults.



Figure 1. Author's country in Tai chi (1996-2019) Source: The authors.

The authors' Institutions of the pruned network has low density (0.01) and good modularity (0.515), being distributed among 268 institutions (nodes) with 1,237 connections (edges). The most productive institutions in the number the articles include the *Chinese University Hong Kong* and *Hong Kong Polytech University*, both in Hong Kong, with 87 and 64 publications (link strength), respectively. The United States boasts the highest number of institutions (68.4%), showing that it is a big attraction for researchers. The *Harvard Medical School* (USA) has the highest number of inter-institutional research collaborations (59 links), and co-authorship publications (link strength of 54). The *University of Sidney* (Australia) ranks 4th both in inter-institutional research collaborations (34 links) and in co-authorship publications (link strength of 59). The participation of universities and medical schools shows the relevant role of Tai-chi in treating older adult's health, not only from the theoretical basis (universities) but also from its practical application (medical schools). Table 1 displays the top institutions distributed according to co-authorship collaboration (link strength). The number of links and their strength suggest a high collaboration among institutions, with the USA playing the greatest role.

Table 1. Author's Institutions (1996-2019)

Top Co-authorship Institutions	Link		Country
	Number	Strength	
Chinese Univ Hong Kong	35	87	Hong Kong
Hong Kong Polytech Univ	25	64	Hong Kong
Harvard Univ	39	63	USA
Univ Sydney	34	59	Australia
Harvard Med Sch	59	54	USA
Univ Calif Los Angeles	28	48	USA
Shanghai Univ Sport	36	47	China
Univ Illinois	27	39	USA
Tufts Univ	16	38	USA
Univ Hong Kong	15	35	Hong Kong
Emory Univ	13	33	USA
Massachusetts Gen Hosp	22	31	USA
Oregon Res Inst	9	31	USA
Brigham & Women's Hosp	26	30	USA
Osher Center for Integrative Medicine	23	28	USA

Univ Arizona	10	27	USA
Univ New South Wales	19	27	Australia
Beth Israel Deaconess Med Ctr	11	25	USA
Texas Tech Univ	7	24	USA

Source: The authors.

The development of Tai-chi research is analyzed by dividing the time period into four sub-periods of six years: 1996-2001; 2002-2007, 2008-2013, 2014-2019. Over time, there is a general increase in publications, authors and collaborations, although at different rates. Growth has been slower in the number of publications, ranging from 80 in the first six years to 1036, in the last six years. The number of authors increases 7.6 times from 392 during 1996-2001 to 2,969 in the last period, while the number of links shows the greatest increase, around 17 times more, from 857 in the initial period to 15,336 in the latest period, supporting an increase over time in collaborations among authors. The average number of links per author increases slightly from 2.19 to 2.34, while in the last two subperiods they double their values, going from 4.76 to 5.17. The small number of articles by a single author (296 or 13.4%) and isolated authors (262 or 3.84%), indicates that most researchers cooperate with others. In Tai-chi, the collaboration rate has a clear upward trend especially after 2008, when the greatest progression occurs. Excluding the isolated authors, we obtain a small mean article per author (0.29) and a high mean author per article (3.58), which reflect the multidisciplinary nature of a discipline (Ye et al., 2013). Therefore, researchers from different areas seek to cooperate with specialists in Tai-chi, enriching the study by including different perspectives of scientific approach, with positive effects on disease prevention in older adults. Table 2 represent the collaborative network of Tai-chi in each of the four subperiods, to obtain a more stable analysis of the effects over time.

Table 2. The collaborative network by time periods

Year	1996- 2001	2002- 2007	2008- 2013	2014- 2019
New:				
Publications	80	357	729	1036
Authors	392	1574	1885	2969
Links	857	3687	8975	15336
Avg.Links/Author	2.19	2.34	4.76	5.17
Cumulative:				
Publications	80	437	1166	2202
Authors	392	1966	3851	6820
Links	857	4544	13519	28855
Avg.Links/Author	2.19	2.31	3.51	4.2

Source: The authors.

According to Braun, Glanzel, and Scgubert (2001), larger teams are more effective than solitary researchers. In fact, within the giant component, most critical authors are spread over 7 larger communities each one with more than 10 authors. The data show that the characteristics of these communities: modularity (0.609) is superior to 0.30 (Chen et al., 2014; Newman, 2006); diameter is not superior to 6; density and average cluster coefficient are above the homologous metrics observed in the network (Savié et al., 2014), and there is a small, averaged path length in each community (Cheong, et al, 2009). The larger community has the number 1 with 31

authors. The relevance of the degree of centrality in the study of collaborative networks is explained by the fact that this metric indicates the total number of collaborators of a researcher, thus allowing us to assess the extent of their collaborations. Researchers with more collaborators are more popular and influential in the academic community, assuming more responsibility in the transmission of information. All critical authors have low values of closeness centrality, reflecting their independence and efficiency in communicating with other authors. Concerning betweenness centrality, it identifies authors that are on the shortest path between many pair of authors, occupying a critical place in the network. Frequently, the path through a node with high betweenness centrality is the most efficient path for the control of the information. The table 3 shows twenty critical authors identified by their productivity and centrality measures. These authors produce 643 articles, which correspond to 33.7% of the total publications and collaborate with high scored authors. For example, Zhang Yan, from Beijing University of Chinese Medicine (China), collaborates with 34 researchers. Liu Jian-Ping, from Beijing University of Chinese Medicine (China), collaborates with 31 authors. Both authors can reflect the strength of their research collaboration with other authors from different countries, mainly China and USA, suggesting the internationalization role of Tai-chi research. Wayne Peter M., from Harvard Medical School (USA), is the most productive Tai-chi author, and has a quick effect on transmitting Tai-chi information across the group and on controlling the dissemination of information. Wolf Steven L. from Emory University (USA), is the most cited author and the author with the most influence over the control and spread of information anywhere in the network.

Table 3. Productivity and centrality of some top 20 researchers

Authors	Community	Productivity	Citations	Degree centrality	Betweenness centrality	Eigenvector centrality
Wayne, PM	1	72	1,200	25	0.503	0.999
Wang, Chenchen	2	56	1,068	21	0.238	0.499
Li, FZ	2	51	1,632	13	0.349	0.525
Yeh, GY	3	45	263	18	0.501	0.913
Tsang, WWN	4	42	727	14	0.631	0.998
Zhang, Y	5	37	328	34	0.323	0.931
Zou, L	5	35	257	22	0.154	0.929
Lee, MS	6	35	666	9	0.188	0.155
Wolf, SL	2	27	2,797	12	0.833	0.515
Yeung, AS	2	26	162	26	0.217	0.879
Liu, Y	7	26	195	23	0.372	0.656
Li, L	4	26	211	16	0.151	0.611
Taylor-Piliae	5	26	212	7	0.129	0.306
Wang, Y	2	24	144	9	0.169	0.378
Liu, J	7	23	213	31	0.355	0.987
Wang, L	6	22	119	19	0.341	0.704
Woo, J	2	22	467	5	0.122	0.219
Song, R	5	19	429	9	0.193	0.293
Lam, P	5	19	649	7	0.186	0.122
Sherrington, Catherine	5	10	1,472	5	0.356	0.245

Source: The authors.

The results show a positive and statistically significant association between the authors' centrality attributes, using Spearman's Rho. Authors with higher degree of collaborations are more independents (0.716, $p = 0.01$), have a high eigenvector centrality meaning high quality of contacts (0.704, $p = 0.01$), and a moderate betweenness centrality, with a moderate role in connecting different groups of researchers (0.583, $p = 0.01$). There is a significant negative correlation between year of publication and number of citations (-0.309, $p = 0.01$), suggesting that, on average, the greater the number of citations received for an article, the older is the article. This result is expected as these articles will have more time to be cited than the most recent ones. Although it is observed that most productive authors have a greater number of collaborations, this relationship is not statistically relevant in Tai-chi (0.214, $p = 0.11$).

The network has 2,955 keywords and is analyzed in four sub-periods in order to identify more stable variations in the evolution of themes. Top topics and areas of research are analyzed among 103 keywords with 10 or more co-occurrences. This network shows a clear representative interconnected keyword per slice, with many of its links dispersed around a few nodes (Table 4). All keywords are highly connected, as can be seen by the highest values of average clustering coefficients, as well as by the small number of intermediary's keywords between any two nodes. The average degree centrality is increasing over time; therefore, it is possible to identify the expansion of the core keywords. The density is high in all time periods, where a small group of core keywords dominates. In fact, there are 23.8% of keywords with three or more co-occurrences, suggesting that research on Tai-chi focused on a small area.

The selection of the most frequent keywords led us to identify the scientific production with greatest scientific impact, representing the mainstream of Tai-chi research in each sub-period and their evolution.

Table 4. Keywords network structure

Year	Keywords N	Keywords Links	Avg. degree	Density	Avg. clustering coefficient	Avg.path length
1996- 2001	11	49	8.91	0.89	0.92	1.11
2002- 2007	34	427	25.12	0.76	0.85	1.24
2008- 2013	58	1351	46.59	0.82	0.89	1.18
2014- 2019	59	1492	50.58	0.87	0.91	1.12

Source: The authors.

Figure 2 shows the top keywords by degree in each of the four sub-periods of time, represented by the increasing size of the characters. From 1996 until 2001 the literature is dominated by the smallest number of 11 central keywords with 49 connections (links); increasing successively to 34 central keywords with 427 connections from 2002 until 2007; to 58 central keywords with 1351 connections from 2008-2012, until 59 central keywords with 1492 connections in the last period.

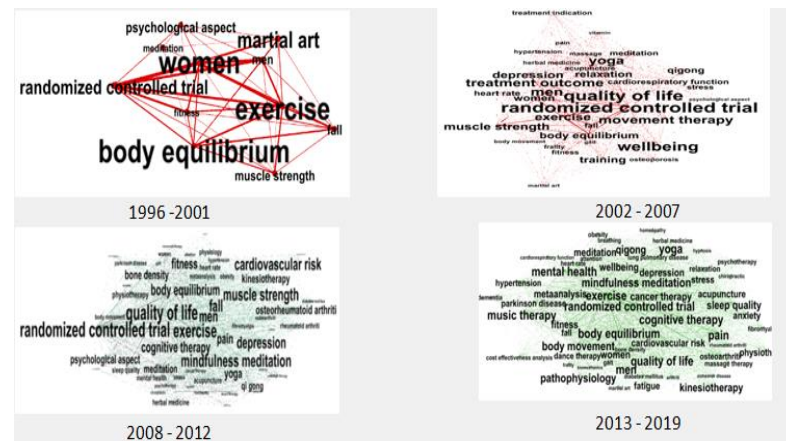


Figure 2. Keywords by degree centrality: top (1996-2001), second (2002-2007), third (2008-2012), bottom (2013-2019)

Source: The authors.

Exercise, fall, body equilibrium and internal validation through randomized controlled trials are considered important topic in all sub-periods. The last one is needed to ensure the scientific rigor of studies on intervention (Steckler & McLeroy, 2008). In the second sub-period, new topics emerge, such as quality of life, wellbeing, yoga, movement therapy, depression, relaxation, pain. After 2018 occurs the greatest amount of research and therefore new topics emerge. From 2018 until 2012 the new topics include, among others, cardiovascular risk, meta-analysis, cognitive therapy, osteoarthritis, kinesiotherapy, bone density, rheumatoid arthritis, Parkinson's disease, mental health, and music therapy. In the last sub-period, new central topics emerged: pathophysiology, fatigue, anxiety, cost effectiveness analysis, breathing, attention, and Alzheimer's disease. The research topics can be grouped mainly into four main areas of investigation: physical function; bones and muscles; emotional and cognitive function and internal validity. Essentially from 2018 onwards, the application of Tai-chi includes broader fields of medicine, like medical emergencies, medical rehabilitation, nervous system diseases and several different organic diseases, such as cancer, obstructive pulmonary disease and cardiovascular disease.

Through Citespace, focusing on the last period, we observed that the most recent and hot topics of research, that are attracting an extraordinary degree of attention from researchers (high burst strength), connect the Tai-chi program with the reduction or prevention of risk factors like pain, cardiorespiratory function, cancer therapy, osteoarthritis. Other hot sub-topics of Tai-chi are sleep quality and mindfulness-meditation exercises (Table 5).

Table 5. Hot spots in tai-chi research

Keywords	Strength	Begin	End	2014 - 2019
pain	16 709	2014	2019	
cardio respiratory function	26.57	2015	2019	
cancer therapy	66 255	2016	2019	
mindfulness-meditation	196 256	2017	2019	
osteoarthritis	177 401	2017	2019	
sleep quality	88 798	2017	2019	

Source: The authors.

4. DISCUSSION AND CONCLUSION

Data were extracted from two high quality databases to model the collaborative author's network and co-occurring keyword network over the period 1996-2019. We show that Tai-chi is a small world network, evolving over time mainly after 2008, as a result of new researchers with new ideas have entered in this field. These results are in line with other studies also demonstrate that SNA are small worlds (Barabási & Albert, 1999). Most articles were produced among universities and medical schools, displaying a connection between theoretical knowledge and pragmatic applications. The large set of Tai-chi collaboration indicate not only its multidisciplinary nature, but also the high globalization of its research. The scientific achievements mainly come from the USA, China, and the UK. The most productive institutions are in China, while the USA has the highest number of inter-institutional research collaborations. Several metrics were used to identify the structure of both networks (authors and keywords), making the results more credible. We show the existence of a high association between the attributes of influential authors, indicating the maturity of the network structure with close relationships between researchers, which are in line with Bibi et al. (2018). There is a positive correlation between productivity and degree of collaboration, a trend which aligns with other studies (Ye et al., 2013). All critical authors have received a great number of citations showing their power in providing links between people, ideas, publications, and institutions (Blázquez-Ruiz et al., 2016). Although Tai-chi has demonstrated a high level of collaboration between authors, critical authors can play an important role in strengthening the existing collaborative network, creating connections with peripheral authors or with other isolated authors. Considering the authors' research areas, we see a convergence in Tai-chi studies focused on disease prevention. Future opportunities for older adults are mainly mindfulness-meditation, osteoarthritis, sleep quality, cardio-respiratory function, pain and external validation, this one needed to substantiate the theoretical and medical research. The most frequent keywords and those with citation bursts identify important research topics to be included in new publications. According to Sarigöl et al (2014), the topics thus created will have a high probability of relevance and, by attracting the attention of researchers, can generate many citations in the future. The relevance of our study extends past bibliometrics because we combine collaborative analysis with co-occurring keyword network to understand the development of this field from different perspectives. The complexity of the research created the need for a SNA analyses and its visualization, which was performed at micro and macro level. The application of SNA for both collaboration between authors and for research topics is innovative for the subject of Tai-chi. Nevertheless, like most studies, our own presents some limitations. In fact, the analysis is based on articles extracted from WoS and Scopus, and only includes those written in English. Therefore, it may exclude relevant authors who have published in other languages and data sets. Nevertheless, the results of our study provide new theoretical bases for future research in this field by combining four different software tools through SNA to obtain deeper insights about the collaborative network. This study intends to provide a unique understanding about the collaborative Tai-chi network as demonstrated by centrality metrics to be a knowledge domain allowing information to be easily accessed and updated; Tai-chi itself is a useful tool to all researchers interested in improving the health or preventing diseases in older adults. Centrality metrics and network metrics used in SNA and in the keyword network, can capture the social aspects that support and transmit Tai-chi-related scientific ideas, allowing stakeholders to map the intellectual structure of Tai-chi and its changes over time. In a dynamic world, a network science approach analysis should be done regularly to keep pace with research changes. Tai-chi by involving physical movement, controlled breathing and meditation helps to maintain emotional regulation and to be aware of ourselves, necessary for a healthy mind.

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DIGITAL STUDENT ID, IDENTITY MANAGEMENT AND INTERNET OF EVERYTHING IN EDUCATION DURING COVID-19

Ramona Markoska*, Aleksandar Markoski,

Faculty of ICT, Uni. St. Kliment Ohridski-Bitola, Republic of North Macedonia

Abstract: In the conditions of the new reality imposed by COVID19, certain organizational problems of online teaching are noted worldwide. These problems can be classified into two main categories. The first category includes ICT support of the online educational processes, such as internet grants and appropriate hardware and software, for general and individual usage. The second category includes the creation of digital identities through a special category of smart cards, known as digital ID cards or e-ID cards. Starting with an overview of the different types of smart cards, this paper explores the potentials of applying e-ID cards to students in educational processes and beyond. Different stages of development and implementation are considered, such as linking the personal data included in the student eID cards with management systems and the Internet with everything. As an integral part of this paper, a questionnaire was made about the opinions of students, regarding the possibilities and areas of using student e-ID.

Keywords: e-ID cards, IoE, ID management, Covid19

1. INTRODUCTION

The concept of smart cards was created in response to the need for electronic transfer of personal data during various personal digital activities. Despite changes over time, smart cards have retained some basic features present since their first appearance. The evolution of smart cards dates back to 1968 when a plastic card with a built-in chip was first promoted, and in 1996 was the first deployment of chip cards on an university campus. Since the beginning of the 21st century, the use of smart cards has been expanding due to the widespread use of the internet and mobile telephony. The major advantage of the smart card over the classical ID card is its capacity to store a larger amount of information, and its programmability for various use, such as ID validation, data authentication, financial transaction, loyalty marketing programs, secure computer networks (Praveen et al, 2018). These cards are available in a variety of formats, physical and digital, and are used by banks, shops, government and educational institutions, service offices, in order to perform a variety of transactional activities. Regarding the realization of smart cards, various applications, communication and manufacturing specifications, developed by the International Organization for Standardization (ISO) are used, such as: ISO7816-1, for physical characteristics, ISO7816-2, for electronics contacts, ISO7816-3 for electrical signals,

* Corresponding author: ramona.markoska@uklo.edu.mk

ISO7816-4 for communication protocols and ISO7816-7 for commands of query language (Heichlinger&Gallego, 2010; Praveen et al 2018). According to the infrastructure and standards for smart cards (Shelfer et al, 2014), the following categories stand out: standard chip cards and digital identification (e-ID) cards, both smart cards used for all of the aforementioned applications.

The chip cards, can be recognized in one of the following main categories:

- Contact cards - the most common type of smart card, which has external contacts available to interact with the card reader;
- Contactless card - these are smart cards that use technologies such as radio frequency (RFID) or Near Field Communication (NFC) between the card and the reader without without physical insertion of the card;
- Multicomponent cards - these types of cards are for certain predefined business needs, such as the application of biometric solutions, built-in fingerprint sensors, generating a one-time password for Internet banking applications.

The digital ID card can be described as a card that stores digital identity data and enables digital identification and verification wherever needed. Digital identity is primarily a question of “digital user ID” in which data security is the dominant concern and primarily of interest to businesses and public administrations. Digital identification, is a digital solution for proving the identity of citizens or organizations, such as online authentication and login, and the use of a digital signature. In this context, a digital ID card is the electronic equivalent of an individual ID card.

The digital ID can be submitted electronically to prove the identity of the individual and their right to access information or services over the internet (Geteloma et al., 2019). Digital ID card or e-ID is a concept that allows the card to be non-physical, which means that the data it contains can be completely cloud based (Bart, 2019). This digital form of card is especially convenient because it allows access to mobile devices, such as smartphones, through appropriate software. Depending on the country and the scope of application, digital ID cards, as a separate category of smart cards, are used under different names, such as e-ID Card, Citizen Card, National ID card (Lentner & Parycek, 2016), and more recently the term e-ID global passport, in a geopolitical context (Dijck&Bart, 2019).

Depending on the applications available for installing a smart device or logging in to the cloud, the possible areas of separate or combined use, follows: National ID card, e-Banking, e-Education, e-Government services, e-Voting, European travel card (Dijck &Bart, 2019). When enhanced authentication and security measures are required, the use of PIN (Personal Identification Number) and OTP (One Time Password) is preferred over the classic password.(Geteloma et al 2019; Nivetha et al 2015). Smart card technologies include ID management systems in charge of rights and privileges that individual users and service providers have mutually agreed upon as a work paradigm.

2. HIGHER EDUCATION ITEMS IMPOSED BY COVID-19 REALITY

The widespread presence of Covid-19, during the 2020, and the half of 2021, has changed many traditional ways of communicating towards their partial or complete digitalization, in many areas of human living including higher education. In addition to the digitalization of educational processes, organizational problems arose that needed to be addressed.

The digitalization of higher education, in addition to the digitalization of educational content, also includes the organization of educational processes. Some of these processes are indirectly educational and require interactive work and knowledge assessment processes, which should be related to the each student digital identity. On the other hand, working in virtual classrooms imposes the need for management of rights and privileges for access to content and tools for practice and evaluation, as well as the need for full tracking of student activities. Another category of digitized activities are the administrative procedures related to the educational processes, as well as the records of the students' behaviour and progress during the semesters. Around the world, governments in many countries have provided relief to the student population by awarding various vouchers, promotions and discounts to help and facilitate the social aspects imposed by the Covid-19 situation. The previous introductory explanations lead to the conclusion that digital e-ID cards are especially suitable for students and applications in higher education. Their advantages are enhanced by the effects of the Covid-19 situation.

2.1. DIGITAL STUDENT e-ID – RESEARCH QUESTIONNAIRE

During the first semester of 2021, the students who were enrolled on the Advanced Programming course at the Faculty of ICT - Bitola, filled in an anonymous voluntary questionnaire on the topic of Digital students e-ID cards use during the crisis COVID-19 and in general. The questionnaire was completed by 60 students, which is 78% of the total number of students. The purpose of the questionnaire is to get an informative overview of the trends in the answers. The reason for the analysis of the student e-ID card are the intensified online activities in the pandemic, but after the analysis the many reasons for its comprehensive application are seen. The following is a brief overview of the findings.

According to Fig. 1, when asked about the familiarity and attitudes on the smart card and e-ID card, the students gave the following answers:

- From the total number of students who answered the questionnaire 88% of them are familiar with classic smart cards, versus 67% which are familiar also, with e-ID cards.
- Student e-ID card as more appropriate for the needs of students is assessed by 76.3% versus 23.3% who prefer a smart card with physical realization card
- Regarding the use of various types and formats of smart cards, which are in circulation for different uses, when asked if they use them personally or know someone who uses them, the students answered positively, as follows: 96,7% bank electronic cards; 73,3% , ID cards for discounts and promotions, and sets of various conveniences, offered by shops for various types of appliances, jewellery, drug and cosmetics drug-stores, food, IT equipment, medicines and cosmetics pharmacies, food, IT equipment; 40% reported using smart cards for membership in various clubs, such as fitness clubs, beauty salons and much more; and finally only 1% answered with none of them.
- According to the applicability and usefulness, specifically on the student e-ID card, 98.3% of students think that it is useful as a product and need of the new time, regardless of covid-19

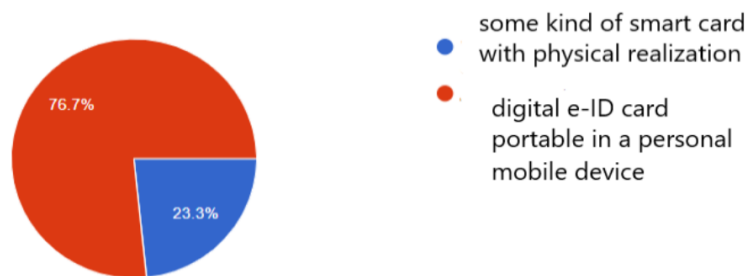
Which of the terms do you know?

60 responses



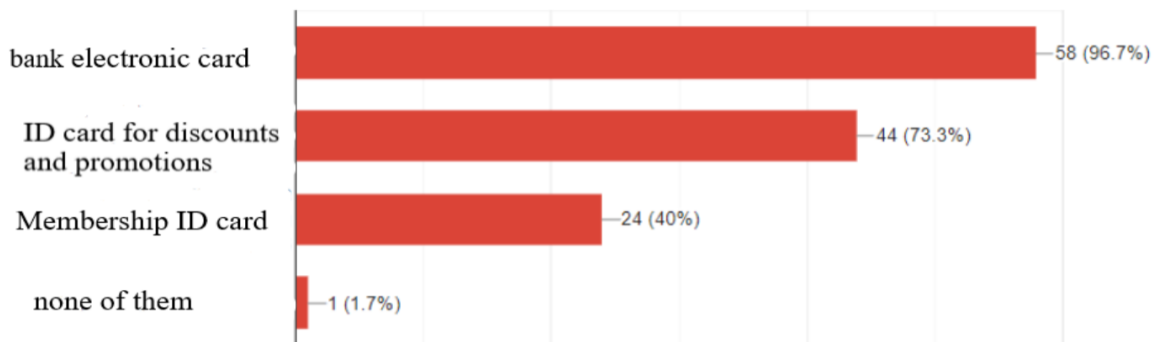
Which card is more suitable for the student needs

60 responses



I use one of the listed smart cards, or I know someone who uses it

60 responses



Applicability and usefulness of student e-ID card

60 responses

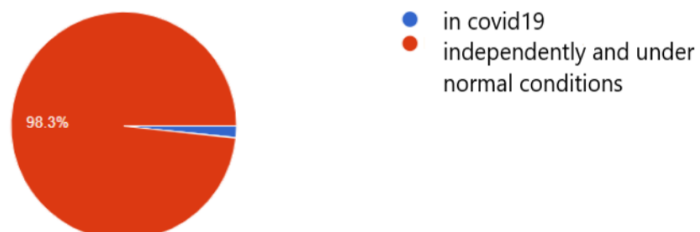


Figure 1: Basic review of familiarity and attitudes about a student e-ID card

The previous findings mostly referred to the direct information and experiences with the e-ID card, as well as to some basic views on its use. The following remarks represent the student e-ID card, from the point of view of the functionalities and the most convenient ways of its realization, according to the opinions of the students.

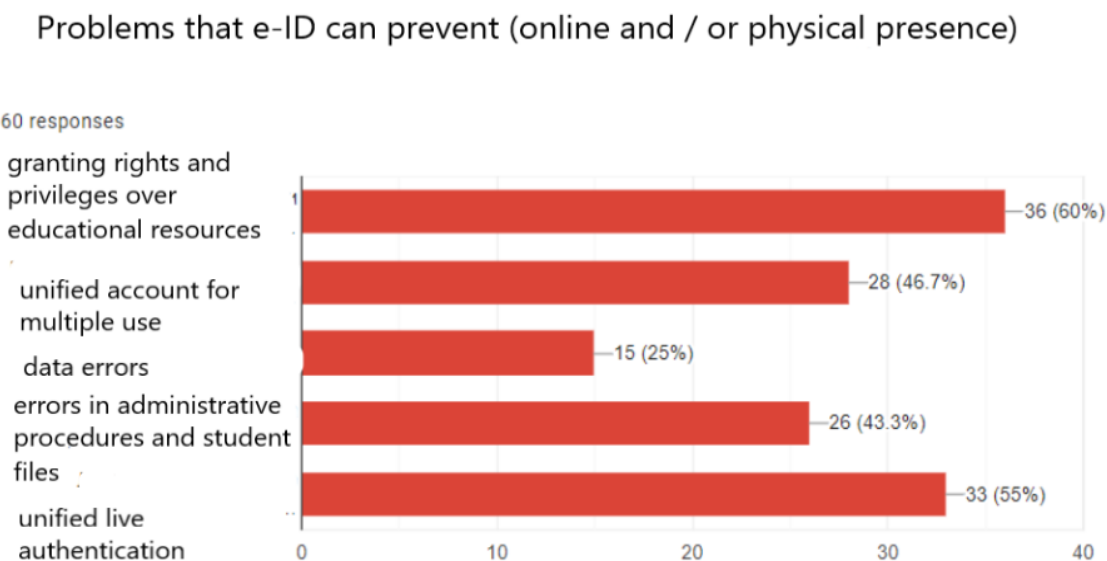
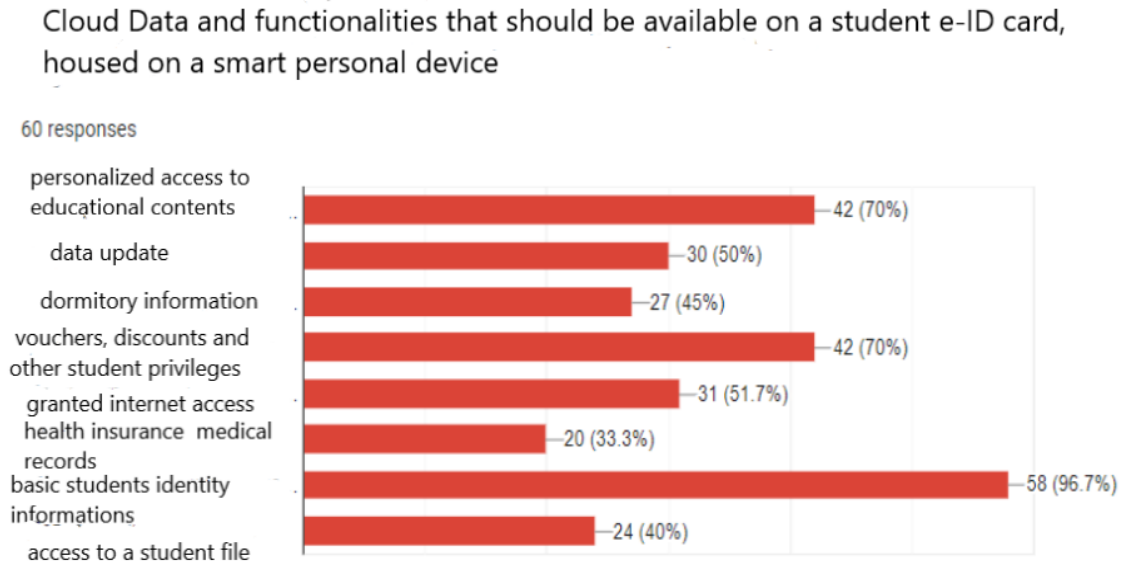


Figure 2: Functionalities and solutions offered by the use of the student e-ID card

In terms of students' expectations for a student e-card, they can be classified into the following main categories: functionalities it may have, problems it may solve, and how data is stored to be customizable and accessible. The most appropriate solution is for the data of interest for the students to be placed on the cloud management system and to be available on a personal smart device. A new trend, which is growing, is connecting data and combining it in different ways through new and up-to-date functionalities.

According to Fig.2, the expectations and functionalities seen by the students, their perception is as follows:

- For 96.7% of the surveyed students, an e-ID card should contain basic information about the student.
- A significant 70% of students find it useful to have a student e-ID card to provide personalized access to educational content in terms of assigned rights and privileges, as well as monitoring the activities to be evaluated
- An identical percentage, 70% of students find it useful to have access to the card and information on various student discounts, vouchers, promotions of IT equipment, and other student offers and privileges, with the possibility of replenishment, as given to students as an opportunity
- Almost identical percentage of 50%, respondents think that they should be given the opportunity to update the data, compared to 51.7% who think it is good when travel to different universities and various student campuses, to have free access to the Internet
- 45% of the respondents think that the information about the dormitories is welcome, 40% that there should be an option for connection with the student dossier, and some of the students, more precisely 33.3% find it useful for accommodation of medical data and health insurance.

The availability and organization of data from a student e-ID card can solve and prevent many of the occasional and potential problems, in the following context, according to Fig.2:

60% of students see student e-ID card as a solution to inconsistencies and problems in accessing educational content, when in different places there is a discrepancy in the assigned rights and privileges.

In the previous context, 55% of respondents believe that an e-ID card would prevent problems with unified identification, and

Almost the same percentage, 46.7% believe that it is good to integrate and merge multiple different accounts into one contained on the card.

25% of respondents believe that with good data management, a student e-ID card use will prevent data errors.

The received information is only a framework direction, towards the preparation of a conceptual solution for student e-ID card development.. The following are theoretical and practical analyses of the potential solutions that can to the greatest extent possible meet the expectations and needs of the students who should be users of the student e-ID card.

2.2. INTERNET OF EDUCATIONAL THINGS AND STUDENT E-ID CARD

During the last decade the term Internet of Things (IoT), as a networking of physical objects, has been recognised as a widespread concept in many areas of everyday life. Furthermore, as the next stage of evolution in the use of smart object-interconnected things in which the line between physical object and digital information about is blurred, the Internet of Everything (IoE) concept appear. As the use of new technologies to acquire generally new knowledge becomes more and more widespread, the transition from IoT to the IoE concept is gradually taking place, which basically means networking of people, processes, data and things (Selinger et al, 2013). In the particular case where data, processes and people are related to educational activities, and things are general purpose, the Internet of Everything (IoE) concept grows into Internet of Education (Aldowah, 2017).

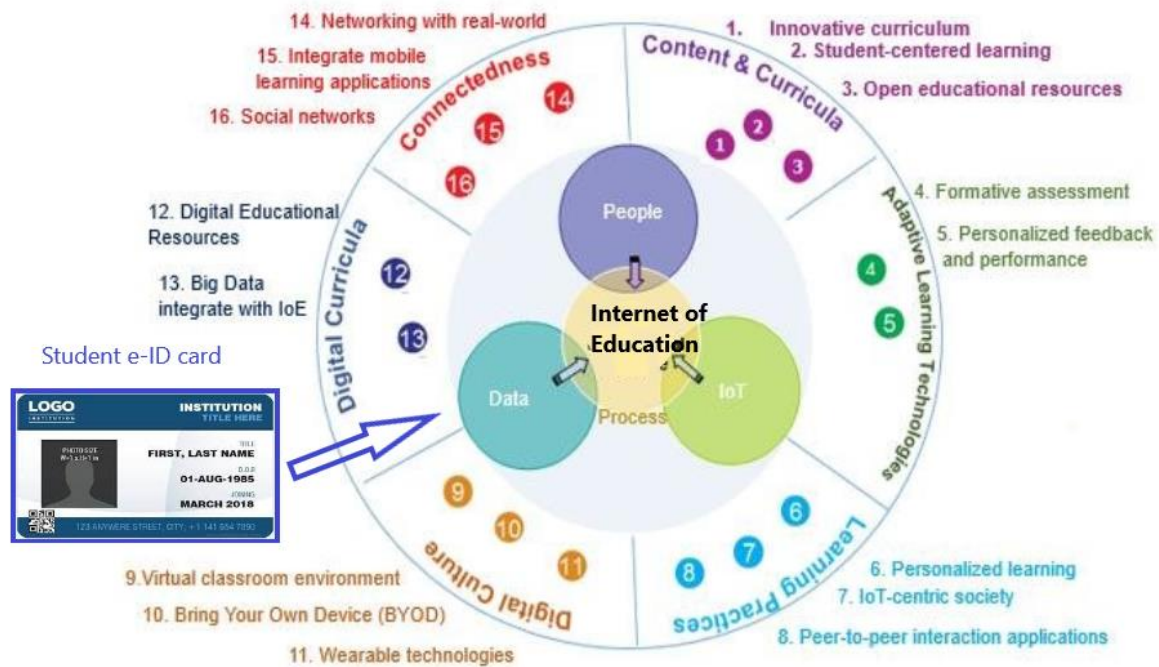


Figure 3: Internet of Educational Things and e-ID card (adapted from Bandara & Ioras 2016).

The permanent growth and changes of educational contents, create an endless demand for new forms of learning. New technologies such as cloud computing, mobile learning, learning analytics, open content, virtual and remote laboratories, games and gamification, tablet computing, and wearable technology is instilling a new digital culture, where a new educational paradigm called Internet of Education appear (Bandara, 2016). The Internet of Education, in theory and practice, (Putjorn et al., 2015) to distinguish itself from the Internet of Everything (IoE), is also known as the Internet of Educational Things (IoET). In the IoET concept, the digital student e-ID card fits in perfectly, as a very appropriate digital identity in a digital work environment. The digital student e-ID card and the Internet concept of education, developed and used before, have gained their full meaning and applicability in conditions of pandemic COVID-19. Certain solutions and educational practices may have been conditioned by the pandemic, but the positive experiences and real relief they have brought will no doubt remain in place after the COVID-19 crisis.

3. DEVELOPMENT CONCEPT OF DIGITAL STUDENT E-ID CARD

The reason for making this paper and studying the subjects in it, was the idea of using digital identity in a digital environment, including digital education, imposed by COVID-19. As research and insights have progressed, it has become clear that COVID-19 is just an occasion, and the reasons for using student digital ID cards are much greater, due to the conveniences and scalability they offer. The student e-ID card can be analysed from two aspects: the requirements it needs to meet, in terms of data and functionalities, and the digital identity protection it needs to provide.

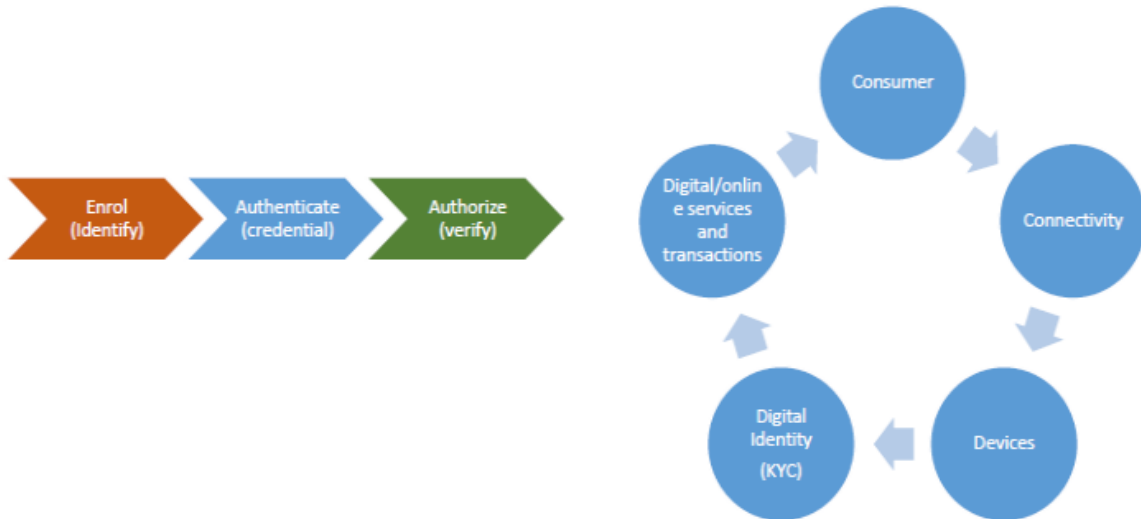


Figure 4: ICT ecosystem for Digital identification (ITU, 2018)

In continuation, the basic items for the development of an open source student e-ID card will be reviewed. The following is an overview of the main functional and non-functional requirements of the lightweight open e-ID Card application (Hühnlein et al., 2012) stored on a personal smart device: Support for all popular platforms (Windows, Linux or Mac OS, NFC enabled mobile devices, Android); Modularity, open interfaces and extensibility; Architecture based on related ISO standards; Browser integration; Security components; Open source capable; Transparency; Stability; High usability; Accessible GUI; Event manager, with function to return the state of a monitored terminal, or cloud data, after an event has occurred; and Card recognition options.. As shown in Fig.4 the identity identification process consists of three stages: Enrolment(identification); Authentication(credential) and Authorisation (verification). After that, the circle of requests is approached, which is given in general form not only for student e-ID but also, but also for other activities (Lentner&Parycek, 2016; Ratakonda et al., 2020) necessary for everyday life. This circle contains digital network services and transactions (International Telecommunication Union, 2018), related to digital identity, most often accessed on a specific consumer's smart device.

3.1. STUDENT E-ID CARD -SOLUTION COMPONENTS AND REALISATION WAY

In the last decade, digital identity, realised on scalable platforms, has been available in several European countries under different names, such as: smart ID, in Estonia (www.e-estonia.com), German e-ID (www.bsi.bund.de), E-card of Malta, with a trend of expanding use. Furthermore, assessing the importance of these trends, the European Commission has adopted a Regulation on Electronic Identification, Authentication and Trust Services (eIDAS) providing the basis for cross-border electronic identification, authentication and certification of a website within the EU. The European Commission has set a number of goals and milestones for the electronic identification of its borders and beyond. For example, by 2030, all key public services should be available online, including a significant amount of open source content and offers for higher education. On the other hand, worldwide, services are available for creating digital eID cards, for optional purposes, accompanied by content management systems, with the possibility to be tested and used in a trial period and then leased by of institutions.

3.1.1. Digital ID Card application and ID Management System – ID123

The following is a description of software for creating a digital student e-project, as one of the offered options, with a cloud management system and an application available for installation on a smart personal device. As a pilot software, for the description of the required items and components, completely rounded from application to ID management system, the cloud software ID123 (available on <https://www.id123.io/>), is taken.

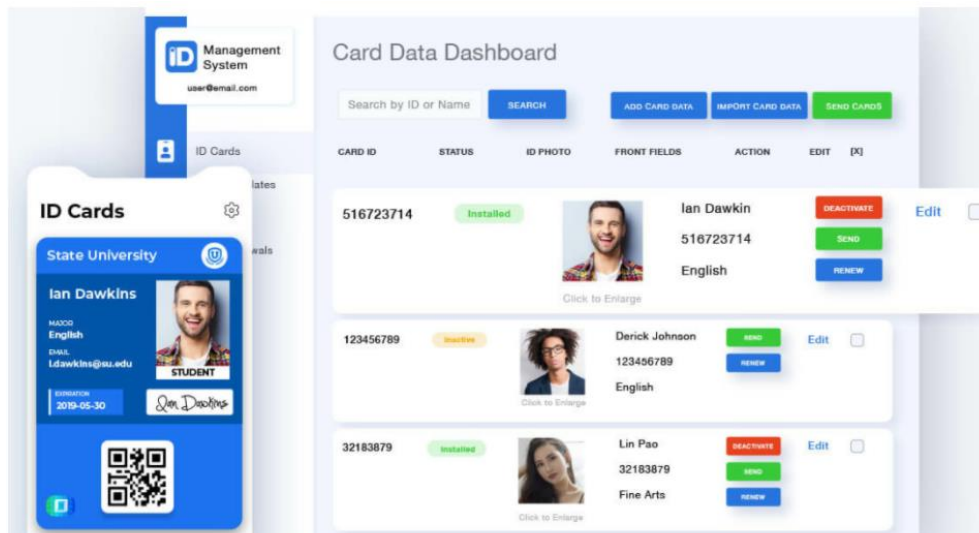


Figure 5: ID123 - Student e-ID card and ID management system

Possibilities for creating various ID cards are provided, including Digital Student ID Cards, briefly described as student e-ID. There is an opportunity for subscription at the level of institution, for example, faculty and university and the opportunity to create and administer various accounts- student e-ID cards. The application available on Google Play and Apple store is equipped with the following features: Offline work mode; In-App ID photo submission; Cardholder signature setting; Scannable barcode with third-party barcode scanner; Multiple digital ID cards storage in the app; Up to 12 fields to add important card information; Notifications when to receive important messages from their institution; System offers multiple layers of security to protect user identity and prevent ID fraud, such as: Two-factor authentication; App activity alerts; Encrypted cloud storage; Screenshot and recording prevention and Automatic card expiration. Cloud ID management system enables all data transactions and security mechanisms at the level of digital identity, including the validity, renewal of each e-ID card or change of rights and privileges in it. The following main specific features are included: ID cards issues management: deactivate, activate, archive, and renew installed e-ID cards; Card data import options via CSV, API or through an integration.

4. CONCLUSION

The transition to a digital society at all levels of human life inevitably brings with it a need for a digital identity. By analogy with the real world, digital identity can also be tailored to a particular set of communication needs, and can be scalable. The main idea for the analysis of the potentials for using the student e-ID card originates from the COVID-19 situation, but during the research, the analyses showed that the student e-ID as a concept, is

very suitable for moderated specific purpose independent of imposed pandemic. In modern ICT solutions, as software solutions are developed and hardware devices are modernized, the concepts of their application are growing. Thus, over time, the concept of IoT has grown into IoT, and with the adaptation to the specific widespread ICT educational ecosystem, IoET has emerged. All of these solutions have been created and are constantly growing, thanks to scalable open source offers and cloud applications and concepts, which have made ICT solutions more accessible than ever before. The findings provide a recommendation for the active introduction and application of the concept of student e-ID card, as a part of the overall digital identity, which technology is striving for in the near future.

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IMPACT OF THE COVID-19 GLOBAL PANDEMIC ON COPPER PRICE INSTABILITY

Ivan Jovanović*, Sanela Arsić, Dejan Bogdanović, Nenad Milijić

*University of Belgrade, Technical Faculty in Bor, Engineering Management Department,
Bor, Serbia*

Abstract: The paper discusses the behavior of the Copper price on the LME (London Metal Exchange) during the COVID-19 pandemic in the period from March 2020 to March 2021. The influence of five indicators on the movement of Copper prices on LME was analyzed: Total Cases; CPI-coronavirus panic index; New Deaths (Daily); SI-stringency index, and ESI-economic support index. Multiple linear regression was applied for data analysis, which determined the existence of statistically significant positive predictive relationships between the mentioned indicators and the Copper price. Also, the research provides an opportunity to define the most influential indicators on the movement of copper prices in the period under review, as well as the possibility of predicting the price of copper in the future, through an indicative review of current impacts.

Keywords: copper price instability, COVID-19 pandemic, multiple linear regression.

1. INTRODUCTION

In 2020 the world entered the largest global deadly pandemic crisis after more than a century. The outbreak of coronavirus COVID-19 was in China at the end of 2019, and it spread rapidly in many countries. As a result of the huge amount of infections by May 2021, more than 160 million infected and more than 3,350,000 dead people were recorded worldwide (WHO, 2021). The World Health Organisation (WHO) officially declared the outbreak of COVID-19 a pandemic on March 11, 2020 (WHO, 2020). Accordingly, the Organisation for Economic Co-operation and Development (OECD) reports that the economic turmoil is greater than the global financial crisis during 2007-2009 (BBC BusinessNews, 2020). Also, the International Monetary Fund (IMF) describes it as “the coronavirus pandemic has fueled an economic downturn that the world has not experienced since the Great Depression” (Reuters Business News, 2020).

The end result of global change due to the COVID-19 pandemic is great uncertainty in supply chains, which has led to instability in both the financial and commodity markets. Since stock markets have become extremely unstable and unpredictable and the economic impact of the pandemic is uncertain, and relying on the research results of Corbet et al. (2020), Salisu et al. (2020) on the impact of COVID-19 on the oscillations in the precious metals market, the aim of the paper is to determine a statistically significant relationship between the COVID-19 pandemic based on data for the period March 23, 2020 – March 31, 2021, and copper prices on the London Metal Exchange (LME). Given that the disease has caused extreme uncertainty in

* Corresponding author: ijovanovic@tfbor.bg.ac.rs

the commodity market, the authors want to answer the question of how much and to what extent the five indicators (TC–total cases; CPI–coronavirus panic index; NDD–new deaths per day; SI–stringency index, and ESI–index of economic support) affect the price of copper on LME.

Motivated by the lack of studies on commodity market instability, and especially by examining the impact of defined five indicators on fluctuations in copper prices, this study contributes to the existing literature by joining previous research and expands the literature on the stock market response to the COVID-19 pandemic. Given the range of consequences that could occur to all sectors and taking into account the fact that it is difficult to predict further economic development and life, dealing with the COVID-19 pandemic poses a challenge for academic research.

2. THEORETICAL BACKGROUND

In the Baldwin and Veder di Mauro (2020) study, the authors proved that the COVID-19 epidemic has different impacts on people, societies, and economic expectations. More specifically, the results of their study indicate that COVID-19 has a negative impact on various economic aspects. Also, the work of Baker et al. (2020) states that COVID-19 has caused more dramatic and frequent daily stock market changes than any other disease before. A drastic drop in the prices of many commodities on the stock exchange was recorded, as was the case with the price of a barrel of crude oil (Ji et al., 2020), a larger drop in prices than during the 2007-2009 economic crisis. Also, the World Bank (2020) confirmed a significant drop in the prices of agricultural products (cereals, edible oils, beverages, fertilizers), metals (copper, aluminum, and even precious metals other than gold), during the spread of the COVID-19 disease. In his study, Goodell (2020) suggests that the spread of coronavirus has led to a significant reaction in financial markets, as well as social distancing, which according to him is the main reason for panic and fear, which inevitably affects the negative reaction of stock exchanges. In the paper (Lyocsa and Molnar, 2020), the authors argue that since the coronavirus pandemic began, fear and uncertainty have taken control of commodity and financial markets. Such business conditions have led investors to change their economic behavior (Baker et al., 2020) and start trading in panic (Ortmann et al., 2020).

The results of a study by Haroon & Rizvi (2020) that used the CPI indicator indicate that the panic generated by news related to coronavirus leads to instability in the stock market. The increase in panic and fear for health is extremely affected by the growing number of reported cases of COVID-19, as well as information on the number of deaths, which affects global economic activities. These facts indicate the need to have information on the number of confirmed cases of COVID-19 and the number of deaths in order to establish market variations caused by the coronavirus pandemic. In response to the spread of the coronavirus pandemic, the spread of panic, and the reduction of negative economic impact, governments around the world have taken certain measures such as lockdown, travel restrictions, testing, quarantine, and economic packages, with the aim of achieving social distance between people. The application of these measures led researchers to use the SI indicator in their research. The results of the research indicate the fact that social exclusion of people can reduce mortality but also indicate a direct negative effect on economic activity (Baig et al., 2020; Hussain, 2020; Thunström et al., 2020), but also that they are counterproductive (Heyden & Heyden, 2020; Shanaev et al., 2020; Zaremba et al., 2020). Also, in many countries, the government's policy of supporting citizens' incomes is current, which researchers show with the ESI indicator (Ashraf, 2020; Wright et al., 2020). The results of their research confirm that compliance with the prescribed measures significantly depends on income and that people with lower incomes

are especially motivated. They are more motivated to stay at home which can lead to a reduction in infection.

3. RESEARCH METHODOLOGY

3.1 SAMPLE

For the purposes of the research, data were collected in the period from March 23, 2020, to March 31, 2021. Data on the number of confirmed cases of coronavirus infection (TC), and coronavirus panic index (CPI) were downloaded from the COVID-19 Dashboard by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU). The number of new daily deaths (NDD) is taken from the Worldometer database (<https://www.worldometers.info/coronavirus/worldwide-graphs/>). Data from the Oxford COVID-19 Government Response Tracker (OXCGR) were used for SI and ESI indicators. The Copper price data were collected from the official London Metal Exchange (LME) website. Prices are in US \$ per ton.

Figure 1 shows a graph of copper price instability for the observed period, with defined confidence interval limits for level 95%, and the coefficient of determination 0.954.

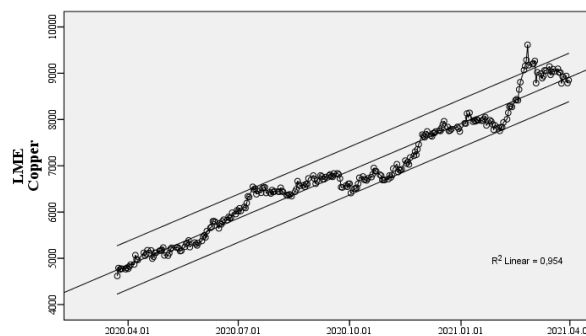


Figure 1. Prices instability of copper, March 23, 2020–March 31, 2021

The data on copper prices available on the LME doesn't exist for weekends and holidays. Therefore, the data collected for TC, CPI, NDD, SI, and ESI, which are available for each day, were adjusted to follow the available data on copper prices on the LME. A sample of 260 cases was prepared in this way. The sample size meets the required requirement that there must be 20 times more cases than the independent variables in the model. In this way, the validity of statistical conclusions was ensured.

3.2 RESEARCH MODEL

The regression model contains 5 independent variables (TC, CPI, NDD, SI, and ESI) and one dependent variable (Copper price). Assuming that there is a linear relationship between the independent variables and the dependent variable, multiple linear regression (MLR) was applied in the paper. It is a statistical technique that uses several independent variables to predict the outcome of a dependent variable. In this way, the linear relationship between the independent variables and the dependent variable is modeled, which is shown by regression equation (1):

$$y_i = \beta_0 + \beta_1 x_{i1} + \dots + \beta_p x_{ip} + \varepsilon_i \quad (1)$$

where are:

- y_i – dependent variables
- x_i – independent variables
- β_0 – regression coefficient of the model
- β_p – slope coefficients
- ε_i – error term
- p – number of independent variables

Based on equation (1), MLR equation (2) defines a research model, as:

$$\text{PredictedPrice}_{Cu} = \beta_0 + \beta_1 \cdot \text{TC}_{Cu} + \beta_2 \cdot \text{CPI}_{Cu} + \beta_3 \cdot \text{NDD}_{Cu} + \beta_4 \cdot \text{SI}_{Cu} + \beta_5 \cdot \text{ESI}_{Cu} + \varepsilon_{Cu} \quad (2)$$

The explanation of the dependent and independent variables is as follows. The *PredictedPrice_{Cu}* dependent variable represents the price of Copper. The independent variable TC represents the total number of cases infected with coronavirus; CPI represents the panic index caused by the coronavirus pandemic; NDD represents the number of daily deaths from coronavirus; SI represents a stringency index that evaluates the effects of government actions of lockdown, travel restrictions, testing, quarantine, and economic packages; ESI represents an economic support index that evaluates the government policy response in terms of supporting citizens' incomes. The regression coefficient β_0 determines the y-intercept at time zero. The partial regression coefficients β_1 denote the average change of the dependent variable *PredictedPrice_{Cu}* when the independent variable TC increases by 1, and all other independent variables are held constant. Analogous to the previous, all other partial regression coefficients from β_2 to β_5 can be described. The error term ε_{Cu} represents a stochastic term.

4. RESULTS

The collected data were processed in the software package SPSS v.17.0 using the standard Linear regression function. Multiple linear regression (MLR) is performed in three steps.

Step 1. Validation of assumptions. Correlations between variables in the model are shown in Table 1.

Table 1. Correlations

	Copper Price	TC	CPI	NDD	SI	ESI
Copper Price	1.000	.956	-.623	.673	-.789	.056
TC	.956	1.000	-.502	.751	-.719	-.120
CPI	-.623	-.502	1.000	-.369	.500	-.425
NDD	.673	.751	-.369	1.000	-.584	-.007
SI	-.789	-.719	.500	-.584	1.000	-.167
ESI	.056	-.120	-.425	-.007	-.167	1.000

By checking the correlation coefficients, it can be noticed that the independent variables (TC, CPI, NDD, SI, and ESI) significantly correlate with the dependent variable (Copper Price), because all correlations are above 0.3, based on recommendations (Ho, 2006). Also, by checking the correlation coefficients between the independent variables, it can be noticed that there is a large correlation for individual variables (greater than 0.7). This indicates a strong relationship and possible collinearity of the variables. Therefore, a diagnosis of

multicollinearity was performed by analyzing the values in the “Tolerance” and “VIF” columns shown in Table 3. So, to identify the multicollinearity of independent variables, the VIF test, and its equivalent - Tolerance test was done. As the value of the "Tolerance" test for independent variables is greater than 0.1, and the value of the "VIF" test is less than 10, the assumption of the absence of multicollinearity is not violated.

Assumptions about atypical points, normality, linearity, homoscedasticity, independence of residuals can be determined by visual inspection of the diagram Normal Probability Plot (P-P) of the Regression Standardized Residual, and Scatterplot. The diagrams are shown in Figure 2.

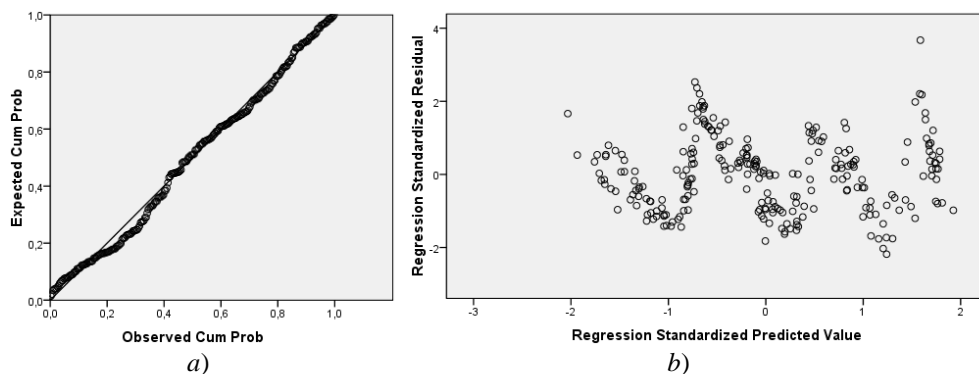


Figure 2. a) Normal P-P of the Regression Standardized Residual; b) Scatterplot

The points extend along the hypothetically perfect normality line (see Normal P-P diagram). This means that there are no major deviations from normality (the residuals are normally distributed). As the residuals propagate without obvious patterns within the residual scatterplot (see Scatterplot) and as most are accumulated in the center (around point 0), the conclusion is that homoscedasticity is at an enviable level. Also, a visual inspection of the scattering of standardized residues (see Scatterplot) revealed that there are no atypical points, ie there are no points that have a standardized residue greater than 3.3 or less than -3.3. After checking, it is concluded that the initial requirements and assumptions of linear regression are not violated, ie that the data are suitable for regression analysis.

Step 2. Model evaluation. The results of the model evaluation are shown in Table 2.

Table 2. Model evaluation results

Models	df (Reg.,Resid.)	F	Sig.	R	R Square	Type of Relationships
Cu	(5,254)	1405.451	<.000	.982	.965	+ very strongly

Based on the values shown in Table 2, it is concluded that the results of the total regression are significant and that the regression model is good. This means that a linear combination of five independent variables: TC, CPI, NDD, SI, and ESI, is useful for predicting copper prices. Specifically, the value R-square of .965 means that the independent variables explain 96.5% of the variability of the dependent variable Copper price, while the model achieves statistical significance Sig.= 0.000 or $p < 0.0005$.

Step 3. Evaluate each independent variable. Information on how much each independent variable in the model contributed to the prediction of the dependent variable is shown by standardized coefficients in the Beta column in Table 3. The standardized Beta

coefficient for the independent variable TC is +.915, for CPI is -.099, for NDD is -.133, for SI is -.143, and for ESI is +.099. The largest contribution to the explanation of the dependent variable *Copper price* is given by the independent variable TC. It is followed by the independent variables SI, NDD, CPI, and ESI. All independent variables give a statistically significant unique contribution to the prediction of the dependent variable because the values in the Sig column are less than 0.05. The t-value (t-statistic/test) is located in the “t” column.

Table 3. Coefficients

Models		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
Copper	(Constant)	3757.202	713.401		5.267	.000	2352.268	5162.136			
	TC	2.750E-5	.000	.915	37.503	.000	.000	.000	.956	.920	.440
	CPI	-114.893	19.148	-.099	-6.000	.000	-152.602	-77.184	-.623	-.352	-.070
	NDD	-.047	.006	-.133	-7.373	.000	-.060	-.035	.673	-.420	-.086
	SI	-21.788	2.760	-.143	-7.894	.000	-27.223	-16.353	-.789	-.444	-.093
	ESI	66.552	10.191	.099	6.531	.000	46.483	86.621	.356	.379	.077

The unstandardized coefficients shown in column B are used to compile the linear regression equation. The equation for predicting the "copper price" based on the indicators TC, CPI, NDD, SI, and ESI is shown by equation (3).

$$\text{PredictedPrice}_{Cu} = 3757.202 + 2.75 \cdot 10^{-5} \cdot \text{TC}_{Cu} - 114.893 \cdot \text{CPI}_{Cu} - .047 \cdot \text{NDD}_{Cu} - 21.788 \cdot \text{SI}_{Cu} + 66.552 \cdot \text{ESI}_{Cu} \quad (3)$$

The coefficient $\beta_0=3757.202$ represents the predicted *Copper price* at the beginning of the research. The coefficient $\beta_1=2.75 \cdot 10^{-5}$ represents the expected increase in *Copper price* with an increase in the number of infected per unit value, ie US \$ 27.5 per tonne per 1,000,000 cases of coronavirus infection. The coefficient for the independent variable CPI is negative, which means that the regression is reversed, ie with increasing value for CPI, the *Copper price* decreases. The same is the case with the independent variables NDD and SI because their coefficients are also negative. For the independent variable ESI, the coefficient is positive, so that with the increase of its value, the *Copper price* will also increase.

5. DISCUSSION. IMPLICATIONS AND LIMITATIONS

Numerous news of the number of confirmed cases burdened with panic shows a negative reaction of stock exchanges, which has been confirmed in numerous studies (Baiga et al., 2020; Lyocsa et al., 2020). Also, an increasing number of deaths that cause fear is linked to growing instability in stock markets (Haroon & Rizvi, 2020, Salisu et al., 2020). On the other hand, governments have established various policies and taken different measures at different times and with different severity. Government reactions such as job closures or restrictions on movement to stop the spread of infections are seriously affecting the metal industry market, and thus the global economy. In addition to instability in the stock market, our results also confirm that various indicators of coronavirus cases around the world and the seriousness of the state measures lead to instability in the metal market as well. The research results confirm that there is a linear relationship between the independent variables TC, CPI, NDD, SI, and ESI and the dependent variable Cu. The general public is increasingly seeking information about the virus

on the Internet (Bento et al. 2020), which causes additional panic. Under this assumption, the authors expanded the scope of the research and give new light on how information about the public health crisis and government actions are relevant to serious fluctuations in the metal market.

Our research contributes to the initial and insufficient literature, ie we document how the metals market has reacted to the panic and fear caused by the spread of information about the coronavirus. In addition, analyzing the impact of government measures of social distancing on price variations of Copper can help create a more adequate government response in the future. The fact that the long-term effect of government action has yet to be seen while discussing the dynamics of the COVID-19 pandemic, this study had the ambition to provide knowledge and information relevant to metal market participants as a contribution to the community. Our findings also provide information of great importance for predicting the behavior of Copper prices during a period of global economic and financial distress. Therefore, considering key attributes and planning measures would reduce the uncertainty and panic that leads to price volatility in the stock market.

This research has several limitations of its own that could have influenced the results. First, the inclusion of five independent variables in the model. In addition to the above, future studies could include other indices. Second, a limitation in the applied methodology. Namely, the adopted statistical approach in the paper was multiple linear regression. Therefore, in order to examine the impact of COVID-19 on the movement of metal prices in the market, future studies could apply other approaches, such as VAR methodology and Panel data analysis. The third limitation of the study is the research of only Copper prices on the LME. Further research in this area stems from the authors' expectations that mentioned limitations will not adversely affect the applicability or usefulness of the study result.

6. CONCLUSION AND RECOMMENDATIONS

This paper is an attempt to present in a comprehensive way the implications of the outbreak of the coronavirus pandemic on the market price of Copper. Therefore, the aim of the study was to determine the impact of five defined indicators on the price of copper determined on the LME during the coronavirus pandemic. By monitoring the behavior of Copper prices, it is clear that they change significantly in response to the events related to the spread of coronavirus and government announcements action. Based on the results of the applied MLR, it is concluded that in the considered period from March 23, 2020, to March 31, 2021, the indicators TC, CPI, NDD, SI, and ESI lead to an oscillation of the copper price on the LME.

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FINANCIAL TECHNOLOGIES AND ITS IMPACT ON FINANCIAL INCLUSION

Salome Silagadze*

Assistant Professor, Faculty of Business Administration & Management, Business and Technology University, Tbilisi, Georgia

Abstract: The fourth industrial revolution presents technologies as the key of development for businesses and societies overall. The digitalization of business models, financial services and products has led to the development of Financial Technologies, also known as FinTech. Technology driven transformation and Fintech have assisted financial companies to better understand and service their customers, while bridging the gender gaps that have existed in financial account usage. The availability of complex financial services through various digital channels (such as social media, internet platforms, mobile, bots and etc) has made banking more overall more inclusive.

The first section of the paper examines Fintech and reviews research on its possible effects on the financial inclusivity. While, the second part of the work observes Georgian banking sector's usage of Financial Technologies and analyzes some of available financial service usage statistics (among women) in the country and globally.

Keywords: Fintech, financial technology, digital finance, banking, gender studies, financial inclusion, Georgia.

1. INTRODUCTION

Fintech has become a subject of active discussion for the past few decades as an increasing number of financial institutions have innovated and transformed their services, through complex digital technologies. Researchers have been analyzing the possible positive outcomes of information technology in financial services since the early 2000's (Berger, 2003).

Fintech has given financial institutions/ companies the ability to analyze data with complex algorithms, offer new digital products to current and prospective clients and also, become more cost effective (Douglas et al., 2017). The use of technologies has decreased the bureaucratic aspects associated with traditional "brick and mortar" banking and made the process more democratic and swift by offloading account services to mobile, social media and internet platforms (Kim et al., 2016).

Due to ease of access and decrease of service costs, Fintech has been increasingly been associated with the reduction of closing gender gaps in financial inclusion, which have been persistent over the years (Sioson & Kim, 2019; Chen et al., 2021). Hence, observing some of the aspects of digital innovations and financial services merge, is a safe mean of conceding how the expansion of Fintech might assist financial inclusion globally.

* Corresponding author: salome.silagadze@btu.edu.ge

Firstly, the article reviews the history of Fintech development. Secondly, it analyzes the products and the research that has been associated with financial technologies and their effect on financial inclusion. The study also overviews Georgian banking sector's practice of digital development and available financial service usage statistics (among women) in the country.

2. HISTORY OF FINTECH

The term "Fintech" was first introduced by banker A.L Bettinger, who defined the term as an " acronym which stands for financial technology, combining bank expertise with modern management science techniques and the computer." (Schueffel, 2016; Bettinger, 1972). The term was later resurfaced during the nineties thanks to Citigroup. As for some of the recent studies, they define Fintech as a process "during which finance and technology have evolved together" (Arner et al., 2015).

Researchers divide Fintech development history into three periods: Fintech 1.0, Fintech 2.0 and Fintech 3.0 (Arner et al., 2016; Buckley et al., 2016; Leong & Sung, 2018; Reiner et al., 2018; Paston & Harris, 2019).

Table 1. Eras of Fintech evolution (Buckley et al., 2016)

Fintech 1.0	End of 19th c. - 1960s	The first transatlantic cable was laid and the usage of transportations (such as railroads and/ or boats) was increased. The development of telex also sped up the financial transactions across the globe and hence, linkages between countries began to be intensified.
Fintech 2.0	End of 1960s- 2008	Financial technologies began to be used not only for international transfers but for electronic payments as well (during the mentioned period of time Swift program, ATM & POS terminals began to be utilized by bank account owners). Hence, the traditional "brick and mortar" banking started to become less relevant, as account owners no longer needed to visit branches for making transactions.
Fintech 3.0	2008- now	E-banking, e-payments and various startups using digital business strategies began to be developed. Financial companies began to depend on complex technologies as being product sales points (for example leading banks started to rely on automated "robo" advisors) and the use of blockchain based services has been increased. The 3.0 is not only marked by the enhanced level of service & product digitalization, but with the increased pace of development as well.

The usage of Fintech innovations has been growing over the years, since 2017 the total global investment in Fintech has increased from USD 59.2 billion to a peak of USD 168 billion (2019). However, it must be noted that Covid negatively impacted the total global investment amount as it decreased to a sum of USD 105.3 billion during 2020 (Pollari & Ruddenklau, 2021).

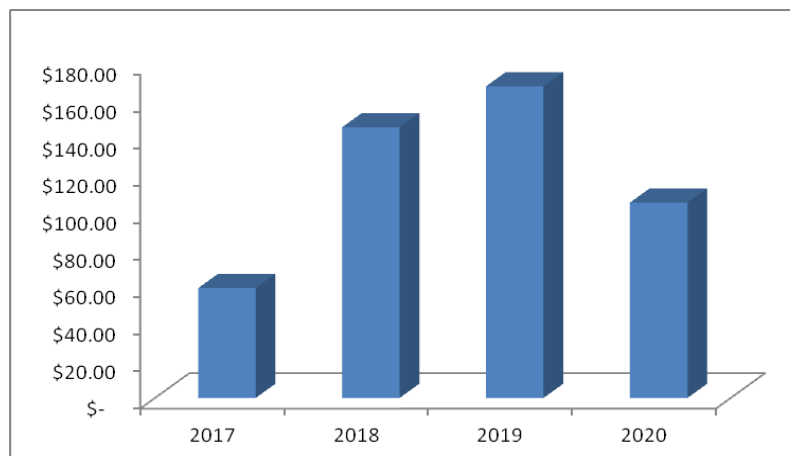


Figure 1. Total global investment activity in Fintech, 2017-2020 (Pollari & Ruddenklau, 2021)

Research shows that financial technologies market is growing rapidly as the global Fintech adoption rate grew to 64% in 2019. The same year 3 out of 4 global customers reported to use Fintech services in order to make transfers (the most commonly used digital product) and 96% of global customers were informed about at least one money transfer Fintech service (EY, 2019).

3. FINTECH AND FINANCIAL INCLUSION

Financial technologies have given financial institutions/ banks an opportunity to develop new business offers and digitalize traditional brick& mortar services. Having up-to-date and user friendly digital platforms has become a competitive advantage for financial institutions. However, the development of complex financial technologies also aids to achieve some of United Nations Sustainable Development Goals (UN SDGs), such as gender equality, decent work and economic growth, reduced inequalities and others (UN, 2015; Arner et al., 2019).

As of 2017, 1.7 billion people did not have access to financial services or mobile banking. Insufficiency of funds, long distance to banking institutions and high service fees have been described as the main reasons for not having bank accounts (World Bank, 2018).

Women (especially in developing countries) are less likely to own a bank account as 56% of all unbanked adults globally are women. Even though the number of account holders have grown over the years, in 2017 only 65% of women were account owners, while the same data was equal to 72% for men.

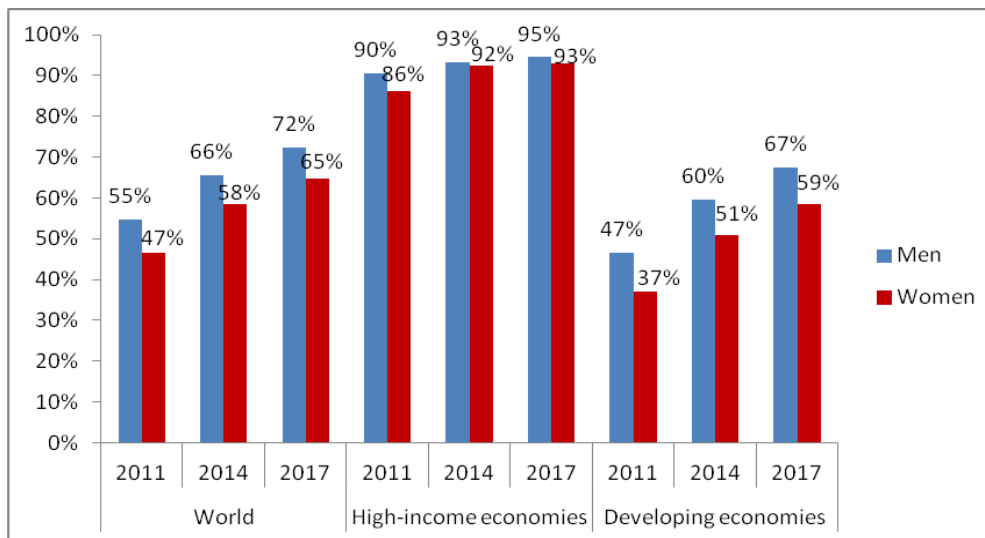


Figure 2. Financial institution account ownership and gender, 2011-2017 (World Bank, 2017)

As companies have been initiating digital product development, the number of customers using technology for their financial goals has been rising as well. Financial companies develop user friendly, resourceful and automated technologies in order to attract new clients (Al Ajlouni & Al- Hakim, 2018). Due to dynamic realization of digital innovations today some of Fintech's most frequently used products/ services include (EY, 2019):

Online transactions/E-commerce: online services via which a consumer can make financial transactions (internet bank, debit cards, e-wallets, PayPal and etc);

Personal finance management and planning: banks have developed various wealth management planning technologies and robo advisor systems that assist clients to effectively plan their investments;

Insurance: ensures faster payment of premiums, assessment of individual risk profiles and customer claim analysis;

Lending: online lending platforms developed by banks enabling clients to receive loans through online applications. Digital peer to peer (P2P) lending services have also been frequently offered as well;

Blockchain: blockchain technology assists to deliver faster online payments, verification, stock exchange transactions and other banking services. The complex technology has also been used to invest in crypto currency.

Mobile money and internet bank digital platforms enable account owners to use traditional banking services like making general payments, paying bills and even investing in various financial products (such as opening deposits, purchasing insurance).

The accessibility of mobile and internet banking has made it possible for women and/ or other groups that had no previous chance of access to banking services, to own financial account. Though the account ownership difference between men and women has consistently been 7% from 2014, it is apparent that developing services through technology increases accessibility to funds and financial services (figure 3) (World Bank, 2018).

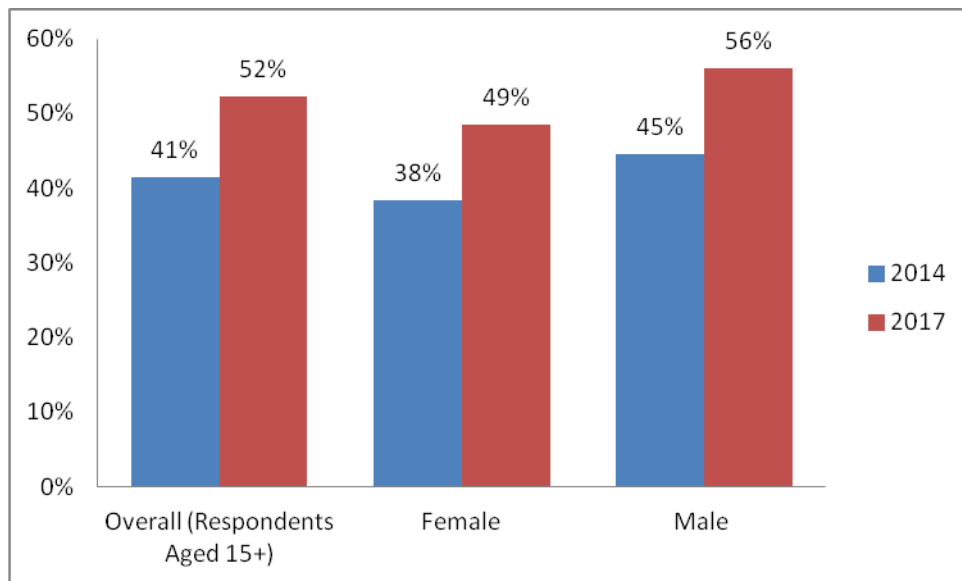


Figure 3. Usage digital payments in 2017 according to gender (World Bank, 2017)

As mobile phone penetration is over 90% globally (Deloitte, 2017), women have been increasingly making various types of payments through internet and using mobile money services as well. For example, according to data, the mobile phone based financial service - M-Pesa (operating in Kenya and Tanzania) was able to raise approximately 194,000 Kenyan households out of poverty and helped Kenyan women to amplify their consumption and workforce prospects (Suri & Jack, 2016).

Table 2. Ownership of mobile money account, usage of internet for account access and online payments among women, 2014-2017 (World Bank, 2017)

	Mobile money account	Used a mobile phone or the internet to access an account	Used the internet to pay bills or to buy something online in the past year
2014	2%		16%
2017	3%	23%	28%

Because of easy access, digitalized processing and low fixed costs, Fintech loans are assumed to reduce inequality in access to funds (Jagtiani & Lemieux, 2017; Phillipon, 2020). Financial technologies assist a growing number of people to have access to credit. Customers are willing to pay for quick lending procedures and elastic loan supply (Fuster et al., 2019).

Various reports have found that Fintech increases financial inclusion among minorities, SMEs and/or groups that traditionally would have been rejected by banks (World Bank, 2016; Schweitzer & Barkley, 2017; Desai & Meekings, 2016). According to a study by Bartlett et al. (2018), Fintech algorithms discriminate minorities 40% less than traditional lending institutions.

As for online wealth management advisors, they contribute to financial inclusion as well. The robo advisors give account owners a chance to have access to financial advising & planning, a service normally designed for the banks' rich clientele (Abraham et al, 2019).

4. FINANCIAL TECHNOLOGIES AND GEORGIA

After the collapse of Soviet system and the establishment of the National Bank of Georgia (in the early 90's), former state banks were commercialized and by 1995, 102 commercial banks were established in the country. As of 2021 there are only 15 operating licensed commercial banks in Georgia (National Bank of Georgia, 2021).

Banks in Georgia have been using omnichannel approach to sales, with a strong focus on traditional banking services' digital transformation of internet and mobile bank platforms, since the early 2000s. The purpose of developing complex technologies in Georgian finance industry is to enlarge customer centricity by utilizing complex algorithms and capitalizing on data analysis capabilities and/ or technologies.

Local leading banks have developed multi channel tactic to financial technologies and have increased their online presence and accessibility by "building" digital e-products such as: cards, lending systems, peer-to-peer payments, network of self-service terminals, web channel, and bots on social media platform Facebook. Users also have options to make payments via QR payments, e-wallets and/ or Apple pay.

Over the past years principal Georgian banks have been successfully offloading their business processes to digital channels. The strategy became especially apparent during the covid period as the well developed digital banking systems allowed customers to make most of their transactions remotely. It is reported that during 2020 more than 90% of daily banking transactions were being conducted via internet and mobile bank (BOG, 2020; TBC Bank, 2020).

Due to substantial development and digitalization of the finance sector, approximately 61% of Georgian citizens owned an account in 2017. Unlike the global trend of women not actively participating in banking, 64% of Georgian women owned accounts in financial institutions in 2017, while meanwhile only 58% of men reported to have accounts.

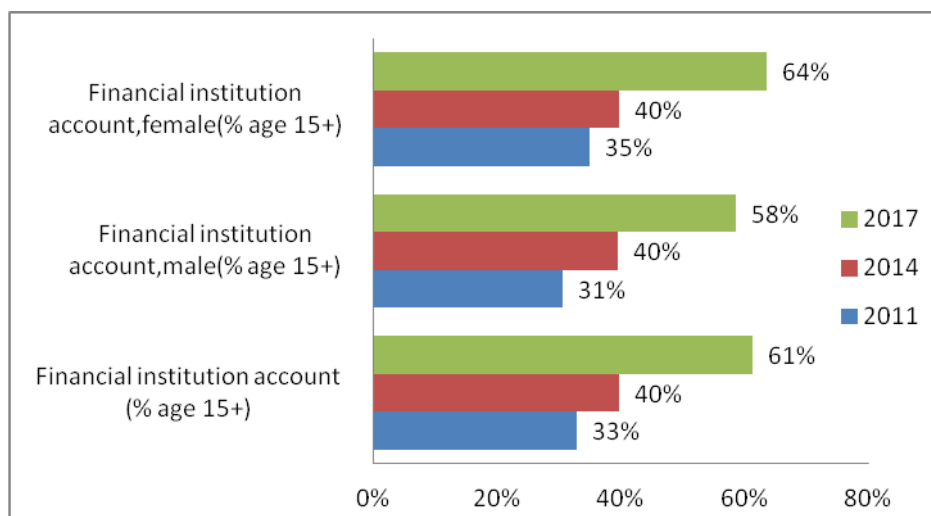


Figure 4. Financial institution account ownership and gender in Georgia, 2011- 2017 (World Bank, 2017)

Georgian women also pioneer in the usage of digital payments and internet in Caucasia, as 55%, 8% and 14% of them have implied that: they own made or received digital payments in 2017, have used the internet access their account and/or to pay bills or to buy something online (consequentially), in 2017.

Table 2. Usage of digital financial services and access to account (through internet & mobile phone) among Caucasian women, 2014-2017

		Made or received digital payments in the past year	Used a mobile phone or the internet to access an account	Used the internet to pay bills or to buy something online in the past year
Armenia	2014	10%		5%
	2017	34%	7%	15%
Azerbaijan	2014	14%		4%
	2017	23%	1%	9%
Georgia	2014	17%		5%
	2017	55%	8%	14%

In July 2020 National Bank of Georgia announced to begin working on the main requirements/ principles of digital banking licensing. The mentioned arrangement will give further support to Fintech development and financial inclusivity enlargement in Georgia (KPMG, 2020).

5. CONCLUSION

Based on the aforementioned information, it may be concluded that Fintech development is valuable for financial institutions and their current/ prospective account holders. Due to financial technology development the companies are able to use large amounts of data to develop further innovative products and produce better, tailor made offers and decrease verification costs (Thakor, 2019). Thus, commercial banks are able to offer their services to a wide range of audience, while decreasing costs and increasing client participation in future product development.

Because of ease of access, practical interface, rapid procedures and innovative digital products, Fintech has been able to grant "unbanked" women the opportunity to own financial accounts and be more financially independent. Hence, with promising enhancement of technology & mobile penetration, there is a possibility that the persistent gender gap of financial inclusion will be lessened.

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THE ON-LINE DISTRIBUTION CHAINS OF ORGANIC FOOD ON PORTO ALEGRE AND METROPOLITAN REGION

Adriano Diego Klein^{1*}, Caroline Rippe de Mello Klein², Glauco Schultz¹

¹*Federal University of Rio Grande do Sul, Brazil;*

²*Federal University of Fronteira Sul, Brazil*

Abstract: This article was developed thinking about mounting an preliminary database, development, and transposition of researched data in relation to the economic agents that commercialize organic vegetables in the metropolitan region of Porto Alegre (RS) through digital media, such as websites, marketplaces, social networks and instant messaging applications. For the purposes of building an initial database, the formation and functioning process of this market will be analyzed, in contrast to the latest movements and expressions that give rises to a new way of looking at food and lifestyle. Understanding thus, that the performance of these agents is mixed in the diegesis of the organic commercialization markets in a unique way of expression situated in its time yourself, considering the social crisis of the present that presents itself in the 21st century. Because it is through all those new technologies, access, and globalization, it is necessary to reinvent and readjust to the new social and economic conjunctures that present themselves. Therefore, to elucidate these analyzes of this type of e-commerce and its relationship in the marketing of organic products, we resorted to an analysis thinking in a perspective of the distribution chains as a methodological guide to evaluate the way in which this trade operates. So, we concluded some relevant aspects to maintain and good work of this kind of business as: Local and fresh products, seasonality, products direct from the producer, fair trade and price, presence of cooperatives and associations and selling health and organic food.

Keywords: E-commerce, organic, distribution chains, slow food, fairtrade

1. INTRODUCTION

The aim of this article was to investigate the market dynamics of buying and selling organic products over the internet, which has been growing rapidly in recent decades and has peaked because of the spread of Covid-19. This type of trade was originally based on industrialized products that were produced through global supply chains, but over time it expanded to new products, including food and perishables. In this organic online market, the links, and relationships between those who sell, and buy is very dynamic and fluid. Another great advantage is that the cost of using the platform itself is free, as it is paid for through advertisements. People in developed countries rapidly gained access to this system and increasingly those in developing countries did too.

* Corresponding author: kleinagro@gmail.com

E-commerce now applies to food, using supermarket delivery applications, shopping websites, etc. This has also spread to the realm of organic food, including items with a shorter shelf life, in this case, vegetables that are more perishable and locally produced (Yusra, 2020). This is the result of an increasing interest in the production of organic and fresh food, which has become a common feature on the agenda of several initiatives and areas of discussions (Turk, 2017). These discussions tend to revolve around finding ways to connect producers and consumers, to rediscover rural aspects and food, by making consumption more “local” (SEYFANG, 2008). The search for healthy and safe food is part of the growing concern for the environment that focuses on agriculture and food consumption (especially regarding waste), and which is also linked to some of the ideas currently being discussed in academia, which have resulted in new courses that are linked to such issues as gastronomy, food engineering and new approaches to traditional studies such as the study of short supply chains and new market formats.

In Brazil “you can also see a trend in favour of this in the Brazilian consumer market – probably the largest in Latin America – which is driven by a middle class that wants healthier food”. (LIMA, *et al*, 2019, p. 30). The growth of the organic food market is driven by concerns to do with environmental issues, safety and the appropriate amount that should be produced and consumed, based on agricultural and food production models, as well as the increase in production of these products, also according to Lima et al (2019, p. 27), the organic farms have increased by 19% each year on average between 2010 and 2018, and the number of organic producers registered with MAPA (Agriculture Ministry) in the last seven years has increased by almost 17% each year on average.

But the demand and values behind this trend did not spread spontaneously in a simple nuclear way. Much of the demand is the result of it being championed by various movements and organizations. These entities have different approaches. They have different points of view on the food and its cultural, nutritional, and social importance and on the impact our choice of consumption has on our health and the environment. Some movements may be more focused on agroecology and sustainable agriculture, traditional cooking, the recurring problems with obesity and empty calories, other problems relating to the supply of food or the survival of farmers in the countryside. To provide some detail for the debate, we will mention some and their main areas of interest and activities later in this article.

Therefore, it is important to analyse what are the possible motivations and inducements; whether due to traditional product factors (price, availability, convenience, etc.), or due to more specific reasons or values. As a result, it is important to understand these factors, both from the traditional point of view of the company, but also the importance of “diverging” and “converging” aspects that affect businesses that sell organic products and the tension between traditional retail and the impact of other issues for the consumer, who has new drivers, concerns, and values.

2. ONLINE ORGANIC BUSINESSES, FROM THE PRISM OF SUSTAINABILITY, SHORT SUPPLY CHAINS AND NEW SOCIAL ORGANIZATIONS

The management of this type of organic trade depends on a series of factors that range from: the availability of rural producers who are engaged in such production, to a consumer public that appreciates the value of this type of initiative - products and services in a complex organization that are not normally part of a linear production chain. However, the new “green wave” has found fertile ground in established traditional farmers, where it has helped to develop effective new production systems to take advantage of this niche. Sustainability has become a

central theme. It can work in different ways, as it does not necessarily have, according to Aerni (2008), a definitive concept. It can include related themes such as short supply chains, and is often used as a principle organizational model, linked to sustainability in urban and vertical agriculture and the agroecological production of small producers, which is increasingly used in studies on the agribusiness. This new organization generates not just linear web chains, where products, knowledge and interactions between individuals and organizations take place, it also leads to the consolidation of these production systems.

Within the field of sustainability there is a diversification of theories with issues like study of short production chains and local consumption, we have a multitude of different ideas that can conflict with each other. This is generally due to concerns about greenhouse gas emissions or energy efficiency, which might suggest some negative social aspects or indirect environmental damage in the medium or long term, and which cause these to be treated as “uncertain choices”. According to Winter (2003), when local consumption is part of the culture it creates deep-seated values about the world, which creates a form of cooperation between producers and consumers, as part of their idea of community. While other authors, such as Blake (2010), state that it is normal for larger players to get involved in this market, attracted by the niche market and being able to attribute ‘local’ to greater efficiency, a low carbon footprint and less waste than others with greater food mileage and he argues that it is normal for small producers and establishments to become integrated into larger networks.

One of the best guiding concepts, therefore, is that relating to Information Technology and the advent of the online and Communication era. This is an example of a short production chain because, as Schneider and Gazolla (2016, p.12) point out, “the definition of short production chains relates to the central aspect of economies of proximity and the scope of which refers to the importance of geography and the interaction between the physical location and the economic activity”. In relation to competition, according to Montanari (2007), short chains are an alternative way of reducing the cost of transactions and “adding value to products” through certification / origin or even reputation. In general, short chain strategies try to use proximity to achieve recognition, to be seen as high quality and to be able to apply a premium price, while also reducing the costs involved in the process. To be enabled to be more competitive, the short chain must contribute something different, other than being just a short chain or part of an association, it must contribute to the value chain.

The central factor for the existence of a short chain, according to Marsden et al. (2000), is not geographic proximity, but information, which is a feeling of “a mutual awareness of the situation among those participating in the chain”. This information can be publicized in various ways, through direct contact, labelling, reputation, or other media. This information transmission is the main way to characterize types of short chains. According to him, there are basically three types of short chains: face to face, proximity and expanded.

Face-to-face is characterized by direct contact between the producer and the consumer at, for example, fairs or through purchases on the producer’s property or their own store. Proximity is based both on geographic proximity and by the lack of intermediaries (but not in-person delivery) or just one, which suggests a more direct flow of the product physically and in terms of information. With expanded, it’s not a question of distance, but about the mutual recognition of this state between producer and consumer. Some fair-trade products or those from highly reputable places fall into this category, where the consumer recognizes the producer, despite being in another country.

There are several movements that have grown up since the end of the 20th century that are related to food. Their goals are diverse, but their central position is to try to change the existing paradigm relating to the production, distribution, and consumption of food. These movements, as well as being critical of the existing system, have tried to provide solutions to

many of the challenges of the 21st century, such as food safety, environmental degradation, and production systems, helping production to reduce its impact in terms of CO₂ emissions (global warming), the preservation of food culture, biological and food diversity, food waste and health problems arising from insufficient, excess, or inappropriate nutrition.

The movement to encourage organic, biological and agroecological agriculture, although not a single entity, but a series of initiatives that began in India, Japan and then later France and the United States, took on more shape after the Second World War as an alternative to “industrial agriculture”. It criticized the use of pesticides, the unsustainability of the extensive use of fertilizers and the impact this would have on the environment and on the quality of food. The search for a production process that was more balanced with nature, along with the various certificates attesting to certain production criteria, created alternative production methods; not just Organic/biological, but also “permaculture”, biodynamics, and agroforestry. Nowadays, organic agriculture and its variants are well known in practically all countries in the world and a common food production system.

One of these movements is *Slow Food*, which is an international NGO based in Italy, which has been going since 1989 as an alternative to fast food. Their interest is in preserving and preventing the disappearance of local food culture and to make food interesting to consumers and explain how their choice of food affects the environment and the world around them. The basis of this movement is that food is not just one dimensional; it influences many different aspects of life such as culture, politics, agriculture and the environment and, therefore, the way we choose how we eat has an impact on the food; from production to consumption. Therefore, its premise is that food should ideally be “good, clean and fair”.

The Slow Food for Biodiversity Foundation was created in 2003 and, although it is part of the Slow Food movement, the foundation has its own statute, finances, and administration, enabling it to fund projects such as the Ark of Taste, Presidia and Earth Markets. In general, they work to promote the projects of the Slow Food movement to support agricultural biodiversity and gastronomic tradition. They work mainly in developing countries where the most important factor is not improving welfare, but the very survival of people, communities, and cultures. (FREITAS, 2014, p. 20)

Many projects and groups are encouraged and guided by the activities of awareness campaigns such as *Slow Food* and others like *Food Miles*, as a purchasing basis designed to publicize the need to reduce the "ecological footprint" and support "rural or ecotourism" (EDWARDS-JONES, 2008). In other words, scientific concepts that are gaining acceptance among the consuming public to support the environmental and ecological agenda relating to food production. These initiatives recommend, and sometimes aim to change the way people think about systems in order, at the same time, to encourage ways of reducing the environmental impact and improving the quality of food, which are often linked to movements in support of traditional / local cuisine and organic / agroecological agriculture. In terms of practical issues, to achieve these objectives, they focus on the issue of urban/peripheral agricultural production, the creation of farming cooperatives and more environmentally efficient ways of consumption and marketing (BLAKE, 2010).

Another of these food-based movements is "fair trade", which is based on various organizations operating in several countries across the world. The aim is fair trade, in other words a guaranteed product price for the producer, that is sufficient to at least maintain their production and provide a decent livelihood. It seeks to stamp out conditions such as slave labour, precarious existences, discrimination, and child labour, and develop the farming communities, so that it has a positive impact on the places where the food is produced. For consumers, it is a guarantee that the food they are buying has reached them by a process that respects social justice and environmental and economic issues, as laid out under the fair-trade

rules. In addition, these standards ensure that their "preferred" products will continue to be produced in a sustainable manner in the future.

Fair Trade is a commercial partnership, based on dialogue, transparency, and respect, which aims to make international trade more equal. It supports sustainable development because it provides better trading conditions and it ensures the rights of marginalized producers and workers (IFAT, 2001 apud SALGUERO, CLARO, 2015, p. 96)

The organizations of the consumers are mainly located in North America and Europe, while the organizations of the producers are mainly concentrated in Latin America, Africa, and South Asia. This is mainly due to the income disparity between these regions. In a study carried out in Europe in 15 countries, about 50% of consumers were familiar with fair trade and of these 80% considered that it was a good thing to have this brand on the products they bought. To get to this position, this organization has a global network which carries out educational and awareness activities, as well as working with producers (Mihajlovic, 2016). It has 1 million, 700 thousand producers as part of its system and is actively involved in lobbying and promoting policies related to the agricultural production chain.

And final, there are also other movements such as *Rethink Food* that are primarily a nutritional approach but go further. These are established to promote healthy food, due to concerns about high-calorie food, with few essential nutrients (empty calories); while there are others such as *city harvest* that focus on food distribution and guarantee that they can deliver to people as fast and efficiently as possible. Both acknowledge "empty calorie" foods are generally cheaper and are aimed at those on low-incomes and children. They usually last longer and are less perishable. These campaigns promote courses and campaigns about food waste and recommend alternatives that are more nutritious and healthier. These movements certify partner restaurants, distribute meals to vulnerable groups and try to create a network around restaurants, communities, and vulnerable individuals, as well as working with farmers, restaurants, stores, and the community to avoid food waste.

3. THE MAPPING OF ONLINE ORGANIC PRODUCERS IN PORTO ALEGRE AND METROPOLITAN AREA

Based on the scope and purpose of the study, it was configured to use some basic criteria to select the businesses, which enabled us to set some categories. The primary category was that they had to sell organic products over the internet in the greater Porto Alegre area, these products had to include food (discounting those who only sold medicines or beauty products, perfumes etc.). 20 businesses were identified within these parameters using the Google, Bing, and Yahoo search engines. All of them sold organic products in the greater Porto Alegre area. During the period between the time the businesses were selected (September 2020) and the data being analysed, five of the companies ceased trading; however, it was decided to keep the data for statistical purposes on the basis that it was still relevant (25% of businesses ceased trading during the pandemic in 2020, despite online sales and delivery) and of interest.

The data gathered was based on the information published by these businesses on their websites and any additional material such as magazines, interviews, reports and articles about these businesses that could also be found on the internet. These data were divided based on relevant criteria for the analysis, beginning with the theoretical framework, such as types of products, intermediaries, involvement in cooperatives, involvement of farmers and then including the values and market positioning of the business, as well as data on the main aspect

of their daily business for the type of e-commerce, such as frequency of delivery, ordering method, platform used for sales and interaction with consumers.

A table was created from the data gathered, which can be found in “Appendix 1”. The businesses used various marketing channels, including websites, social media, and messaging apps. When we analysed the data, we noticed that only four of the fifteen used only one channel/platform, which indicates how important it is to have an intensive presence on social media. We also noted, looking at each example, that those who did not take part were older traders. The data showed how important social media is as a source of contact and interaction between producers and consumers. Only more traditional businesses that already have extensive advertising or a long history of operating in the region and interpersonal contact, can do without it.

We analysed the businesses to examine the impact of physical stores and to examine the degree of dependence and how the activities were complementary within the various sales models. Of the websites surveyed, seven out of fifteen, according to Appendix 1, are in the sixth category. Among these, five indicated that they had started with a physical store and had expanded to online sales, while still maintaining the store, and for the other two it was not possible to verify the progression. This shows that alternative methods do not have to be at the exclusion of others, but that there is a general tendency for this sector to migrate to or at least have an online presence as well as physical sales. Some businesses explained that being only online enabled them to be “simple, agile and low cost”. As there were no businesses that were online and had then clearly established a physical store, at least in this sample, online sales are a sufficiently resilient business approach.

Regarding the frequency of delivery, the minimum frequency was weekly and the most common was two or three deliveries. The most common delivery model was to the door; however, in some cases, orders could be picked up at the physical store (where available) or at other reference points. Many linked the frequency of delivery to certain regions or to certain quantities, due to scale and costs. In other words, logistics was a relevant issue for this aspect and had to be considered by these businesses. It is interesting to note that for businesses that sold perishable or “freshly picked” products, the main characteristic of good service was the frequency of delivery. On this point, establishing a round tends to be beneficial as it makes it possible for customers to subscribe to regular services and supplies.

Once we had analysed and considered the data, we identified three common features that applied to nearly all the businesses that managed to continue operating: having farmers that were connected to the sales platform (enabling products to be fresh), the importance of customer loyalty (regular monthly deliveries, loyalty schemes, engagement, etc.), and an integrated logistical system connecting production-order-dispatch together within the one platform. Despite the limitations of the field research and the geography, the fact that all these features applied to those participants who survived while those who ceased trading did not have them is a correlation that cannot be ignored. We simply need to understand why it was the case.

Those businesses which included farmers that were actively involved with the platform were able to provide some specific features that gave them a definitive advantage. The ability to deliver fresh produce, much of which would pick on the same day it was delivered and then brought straight to the point of sale or very quickly processed. When there is a link between the consumer and the farmer (it is possible to visit, and/or there is content and courses available), not only can this be exploited on social media, but there is also an identifiable connection between those who produce and those who consume and there can be an exchange around expectations and needs. These features not only help with the logistics and with ease of distribution, as you are dealing with a short, dynamic, and efficient chain, but they also help with two other aspects. Firstly, consumption is more appealing, there is a connection and a

certain co-responsibility in producing and supplying food, it creates loyalty. Secondly, because this is a short supply chain of 'just in time' products, which has respect for the seasonal availability of crops, conscious consumption, etc., the result is a simple, comprehensive logistics systems with, consequently, lower costs.

One of the most interesting aspects is customer loyalty, which has become almost a requirement for businesses to survive; largely because it provides guaranteed revenue, because of the importance of engagement and how much easier it is to plan production, distribution, and other related activities. Loyalty itself, implies a direct link between producers, the platform, and consumers. This synergy and requirement can be clearly seen in the values and objectives described by the sales platforms and by their philosophies. This loyalty also provides a shield when it comes to seasonal availability and those months when harvesting is more difficult (especially in businesses which have some flexibility in which products to deliver). Customer loyalty can lead to guaranteed orders, which helps to attract producers, establish delivery rounds, and support the business, which explains why regular orders feature so prominently on these websites.

An integrated logistics system involving production-order-dispatch was also an important factor for all those involved and seems to be one of the key features in ensuring this type of business is efficient. Orders are automatically generated on request, or, for regular deliveries, they are established when the monthly orders are taken. Many of the businesses continue to pay attention to seasonal availability and production issues and therefore they tend to be flexible in which products are available for delivery. The flexibility and automation of the process, combined with scheduled harvest and geographical proximity enables deliveries to be frequent, which has a positive impact on both the shopping experience and the cost of products. As a result of all the efficiencies from placing orders and providing receipts, delivery costs can be reduced to match those companies who are able to offer efficiencies of scale. This efficiency in short supply chains also makes it possible to lower prices, which is important to be able to maintain and attract customers.

Those businesses that were still operating had some interesting features in relation to loyalty and engagement. They engaged with the customers through things like subscriptions, monthly payments, clubs, and other kinds of more direct participation to get more commitment from customers. It is worth mentioning that the websites generated this loyalty and engagement by appealing to the values that are part of those topics of interest promoted by the various movements concerning food that we discussed earlier in this article. Some of the topics that these businesses mentioned most frequently or were most prominent or important were:

1. *Local, fresh product*: All the stores advertised fresh, locally produced products, focusing on the importance of "reducing the distance between the farmer and the consumer", not just in terms of "Food Miles", but also by often explaining who the farmers were, where they lived and what they did. Even online, what is important here is the influence of short supply chains and establishing a close relationship. More practically, it acts as an important element in explaining the difference (fresh product, less transport, short logistical chain, a difficult product to produce through long chains)
2. *Having Respect for Seasonal Produce*: Only one of the businesses did not make a point of advertising the importance of seasonal availability (although that could still be a feature). It is mentioned to suggest how fresh the food is, and to explain how this practice helps ensure production is more sustainable: because providing this product outside the usual harvest period adds extra costs for every kg produced and storage adds extra energy costs and other losses. It also promotes a philosophy around respect for nature and the option for a more harmonious approach. On a

practical level, it has the advantage that it ensures that crops are used as they are harvested (reducing production costs over the year) and the range of products is such that pricing is better and more competitive.

3. *Direct from the Producer*: All businesses that were surveyed had as a policy, providing food directly from the farmer; although six of the fifteen did not identify who the producers were on the website. Most of the businesses emphasize the role of the farmers, by aggregating the orders so that they can be satisfied on the day of delivery and providing fast and cheap logistics while at the same time guaranteeing that the food is fresh. Many of the addresses of the farmers were given, offering consumers the option even to visit the farms, which helps to form bonds between them and makes the claims the business makes more credible. Practically, by using short supply chains and directly involving the farmer, costs can be cut, a unique product is provided, and this all helps to engage consumers.
4. *Fair Trade and Fair Price*: Only one of the businesses did not make a point of advertising respect for fair trade or price (although they may still do so). The businesses do try to mention the balance between cheaper products and better remuneration for the farmer. What is more important than the amount paid per unit or kg, is that they try to emphasize the importance of ordering in advance or regularly to encourage or enable agricultural planning (avoiding waste or shortages) and supporting farming in general. From a practical point of view, agricultural planning and guaranteed quantities help farmers considerably with managing their costs. It also helps with the setting up of delivery rounds and logistical costs, helping them to manage the business better.
5. *Cooperatives/Associations*: Only two of the businesses did not make a point of publicizing their respect for cooperative agriculture and associations (which could also relate to certification and other cooperative advantages). These characteristics, as well as the certification of organic products, generates a form of network, which is a very important method for enlisting farmers and reaching more consumers. It provides a sense of scale, while still evoking the spirit of cooperation or solidarity. In practical terms, it is a cheap and efficient way to become certified as an organic producer, while the cooperative network can also provide other advantages in terms of production or relationships.
6. *Organic and Healthy Food*: All of them highlighted the advantages of organic and healthy food. Beyond this, there was a flood of different terms used: “whole”, “natural”, “low calorie”, “rich in fibre”, “without preservatives”, “in natura”, “traditional” etc. Mentions of “weight loss” and other health benefits are also frequent in the majority, trying to demonstrate the benefits of exchanging existing food, principally processed, for food from their store. From a practical point of view, concerns about weight and health have become especially important for consumers, it is an extra sales pitch that justifies the higher price of the products.

As we can see, many of the features that were important in supporting the businesses, have also proved to correlate to the arguments by the main movements in the debate around food. It seems that, although it still requires further analysis, these businesses who are selling organic products online can differentiate themselves from other sellers of organic products on other networks, precisely because they have short supply chains which match the ecological values of the consumers. These consumers are willing to pay producers monthly to generate the necessary efficiency savings for the businesses to be economically viable. The advantages of social media and the internet may have also helped, as one of the key features is reducing

transaction costs, especially for small-scale producers, and reducing investments in traditional channels.

4. FINAL THOUGHTS

When we have a look at the characteristics of those businesses that we investigated we can clearly see how important are those factors that are also related to intangible assets. The importance of cooperatives and cooperation is itself already a common feature in agriculture, but it was uniform among the 15 businesses surveyed. All of them were either created by farmers or farmers were involved in the process in a profitable way, and usually they were clearly identifiable. In many of these businesses, these farmers produced, not only their products, but also content for the website and connected with the shoppers. In this sense they became a valuable and integral part of the business, and not one that could easily be replaced by another supplier.

Most of the businesses had core values of responsible consumption, respect for seasonal availability, fair trade and a sense of local, rural culture and proximity (forming short supply chains with a close relationship between producers and consumers). In this respect, the consumers of these products, based on what the websites themselves stated, identified with these values, and become “engaged” consumers. These consumers, however, do not appear spontaneously; they are influenced through “networks”. These are the series of events on such themes, rural tourism, fairs, courses and other events and civil society movements. Therefore, the time and effort to set up their base does not appear to be just about having a product and a website. The entire mechanism itself is an asset that needs investment to establish it and maintain it.

These organizations use the ecological stance of the movements relating to the debate on food, and at the same time they feed the local systems with these ideas, creating a form of feedback. As a result, the initiatives about debating the food system, result in changing the market, and attracting consumers to enterprises such as those we looked at. Therefore, the businesses we surveyed have ended up reflecting many of the concerns, aspirations, and desires of consumers, which in turn means they gain their “loyalty”, and this has proved to be the key to the business models in our survey that have thrived.

Therefore, our survey has provided a clear direction for businesses of this type that are based in being organic and local. The common approaches are to highlight how products are picked fresh on the day, that they come from specific farmers and that this type of supply is natural and sustainable. They frequently include references to local gastronomic and cultural events and fairs in the news sections of their websites. All of this helps to make a business seem more human and relatable, which they also encourage by including plenty of videos and photos and being involved on social media. As a result, the distance created by being online, turns into a closer relationship, based on sharing information and experiences and by creating somewhere where consumers can buy products and learn about food and about local farming.

When we examine the niche for organic products, one of the dynamics of the “fresh vegetable market” is highly fluctuating prices, due to the short shelf life of the products, as well as the short production cycles and high impact of the weather on planting. This means that supplies are unstable while demand is consistent. This is even more accentuated than in conventional cultivation because pesticides are not used. In the field of organic products, if there is an impact on price and availability of supplies, this creates a challenge for businesses to achieve competitive availability and prices with conventional products, despite the consumer being willing to pay more for organic products. In this respect, the central factor used to

minimize this issue was customers signing up for regular deliveries, which may well have helped to keep those businesses we investigated going.

Finally, this research mapped a relevant number of “locations” that sell organic products in the region of Porto Alegre/RS and highlighted their main characteristics in terms of the sales channel they use, their logistics and their values. As part of this objective, it was possible to take these data and put them into tables that helped to analyse the most striking characteristics of these “locations”. Once the data were analysed from a theoretical perspective and discussed, three key points emerged: a) the importance of having farmers who were intricately linked to the sales platform; b) the importance of customer loyalty; c) an integrated logistics system involving production-order-dispatch). Six features that were common to all these projects were also identified: a) local, fresh products; b) respect for seasonal availability; c) direct from the producer; d) fair trade and fair price; e) cooperatives and associations and f) selling organic food emphasizing the health aspects.

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THE ACADEMIC REVISIONS ABOUT SELLING ORGANIC FOOD ON-LINE IN BRAZIL

Adriano Diego Klein^{1*}, Caroline Rippe de Mello Klein², Glaucio Schultz¹, Leticia de Oliveira¹

¹*Federal University of Rio Grande do Sul, Brazil;*

²*Federal University of Fronteira Sul, Brazil*

Abstract: This article brings to discussion about a bibliographic survey of the main articles that emphasize the e-commerce of organic foods, for which a search will be carried out using three keywords (e-commerce, organics and food) in the two main online platforms for academic research, thus, respectively, Scopus and Web of Science (WoS). In order to build and understand how these three concepts are worked in academic intricacies in international journals in these respective indexers, a bibliometric study will be carried out that provides us with an organizational perspective to deal with these collected data. Therefore, it is necessary to emphasize that in times of sanitary crisis established since 2020 with the emergence of Covid-19, digital commerce has grown a lot, and in addition to this, other more sustainable and healthy forms of food, with the inclusion of organic food in the diet as being something exponent, among the most diverse forms of readjustment to the daily eating and work habits. The research showed a series of articles that focused on two main aspects: one more linked to the study of the consumer in a neoclassical way and one more focused on the collective study of values, intentions and civil organizations.

Keywords: E-commerce; State of art; Indexers; Bibliometrics; Search analysis.

1. INTRODUCTION

The main topic of this article wants to research the trade of organic products on the Internet, which has grown over the years, especially after the events resulting from contagion by Covid-19. Therefore, we intend to analyze the main publications and try to find the convergences and divergences between them, as well as the main topics covered, it is essential for anyone interested in the theme. Just like Ferreira and Serra (2004, p. 64) pointed out, this phenomenon has been occurring since the mid-1990s, on April 1995, when the control over Internet started to be guaranteed by non-governmental organizations, the network became with an universal access. Since then, there has been an exponential growth of members and users, allowing the Internet to assume itself as a means of fundamental information, followed by the use of the marketing tool as a channel to find the most diverse products.

The advent of these new forms of communication has altered the way that the individuals communicate themselves. Santos (2013, p. 22) points out that “it results in reconfigurations in the modes of interaction, of strategies for searching and retrieving information”, thus, it can be observed that in today's society a mediated communication is

* Corresponding author: kleinagro@gmail.com

organized based on the idea cyberculture, a postmodern phenomenon that influences life and relationships between individuals (ALBERNAZ, 2014).

The development together with the dissemination of the World Wide Web (WWW) represents an informational revolution, with rapid and practical distribution and storage of data available worldwide. One of the most prominent examples of improved storage and distribution of important information is the development of scientific databases, the meaning of which was recognized early (FALAGAS, et al, 2008, p.338)

The online sales of organics increased, and to work with that many academic publications are being doing to write of this case, many of the main scientific journals no longer have the habit of making their printed issues available, due to the economy of paper and the precepts raised by sustainability. A range of these scientific journals is indexed on specific search platforms, such as Scopus and Web of Science, the focus of this article. In a recent study by Mongeon (2016) shows that the Web of Science (WoS) has about 13,605 registered journals, while Scopus has 20,346, so it is important to note that these indexers do not include a total of journals, but rather, they have a part and certain countries.

The growing adherence to the sale of organic products, overcoming the “tribalism” that was considered to be the central, and often critical, point of organic products, makes this work interesting to understand this process and what are the main characteristics of this new market. The availability of key articles for this understanding for enthusiasts of the theme is also a possible objective of this publication, trying in an objective way to synthesize the main publications and their characteristics.

2. METHODOLOGY

For the purpose of the analysis of these two indexers, it is more appropriate to use bibliometric methods, as they have multiple application domains, which are widely used in the area of information sciences, sociology and the history of science for the evaluation and measurement of scientific research and policies. (GINGRAS *apud* MONGEON, 2014). As Wouters (2016) points out, a large-scale bibliometric research was made possible through the creation and development of the ScienceCitation Index (SCI) in 1963, which is now part of the Web of Science (WoS) alongside with two other indexes, Social Science Citation Index (SSCI) and ArtsandHumanitiesCitation Index (A & HCI). These work is a kind of database that brings together several authors and types of articles, which today compete with Scopus and Google Scholar, both created in 2004, but due to the low quality of Scholar's data, their quality tends to be doubtful (MONGEON, 2016, p. 1), thus, WoS and Scopus today are the main sources of data and citations, precisely because of the interdisciplinary coverage they have (ARCHAMBAULT *et al.*, 2006), as this author points out in another article.

Scientometric methods are increasingly used for scientific policy purposes, more particularly in Europe. The use of scientometrics for policy purposes has so far been limited mainly to the natural sciences and engineering (NSE), but this is changing and the extent of this assessment process to the social and human sciences (SSH) may be a cause for concern. A number of scholars have highlighted fundamental differences between the scientific communication practices of academics (ARCHAMBAULT *et al.*, 2006, p. 329-330)

Therefore, directing to the scope of this article, to carry out the search on the platforms, some keywords were listed to give a better direction to the desired object, this was done by choosing three concepts that should be present in the topics of the articles, that is, in the title, abstract or keywords of the author or indexed. These words chosen were: e-

commerce, “organic and food” or “organic food”. These terms were searched for and articles written only in English.

The principle of e-commerce was to read articles dealing with the sale of products over the internet, while organic had the sense of selecting articles that dealt with organic products, the term food in turn, to bring up the issue of organic food consumed, excluding aesthetic, chemical, etc.

For a more accurate analysis of this research, some greater attention will be given to the abstracts raised by the authors and excluded articles that do not deal with trade in organic products, don't present data on form or marketing channels and address data that can be used in results, such as comparative (types of products, products, sales model, etc.). For this filter, the criterion was used to treat food: whether focusing on consumption, distribution or production and to approach electronic commerce. The selected articles will be named, given a brief summary and main aspects in common and divergent, being discussed here as a characteristic of origin, main authors and other relevant aspects.

Knowing the limitation of the articles analyzed, whenever necessary, an analysis of the content of the articles will also be carried out, in order to maximize the result of the research and enrich it. For this, it will depend on the process of understanding the writings by the researchers so, that the biometric and interpretive data results from reading the articles generate an interaction and useful result. This effort will be made not only to separate them, but try to understand the theoretical motivation and field of study of possible groupings of articles.

3. RESULTS AND ANALYSIS

The research carried out in Scopus based on the keywords organic, food and e-commerce returned with 61 articles, of which 11 relevant articles on the subject were point it out, with authors of different nationalities. The Web of Science (WoS), on the other hand, returned with 20 articles and 11 articles were also separated, of which 4 were already present and were in the same as Scopus, totaling 18 articles in both research channels. The 18 relevant articles were chosen, because they deal with the theme and contain the selected terms with the necessary characteristics mentioned in the methodology and had in their summary some relevant and correlated subjects to the electronic commerce of organic foods.

Table 1. Articles found in Scopus.

Name of the article	Authors	Journal
Organic and online attributes for buying and selling agricultural products in the e-marketplace in Spain	Robina-Ramírez, Chamorro-Mera, Moreno-Luna, L.c	Electronic Commerce Research and Applications Volume 42, July - August 2020
Forecasting accuracy influence on logistics clusters activities: The case of the food industry	Gružauskas, V.Email, Gimžauskienė, E., Navickas, V.	Journal of Cleaner Production Volume 240, 10 December 2019,
Evaluation of consumers' purchasing process for organic food products	Scuderi, A.a, Bellia, C.aEmail, Foti, V.T.a, Sturiale, L.b, Timpanaro, G.a	AIMS Agriculture and Food Volume 4, Issue 2, 2019, Pages 251-265

Organic food online shopping in Poland	Brył, P.	British Food Journal Volume 120, Issue 5, 2018, Pages 1015-1027
Influence of online product presentation on consumers' trust in organic food: A mediated moderation model	Yue, L. , Liu, Y. Wei, X	British Food Journal Volume 119, Issue 12, 2017, Pages 2724-2739
Consumers' purchase of organic food products. A matter of convenience and reflexive practices	Hjelmar, U.	Appetite Volume 56, Issue 2, April 2011, Pages 336-344
Study on the green food industry marketing strategy in Heilongjiang Province under E-commerce environment	Li, J.	2011 International Conference on Management Science and Industrial Engineering, MSIE 2011 2011, Pages 1273-1276
Retailing in Germany: Current landscape and future trends	Zentes, J.Email Author, Rittinger, S.	European Retail Research 2009, Pages 153-182
(Re)solving space and time: Fulfilment issues in online grocery retailing	Murphy, A.J.	Environment and Planning A Volume 35, Issue 7, July 2003, Pages 1173-1200
The impact of e-commerce on agro-food marketing: The case of agricultural cooperatives, firms and consumers in Crete	Baourakis, G.a, Kourgiantakis, M.a, Migdalas, A.b	British Food Journal Volume 104, Issue 8, 1 September 2002, Pages 580-590
Forces impacting the production of organic foods	Klonsky, K.a,	Agriculture and Human Values Volume 17, Issue 3, 2000, Pages 233-243

On table 1 it can be seen most journals are international and have a considerable impact factor. In relation to the authors, what we can highlight is the authorship of Chinese and Eastern European researchers who stand out in this field of research while the journals / periodicals in England stand out for being publishers of this research.

Table 2. Articles from Web of Science (WoS). The articles painted are common on both indexers.

Name of the article	Authors	Journal
Organic and online attributes for buying and selling agricultural products in the e-marketplace in Spain	Robina-Ramírez, Chamorro-Mera, Moreno-Luna, L.c	Electronic Commerce Research and Applications Volume 42, July - August 2020
Perceived Risk Reduction Strategies for Organic Food Customers	Pandey, SK (Pandey, Shivendra Kumar); Gupta, AK (Gupta, Ashish Kumar); Sharma, DP (Sharma, Dheeraj P.)	JOURNAL OF FOOD PRODUCTS MARKETING Volume: 26 Edição: 5 Páginas: 344-357, 2020
The Role of Trust in Explaining Food	Yeh, CH (Yeh, Ching-Hua); Hartmann, M (Hartmann,	FOODS Volume: 9 Edição: 1, 2020

Choice: Combining Choice Experiment and Attribute Best-Worst Scaling	Monika); Langen, N (Langen, Nina)	
The importance of websites for organic agri-food producers	Fernandez-Ucles, D (Fernandez-Ucles, Domingo); Bernal-Jurado, E (Bernal-Jurado, Enrique); Mozas-Moral, A (Mozas-Moral, Adoracion); Medina-Viruel, MJ (Jesus Medina-Viruel, Miguel)	ECONOMIC RESEARCH-EKONOMSKA ISTRAZIVANJA Volume: 33 Edição: 1 Páginas: 2867-2880 JAN 1 2020
Evaluation of consumers' purchasing process for organic food products	Scuderi, A (Scuderi, Alessandro); Bellia, C (Bellia, Claudio); Foti, VT (Foti, Vera Teresa); Sturiale, L (Sturiale, Luisa); Timpanaro, G (Timpanaro, Giuseppe)	AIMS AGRICULTURE AND FOOD Volume: 4 Edição: 2 Páginas: 251-265
The Effectiveness of the Multilateral Coalition to Develop a Green Agricultural Products Market in China Based on a TU Cooperative Game Analysis	Deng, MJ (Deng, Mingjun) ; Xiang, GC (Xiang, Guocheng); Ya, ST (Ya, Shuntian)	SUSTAINABILITY Volume: 10 Edição: 5 Publicado: MAY 2018
Organic food online shopping in Poland	Bryla, P (Bryla, Pawel)	BRITISH FOOD JOURNAL Volume: 120 Edição: 5 Páginas: 1015-1027, 2018
Research on E-commerce Platform for Agricultural Products Based on Community Supported Agricultural Model	Guo, WG (Guo, Weigang); Xie, JQ (Xie, Jianqin); Zuo, J (Zuo, Jun); Tu, DY (Tu, Dongyang)	2017 4TH INTERNATIONAL CONFERENCE ON ECONOMIC, BUSINESS MANAGEMENT AND EDUCATION INNOVATION (EBMEI 2017) / Lecture Notes in Management Science Volume: 86 Páginas: 446-45, 2017
Proposed of e-Community Supported Agriculture (e-CSA) system to promote local organic products: The empirical study of Chiang Rai province	Wicha, S (Wicha, Santichai); Photiphun, T (Photiphun, Teerpong); Janjaroenpan, P (Janjaroenpan, Patomporn); Taweesak, C (Taweesak, Chakrin); Chainilwan, I (Chainilwan, Intaratat); Rodmanee, P (Rodmanee, Poramat)	2017 INTERNATIONAL CONFERENCE ON DIGITAL ARTS, MEDIA AND TECHNOLOGY (ICDAMT): DIGITAL ECONOMY FOR SUSTAINABLE GROWTH Autor(es) grupo de livros:IEEEPáginas: 273-281, 2017
Influence of online product presentation on consumers' trust in	Yue, LQ (Yue, Liuqing); Liu, YM (Liu, Yongmei); Wei, XH (Wei, Xuhua)	BRITISH FOOD JOURNAL Volume: 119 Edição: 12 Páginas: 2724-2739, 2017

organic food A mediated moderation model		
Preferences of Chinese consumers for the attributes of fresh produce portfolios in an e-commerce environment	Jin, SS (Jin, Shaosheng); Li, HY (Li, Haoyang); Li, Y (Li, Yao)	BRITISH FOOD JOURNAL Volume: 119 Edição: 4 Páginas: 817-829, 2017

The table 2 shows the presence of articles by Chinese researchers, being very prominent, showing that not only in the economic sector, but in the intellectual sector, it is a country that currently advancing in this field. And, among the 11 articles, there are four that are in both indexers, while another are not, which shows that research in several indexers is necessary and even vital for the progress of good academic research, since there are few platforms and magazines that are congruent. Another relevant point is that the Scopus platform initially showed 61 results, 11 of which were selected, while the Web of Science, of the 20 results, 11 were selected, being that the search for WoS was more objective, which can be especially useful in research with very extensive literature.

In order to deepening the analysis, it was decided to separate the terminologies that the articles brought with them in the keywords and later add them to the platform (expanded), always discarding when a term was repeated among the authors. With that, we can have a complete number of concepts and rescue meanings not placed in the keywords directly, but which are present in the titles and / or abstract, so it is not explicit in the keywords, but they appear at other times. Subsequently, it was decided to mark the “groups of terms” that belong to and relate to a certain “type” of research in different colors as a way to facilitate the interpretation of the data. This group of terms was formed from the authors' perception of the types of articles and the terms that were predominant in them.

Table 3. List of main words and terms and their topics

Number of citations	Terms
18	Organic food/Agriculture
15	E-commerce
6	Willingness to pay
5	Trust
4	Agriculture
4	Consumer attitude
4	Farmers Markets
3	Choice experiment
3	Community supported agriculture
3	Consumer trust
3	Internet
3	Marketing
3	Organic consumers and producers

3	Purchase Intentions
2	Competition
2	Convenience shopping
2	Co-operatives
2	Denmark
2	Electronic word of mouth
2	Female
2	Food industries
2	Food industry
2	Green Agricultural products market
2	Human
2	Male
2	Online review length
2	Online shopping
2	Perceived risk
2	Preferences
2	Quality
2	Service quality
2	Shopping
2	Sustainable development
2	Values

	Organic electronic commerce
	Behavior of consumers/ decision taking
	Trust, Culture, environmental consciousness, etc.

Then 34 aggregated terms (of equal meaning) were raised, showing a wide variety of words. In order to a better understand of meanings, attempts were made by get them together according to their similarity. To this end, articles more related to the study of the classic consumer were separated, closely linked to decision-making and “surveys” on their socio-economic characteristics. Of these, it was also noted a large number of articles more linked to the institutional, social part, focusing on values and cooperativism, some articles more focused on the study of supply and distribution chains were also analyzed.

After formatting the table and reading again the abstracts of the articles, three colors that would represent the content “clusters” were marked, for this, we noticed a pre-disposition for articles derived from the classic consumer study the words cracked in blue, as many articles, are more sociological and institutional focused on the words marked in green, articles that dealt with chain did not have a predominant direction, as all articles presented yellow cracked terms, precisely because they are linked to electronic and organic commerce

The first in yellow mark, simply confirms that the articles written about electronic commerce of organic foods indicate that the list really had relevant results for this topic. The blue color concentrated terms from a group of articles more focused on consumer study, decision making and marketing. The green color, on the other hand, have more focus on studies that raise issues related to trust, culture, social engagement and the search for sustainable and healthy consumption as they can lead people to consume and purchase organic products. In the other hand, some non-aggregated terms were not colorized because

they have references to geographic locations and some points more linked to chain analysis, but centered on two articles only.

Analyzing the tables and the group of colors, it shows that the articles analyzed predominantly show two different ways of points of view on the analysis. One is more linked to studies of the neoclassical view of the consumer with a focus on econometrical characteristics (income, age, sex, intention to buy, etc.), within this it deals with organic food marketed within the view of study common to studies of different goods and widely used in administration and economics in general. The second demonstrates the study of more “structural” and collective elements for the emergence of places for the sale of organic products and their consumption, focusing more on ideological characteristics, values and activism (conscience), also emphasizing the values of those who produce and sell, in addition to the consumer itself. Issues related to geography and chains appear dispersed within the articles, perhaps because of the amount analyzed, insufficient for further inferences.

The journals the papers are published reflect the division was well. The blue color market keywords, decision making and marketing are linked to journals like “BRITISH FOOD JOURNAL”, “JOURNAL OF FOOD PRODUCTS MARKETING” and “European Retail Research”, who are journals who focus on administration, marketing and chain studies. The blue color market keywords are more linked to journals like “SUSTAINABILITY”, “INTERNATIONAL CONFERENCE ON DIGITAL ARTS, MEDIA AND TECHNOLOGY (ICDAMT)”: “DIGITAL ECONOMY FOR SUSTAINABLE GROWTH”, “Environment and Planning”, “Agriculture and Human Values” who are papers more interdisciplinary and with more sociologic and holistic point of view. This supports the scope as the journal reflects that division in the view of topic as well.

4. CONCLUSIONS

Through the research we could generate tables with was possible to separate 18 articles out of 81 found initially on the topic, and they are concentrated in the last 10 years (15 of the 18 final filtered articles), showing that it is a topic that is gaining visibility. The big downsizing from 81 to 18 was mainly due to related issues and articles that do not deal with food or do not focus on commercialization (certification, quality and other attributes), concentrating these broader articles filtered on the Scopus platform. The relatively low amount of articles seems to demonstrate a low frequency of studies focused on organic foods with a focus on e-commerce, differentiating from articles that deal with the organic trade in general.

We discovered that the most of the articles analyzed ended up being divided into “two distinct areas of analysis”, one more traditional in “administration” and another more “multidisciplinary”. The generated article base also shows that some terms can be used to select writings that are more focused on certain “forms of analysis” aiming even more at searches on platforms being terms like “trust, values and consumer attitude” more focused on institutional and approach articles collective and multidisciplinary and terms such as “Willingness to pay, Choice experiment, Marketing” lead to more articles related to administration and neoclassical analysis of the market and consumption. The journals also reflect this segmentation with focus in one or another field of study.

Doing the searches for terms must, in addition to the key words of the article, include the title and abstract as much as possible, given the fact that the terms used in the title are not normally repeated in the key words. At the same time it should be noted that the term often appears several times (title, keyword and abstract) and therefore should not be contacted

multiplely. The research differs from other bibliometric studies by the low number of articles, which led to the need for a case-by-case content analysis, which may contaminate the data with the authors' perceptions, the fact that the articles resulting from the research were manually filtered by the authors, in spite of the rigor in objective criteria (organic food trade e-commerce), the final results may be questionably limited.

So, in the end, due to the low number of results, even more noting that there is more than one theoretical strand on the subject, it is recommended for those interested to filter the “e-commerce” and add other terms described in this article regarding the type of study to be able to expand the base of articles to understand the organic theme, or from “organic food” to “food” to expand the number of articles on online food trade. This makes the study take place in a fragmented way of the theme, but expands the database. A visit to the references of the articles found can also be useful to locate content not indexed on the platforms for reading.

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SHORT FOOD SUPPLY CHAINS INSIDE THE CONSUMER'S ORGANIC COOPERATIVES OF PRODUCTS IN THE SOUTH OF BRAZIL

Adriano Diego Klein^{1*}, Caroline Rippe de Mello Klein², Glauco Schultz¹

¹Federal University of Rio Grande do Sul, Brazil;

²Federal University of Fronteira Sul, Brazil

Abstract: The theme of this article is to explore the case of three consumer cooperatives in the south of Brazil and observe the daily business, organization and supply chain, using as reference the “short food supply chain” to think and understand in which way the theory and praxis are close or far between themselves. The data was collected with research in the stores and interviews with the key-people in them, most of them the owners and some trustfull employees. Analyzing reasons for the beginning of the business, like a mobilization and participation of members and partnering with technical support centers, NGOs, universities and farmers groups who formed the short chain and awareness. The research found some curious results, like the diversity of inside organization between the cooperatives with different kind of food chain commerce at the same time, that became clear on these institutions which are much more entangled with the ideas of short supply chains, local consumption and sustainability in theory, and all of them tried to put it on in practice this.

Keywords: local consumptions, networks, solidarity consumption, organics

1. INTRODUCTION

In the beginning of this century the agriculture and food production have face it many challenges. The Global Warming exposed the necessity of a shorted carbon footprint in every location of the food chains, from farms to the table, passing by the processing, transportation and retail (EDWARDS-JONES, 2008). Concepts like carbon footprint, “fair trade” and “social and economic fair” will have a great impact in consumers choose. This new lifestyles and the constant massive healthcare problems push for a more safe and healthy ways to feed yourself, bringing new meanings and significant care to “organics” and “minimally processed foods”, alternative diets like Paleo, vegetarians and so on.

The consumers cooperatives are a group of consumers who are united under a specific objective: to buy products in collective way, with certain form, with a mix of crow funding, store and association, because at the same time they can provide capital for farms in advance (or promise to buy), to sell products for members and/or general public, normally with a participative and educational background. In Brazil the connection between consumers groups and the sustainability are big, that lead to normally called them Groups Responsible Consumption (GRC), which praises the environmental, nutritional, social and economic aspects

* Corresponding author: kleinagro@gmail.com

in relation to the consumption of organic products, those aspects are relevant in choosing which kinds of food the consumers buy (TURK, 2017).

In this situation nowadays this research explores the *modus operandi* of three companies who work with organics products since the farm to the table of the consumers. It was evaluated a lot of aspects in their routine, such as logistics, suppliers, in relation with the consumers and others relevant aspects for this study. Furthermore, it was exploring the main aspects of their market action and actions to improve and make a better function of organic markets by this kind of company – Collective cooperatives. Beyond this observations of daily basis, we have made interviews with owners and relevant employees in these companies, to observe how they think and collaborate with the function and the role of these new ideas about food and consumption.

The market dynamics have become more modern with the advance of urbanization, technology and globalization that occurred in the last century. In the agriculture sector, the green revolution “industrialized” the countryside, generating a wide and complex agroindustrial chain with large supply lines, in which the initial links - the producers - are very distant from the final links, thus causing a lack of contact on those who produce with those who consume. Within this panorama, there are new initiatives by consumers and producer organizations that try to reconnect these agents, through fairs, “producer festivals”, and more recently, consumer cooperatives that appear with notoriety.

2. THEORIC REFERENCIAL

Thinking as referential to this research, we can observe the studies of Kluth *et all* (2011), Moura *et all* (2010) and Casemiro (2009) that shows the consumers don't have a clear notion of how much those products value themselves, like “organic”, “natural”, “healthy” and “traditional” because of the information about the products, just like as nutritional and productive aspects, are not clear yet to the consumer. The most challenge to these cooperatives are the organizational logic, bringing to the center of discussion, the consumption and demand of organic market, associated with some issues related to responsible consume, slow food, health benefits and the agrarian question, with emphasis in local consumption and strong bond between producers and consumers which is always relevant to the guidelines for cooperatives producers, by the way, facilitating the transmission of information along the chain, or the consumers in a dynamic and fast short food supply chain.

The short food supply chain is a concept which have 3 fundamental types (MARSDEN, 2004). The “face to face” is the direct contacts between the producers and the consumer, like buy inside the farms or farmer markets. The “proximate”, normally have few/one intermediary or/and a short distance between the links in the chain. The last one, extended, the supply chain is geographic far, but the proximity is from the information and awareness of the consumers. The proximity (awareness) can be social, economic or geographic, the information and understanding have a role in the distance (food miles).

The consumer cooperatives bring with them a differentiated bias from retail and producer cooperatives in several aspects. The change in organizational logic brings the consumption and demand of the typical retail market to the center of the debate, mixing issues related to responsible consumption, slowfood, health benefits and the agrarian problem, which is one of the guidelines always relevant for the cooperatives. producers, generating a new interface in the chain, even if, still apparently, the impact is quite uncertain in the mediation of interests of producers and consumers, mainly in terms of the transmission of information along the chain.

3. METHODOLOGY

This research was conducted in the State of Rio Grande do Sul (RS), and Santa Catarina (SC), both states in Brazil, more specifically in three cooperatives located in the cities called Torres (RS) - *Ecotorres Cooperative*, Pelotas (RS) – *Teia Ecológica* and Florianópolis (SC) – *Compras Coletivas Ecosolidárias*. The initial time period of study and research lasted two years, extending from April 2012 until March 2014 to generate a master thesis in Agribusiness. A second round of question and review are being done in 2020 for actualization purposes, to observe how these companies are evolving themselves today.

The data about those three cases of consumer cooperatives of organic products are collected by, no-directive interviews applied with semi-structured questionnaires about the motivations of the formation of the cooperatives, their structure and management, as well as aspects of the distribution chain, and contact with key people in that organization. Some interviews and documents about the cooperatives are being read and most recent (2020) some data are collected in networks on-line in partnership with some past contacts. During this process, the collected data were interpreted in order to generate statistics in order to explain better the most relevant aspects in the chain. Alas, in order to improve this analysis, it was used the focus in “supply chain” and “distribution chains” with emphasis in “short food supply chains” who are a derivation of traditional supply chain.

For Wood and Zuffo (1998), the SCM, or supply chain management is a methodology that serves to align the activities developed in the chain in an organized and synchronized way. Thus, minimizing cycles and maximizing the value perceived by the end customer, exceeding the limit of firms and individual agents dealing with the chain as a whole. To this end, relations with suppliers and customers become a key point in decision making and require joint planning of activities for them to be successful.

Thus, the analysis of the supply chain is a very relevant approach to the logistics of the production chains, in addition, it provides valuable information about the organization and interaction between its agents. The analysis of the supply chain takes into account the information flows in the productive chain, normally, starting from its final link towards its initial links. Like money, commodity has the opposite flow in relation to a more complex approach, and in the more organized chain, information is constantly exchanged for both directions. This analysis highlights the dynamics of exchanges and reveals asymmetries of information present in a production chain.

4. RESULTS AND DISCUSSION

We had made interviews with the key-persons from the cooperatives, and it was possible to develop the following table that contains a summary of information gained in the cooperatives about their general data and how they work.

Table 1. Comparison between the three cooperatives studied in its various aspects (KLEIN, 2014)

	<i>Ecotorres</i>	<i>Teia Ecológica</i>	<i>Compras Coletivas Eco Solidárias</i>
Foundation	1999	1990	2006
Members and partners	120	33	90
Potencial consumers	+/-1000 month	150 day	90 for share

Core	Core manager; management; operating.	Operator; consumers and producers.	Core manager; general partners.
Formalization	Yes	Yes	No
Place	Torres (RS)	Pelotas (RS)	Florianópolis (SC)
Suppliers	+/- 45	+/-35	+/-30
Local Suppliers (-30KM)	70% (local producers cooperative)	75% (two local producers cooperatives)	35% (many small organic farmers)
Statute	Yes	Yes	No; Code standards and coexistence.
Performance	Sales of organic and natural products	Organic restaurant	Sales of organic and natural products
Provide Training/education	Yes	Yes	Yes
Provide Visits to suppliers	Yes	Yes	Yes
Only members can buy	No	No	Yes

We can observe about the constitution of the core management with a significant opposition in the organization that directly impacts the decision making. The *Ecotorres* separates your membership manager of the core group of employees responsible for operating activities. The *Teia Ecológica* focuses on the operators and all decisions that are partners who “work in the operation” while the *Compras Coletivas Eco Solidárias* features as a small core of committed arguing with all other aspects of the cooperative stakeholders.

In the aspect of formalization, we can argue that the formalization exists in two cooperatives and comes with an “formal” apparat status, minutes and several administrative documents, which the *Compras Coletivas Eco Solidárias* is replaced by a code of living, nevertheless the number of partners is very similar among all cooperatives. The number of suppliers of cooperatives presents a similarity in numbers ranging from 30 to 45. If we consider that the cooperative has a fewer supplier (Purchasing *Compras Coletivas Eco Solidárias*), does not work with green products, and does not sell industrial products, we saw that the number of suppliers accompanies the product mix in the three cases studied.

In the process to generate awareness of “food, farmer and the process”, every one of the cooperatives have seminars, workshops, and promotes “meetings” with producers. All these precedents are made in a way of a better understanding of the qualities of the production system, the product and the man who turn the well and make that happen. In some way, some authors like Montanari (2007) considers a product brought from a cooperative like well-known by producers, who, the consumer have a strong bond to be equal a face-to-face buy, generating a similar link to the traditional way.

Two of the three cooperatives have more than 2/3 of the products coming from a local production, this show a sign of a proximity chain. In these cooperatives they are connected to other local cooperatives, what probably generate a useful bond, who permits the consumer cooperative to sell fresh products and have most of the products locally brought. The only cooperative who don’t have most of the products from local producers don’t sell a large number of fresh products.

These consumer cooperatives were formed in a very spontaneous way. The cooperatives analyzed have a very flexible structure, which Batalha (1997) as characteristic attributes of

“new sectors that’s change fast on the process”. In the case of consumer cooperatives, the role of the different actors in the chain is in still tenuous absence often a clarity to industry participants. According to the classification of Dess (1995), none of the cooperative acquires a modular pattern of organization, but ranging from a virtual structure, to other free of barriers.

The closest to a virtual structure, we can mention *Ecotorres* and *Teia Ecológica*, because today they have a specific actuation in market, respectively shop and restaurant, structured. Moreover, nowadays *Ecotorres* has partnerships with agribusinesses that produce things that go beyond your store, reaching other markets, the *Teia Ecológica*, has a structure of operators with engaged partners who depend on this activity for their surviving.

And with free structure barriers, it can say that the three cooperatives have characteristics that may fall within this classification, however, the *Compras Coletivas Ecosolidárias* is the one that best fits in this model. This cooperative has an almost itinerant structure, adding new points of sharing and taking others as often the opportunities arise. Its shape makes virtual marketing called “basket of goods” very cheap and fast, furthermore, members of the cooperative are not dependent for their livelihood, and can more easily risk a change of action.

This organization reflects the nature of how they are conducting cooperative activities such as purchasing, sales and operational decisions. The table 2 below was mounted in order to examine the main activities and how they are developed in cooperatives.

Table 2. Organization of consumer cooperatives according to different characteristics (KLEIN, 2014)

Points analyzed	Cooperativa Ecotorres	Compras Coletivas Eco Solidárias	Teia Ecológica
Frequencysale	Business hours	Monthly	Lunches
Supply of fresh products	Three times a week	Do nothave	Three times a week
Main form of supply	Delivery route	Request Aggregates	Fair
Supply of manufactured goods	1 to 3 months	Monthly	On demand
Products “manufactured”	Orders	Request Aggregates	Orders
Price (decision)	Large margin on product	Large margin on product	Estimated cost for maintaining cooperative and remuneration
Price (promotion)	New products; products with high inventory; perishable	The nonstandard products A; avoid waste.	Doesn’t
Point of sale	Shop	Online; site; email	Online; site; email
Place of delivery	Shop	Local sharing	Restaurant
Disposal of products	Shelves ; shop	Time of delivery	Restaurant ; buffet

The table 2 shows that the frequency of product supply follows the same routine three times weekly for green products (*fresh*) and monthly nature for manufactured products. How to supply, however, we can observe the fair as a source for *Teia Ecológica*, while *Ecotorres* tries to benefit from existing delivery routes producers based on perceived need for custom region,

and the case of the *Compras Coletivas Eco Solidárias* aligned with the aggregate system and shares applications.

And in relation to the pricing politics, we can see a big margin becomes the main way to estimate the final price for marketed products, although in the case of the *Teia*, because it is a restaurant, eventually adopting a system of estimating costs of the cooperative to assess the expenses for its maintenance. Regarding the promotion process, *Ecotorres* have a store, and appears more concerned with selling the products and increase sales, while the *Compras Coletiva Eco Solidárias* only cares to not spoil any product that may eventually be in stock.

Regarding, the process of decision making in these cooperatives it was proved very distinguish in the studies (Table 2). The *Compras Coletivas Eco Solidárias* has been very attached to a core that currently focuses informal operational and tactical decisions and the strategy of action guided by principles discussed with other members, primarily through electronic means in discussion groups. Already, on *Teia Ecológica*, the process is now in the hands of operator's partners and who works in cooperative, leaving producers and partners farthest from the consumers in currently process. In the third case the "Ecotorres", their operational decisions are made cooperative staff and the most tactical and strategic by a governing body parts, mimicking another operation of a commercial shop.

Table 3. Characteristics of decision making in consumer cooperatives (KLEIN, 2014)

	Ecotorres	Teia Ecológica	Compras Coletivas
Buy	Operacional manager	Operatingpartner	Core manager
Sell	Employeesand managers	Operatingpartner	Core manager and site
Tacticsdecisions (bymonth)	Core manager	Sócios	Núcleo gestor
Decisions in wide character (status, method of operation, etc.)	Partners	Partner	Partners (debate groups)

The configuration of environments keys to their training and this success seems to have three basic factors present (Figure 1):

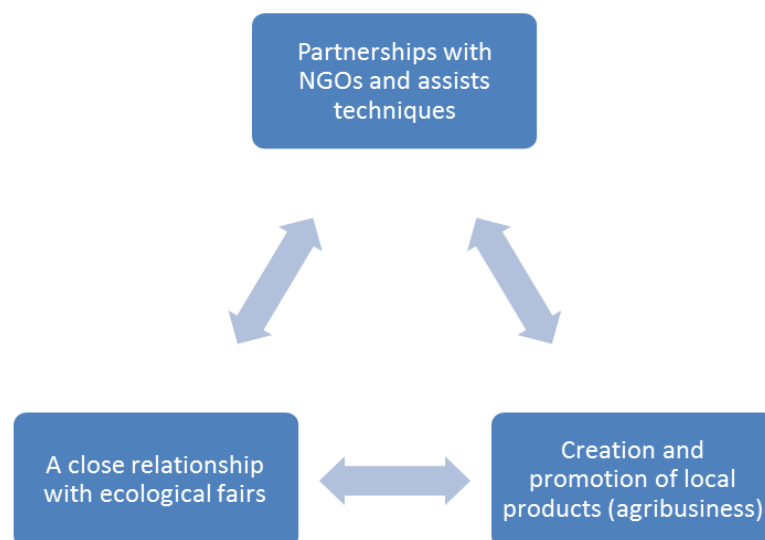


Figure 1. Characteristics of consumers points present in the southern region of Brazil cooperatives (KLEIN, 2014)

Starting from the aspects analyzed in the cooperatives studied, we can assign three factors to an environment that contributes to the formation and maintenance of a consumer cooperative of organic products. The organized producers and their markets, for example, are usually the product of a number of factors ranging from the crop of such region, the process of organizing stakeholders and public politics that encourage and support this kind of initiative. The supporting organizations are NGOs, university, technical assistance or social movements have companies in your determining factor the ability to seek, to bring knowledge and contribute to an essential factor organized and informed consumers with the desire to form a cooperative.

5. FINAL THOUGHTS

The cooperatives had a different way of organizing and adapting to reality. All cooperatives had different structures in terms of institutional organization, acting market and kind of service provided, and also the relationship with the fairs and producers. All of them, however, showed an early focus on the opening of a direct, collective and participatory channel between consumers and producers in a way of reducing the lack of awareness between the members of the food chain.

In this type of organization, the consumers end up becoming closer to the operation and producers, acquiring more knowledge about the production and distribution of food in your table. In meetings, courses, visiting producers and discussions on issues related to cooperative of organic guide the activity of them all, being part of something that makes daily work. This process generates a bond between the consumer and producers, especially with members of the consumers cooperative and members of a farmer's cooperative.

We can observe in the cooperatives in general, that they contribute for a better bond between the food chain, and in general make then shorted, especially the cooperatives who have relations with other cooperative. The consumers cooperative of this study shows there are a mix of "collective buy", "cofounding", "social movement" and "shop/retail" all in one. On the other point the cooperatives show the focus is not only the product, but the process of all the chain involved and living a new style.

The presence of an axis between consumers and "clear and organized" producers with support of NGOs provides technical allowance and seems to be "the formula" of creating consumer successful cooperatives, even though other organizational parameters, market positioning and strategy business show imperfections.

The search for a more efficient supply chain led cooperatives to generate partnerships and close relationships with producers. In the case of *Ecotorres*, has the same focus including the development of unique products. In contrast, the *Teia Ecológica*, showed synergy between the shop and the restaurant, which is vital, with the end of one could easily lead to the end of another due to the volume and frequency of transactions between them. In the case of *Compras Coletivas Eco Solidárias* stands how a high standard Information Technology (IT), that can generate a flow of requests and information organized overlapping the absence of more robust physical structure and generating an efficient structure of distribution malleable.

Therefore, it was noted that the cooperatives studied in this work, show a link between producers and consumers in many ways that go beyond mere information contained on the product that you buying. Search for information on where it was produced, by whom and how a product that the consumer is acquiring, by direct contact and visits the properties or intrinsic information contained in the product sold, visits to producers and to cooperative events and

meetings for discussion, enabling more knowledge and information to the consumer about the product, and approaching the realities of those who produce consume.

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CONSUMER ATTITUDES TOWARDS THE POSSIBILITY OF MISSING OUT A PRODUCT

Anastasia Jefimova¹, Oliver Parts^{2*}

¹Tallinn University of Technology; ²Tallinn University of Technology, Estonia

Abstract: The aim of the article is to identify consumers' attitudes towards the possibility of missing out a product and to draw conclusions as to whether and how the fear of missing out a product influences consumer behaviour in Estonia. The sample were millennials (respondents under the age of 40). A total of 123 people participated in the study. Results showed that respondent attitudes toward the fear of missing out are rather neutral in Estonia. People aged 25 to 29 should be targeted primarily for fear of missing out, as they are most affected by the fear of missing, because their shopping behaviour is more impulsive, and they are more affected by various campaigns. Moreover, fear of missing out is effective for more expensive and hedonic product categories. Respondents were most sad if desired travelling and accommodation services, tickets for events and electronics are sold out. Recommendations to business companies were done based on the conducted study.

Keywords: Consumer attitudes, fear of missing out, FOMO, consumer behaviour, products, Estonia

1. INTRODUCTION

In modern marketing, fear of missing out (FOMO) has been used by marketers for influencing consumer choices, purchasing decisions and behaviour. Current study is examining FOMO phenomenon in the attitudes context. The topic has had very limited research in the world and have been usually left unresolved. FOMO can be defined as a pervasive apprehension that others might be having rewarding experiences from which one is absent. FOMO is characterized by the “desire to stay continually connected with what others are doing” (Przybylski et al., 2013, p. 1841). Mentioned definition for FOMO is the most famous among academic scholars in this research area. Çelik et al. (2019, p. 125) defined FOMO as “a fearful attitude towards the possibility of failing to exhaust available opportunities and missing the expected joy associated with succeeding in doing so”. FOMO phenomenon is closely related to consumption and marketing was emphasized by Odabaşı (2017).

The development of information society influences rapidly consumer behaviour and it is also generating the role of FOMO in campaigns and in consumer purchase behaviour. FOMO is usually boosted by brands and companies, who have learned how to stimulate demand and consumption, especially in social media with limited time and limited quantity offerings. FOMO has connection with the usage of social media (Abel et al., 2016). People are controlling devices, which have internet connection, for the guarantee that their experiences will not be worser compared to these that are available at the moment somewhere else. FOMO is

* Corresponding author: oliver.parts@taltech.ee

importantly influenced by information delivery speed and information that would be shared by another consumers, this will give an overview, what another consumer can be missing out at the moment (Conlin et al., 2016).

Current paper will find an answer to the central research question What are the consumer attitudes for the possibility of missing out a desired product? The aim of the article is to identify consumers' attitudes towards the possibility of missing out a product and to draw conclusions as to whether and how the fear of missing out a product influences consumer behaviour in Estonia. The target group for the research are millennials (people under 40 years), because earlier researches have confirmed under 40 years consumers are the main target group for FOMO related campaigns (Bautista & Saavedra 2020; Kolm, 2015).

2. LITERATURE REVIEW

FOMO was firstly mentioned by Herman (2000, p. 335), who stated that “FOMO is related to ambitions to discover all possible possibilities that are connected with the chance for missing out something”. FOMO has been seen also as immediate condition after getting some information (Hayran et al., 2020). FOMO can occur also in favourable and enjoyable situation, where negative emotions are missing. If customer would find some limited information that there can exist for situational experience some another alternative at the same time, this can cause FOMO occurrence (Hayran et al., 2016). FOMO will start from endless choices from where consumer must done his/her choice (Herman, 2010). Figure 1 will illustrate FOMO components.

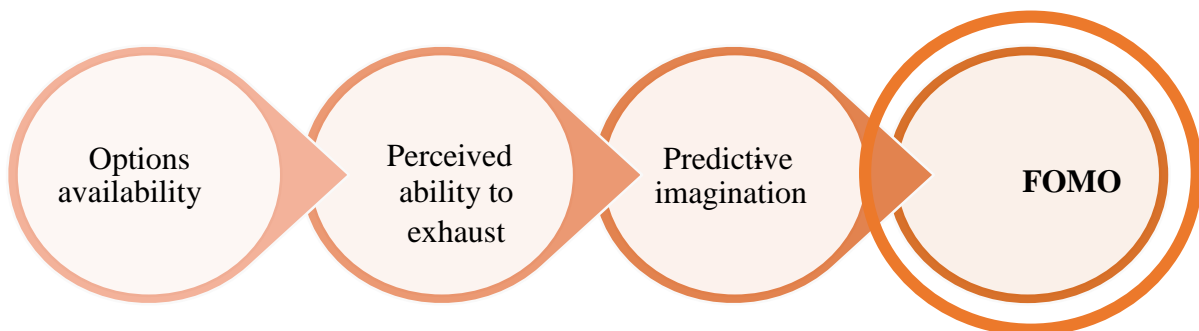


Figure 1. FOMO components (Herman, 2010)

FOMO expresses direct and also indirect effect on consumer attitudes and behaviour (Good & Human, 2020). FOMO forces people to follow and imitate consumer groups in resemble purpose (Inwon et al., 2019). FOMO affects consumer attitudes, motives, intentions, subjective norm and real behaviour (Bautista & Saavedra, 2020). There is a link between FOMO and negative emotional and social factors like dullness, loneliness, irritability, and isolation (Abel et al., 2016), therefore it can be concluded that FOMO affects negatively consumers' welfare and personal feeling. People with low-esteem and isolated ones are more affected by FOMO consequences (Barry & Wong, 2020). FOMO is psychological fear, because people have the need to belong to some social group (Przybylski et al., 2013). FOMO starts usually with external stimulus that is usually advertisement, but the influence of this promoting activity is very much dependent on consumer personality characteristics, affective reactions, situational factors and also from product availability (Hodkinson, 2019).

3. METHODOLOGY

FOMO was measured by Przybylski et al. (2013) and Çelik et al. (2019) scales and questions were adapted to Estonian context. Çelik et al. (2019) scale were also used because it is also measuring FOMO from consumer impulsiveness corner.

Current study was contacted in Google forms in november 2020 and convenience sample was used based on Estonian millennials (respondents under 40 years old). Previous studies have found that millennials are having more fears toward missing out a product (Bruno, 2019).

Questionnaire had four parts: The first part contained socio-demographic questions for clarifying is the respondent part from millennials or not; the second part examined the role of the fear of missing out a product, the third part researched how respondents would react if there is a possibility the product can be sold out fast; the last part investigated consumer attitudes toward different product categories, where consumer will feel much higher risk for FOMO occurrence.

Total sample was 123 millennials, where 82% were women and 18% were men. As usually women are more frequent and important buyers, then the sample is reasonably consisting more women than men. The age structure for the study was the following: 17% in the age group 18 until 24 years, 37% in the age 25 until 29 years, 29% in the age 30 until 34 years and finally 17% in the age group 35 until 39. 62% of the respondents were from Tallinn and 8% from the villages. Sample is not representative and results cannot be generalized to whole millennials in Estonia.

4. RESULTS

Table 1 is revealing consumer attitudes toward FOMO and especially factors that are caused by another people. Respondents agreed the most they trust more friends suggestions than suggestions expressed by influencers (4.54 in five-point scale) and the statement My friends and closed ones opinions are important in making the purchase choice. Agreement with these two sentences were more than scale average, other statements were agreed less than scale average.

Table 1. Consumer attitudes to FOMO, what is caused by another people (Scale 1 from not true at all until 5 absolutely true)

Sentence	Mean
I trust more friends suggestions than influencers suggestions	4.54
My friends and closed ones opinions are important in product choice making	4.18
I will often search information about new products and brands	2.38
Sometimes, I wonder if I spend too much time keeping up with what is going on	2.34
Influencers opinion is important in making personal purchasing decision	2.11

When I have a good time it is important for me to share the details online (e.g. updating status).	2.09
I trust influencers suggestions more than brand suggestions	2.03
I get anxious when I don't know what my friends are up to	1.50
I fear my friends have more rewarding experiences than me	1.50
I fear others have more rewarding experiences than me	1.40
I will be sad if I would know that my friends have bought something that I have not even heard before	1.35

Table 1 shows consumer attitudes toward FOMO are quite low for Estonian millennial respondents (agreements were between 1.35 until 1.50 on the five-point Likert-type scale. The biggest fears were related to the situation where respondent get anxious when he/she will not know what are his/her friends up to or respondents friends have more rewarding experiences (agreement with both sentences equally 1.50). Age group analysis showed that the age group 25 until 29 years old agreed the most that they afraid the possibility that the desired product can be missed out.

Consumers were asked next to give evaluations to different sentences that were measuring personal consumption. These sentences are in Table 2.

Table 2. Consumer attitudes toward purchasing (scale 1 not true at all until to 5 absolutely true)

Sentence	Mean
Sales and discounts affect my purchasing decisions	3.63
I often buy things spontaneously	2.96
When other consumers are drawing more attention toward some product, it will impact my product choice	2.52
I will buy fashionable and popular products with higher certainty	2.44
I become anxious during a sale and tend to buy more than I actually need	2.43
I feel myself anxious if the product is already missed out	2.39
Campaign with limited time will put myself to act	2.35
I will buy in sales and discounts time even I will not need anything	2.34

Table 2 shows that respondents were evaluating slightly higher sentences that were related to general consumption compared to FOMO sentences. One of the most interesting finding is that respondents are admitting sales and discounts affect their purchasing (agreement 3.63). Most of the sentences were graded as 2 or 3 by consumers. Age group 25 until 29 years revealed the most impulsive shopping behaviour.

Consumer attitudes toward different product categories were also examined. Study researched in which product categories consumers weigh their shopping decisions with very limited time. Figure 2 will give the overview about these product categories.

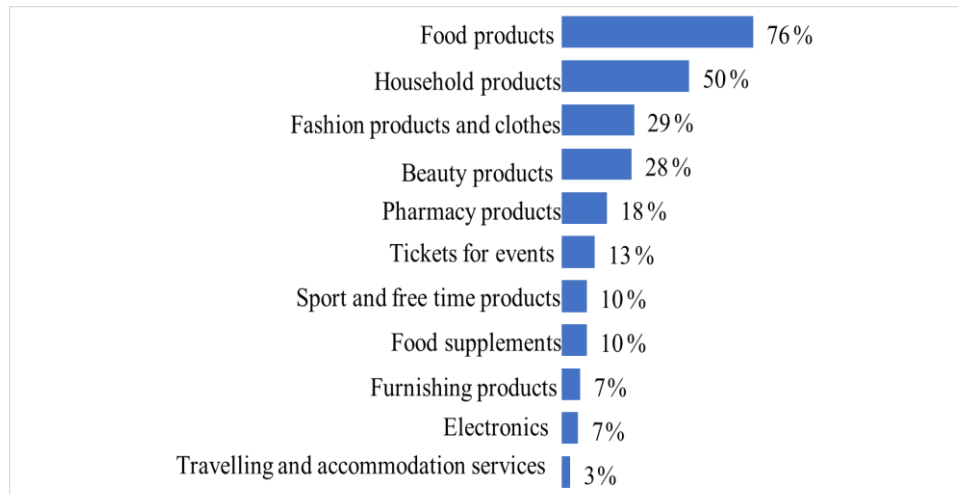


Figure 2. Product categories where consumers weigh their shopping decisions limited time

Figure 2 shows that consumers usually do not waste much time for shopping daily food products and household products and on the contrary they weigh very deeply their decisions about travelling and accommodation services (3% only will not weigh it very much), also they weigh more in buying electronics or furnishing products. This finding is also deeply in line with involvement rate theory, which says consumers will not weigh much in buying habitual and routine products (Beatty et al., 1988).

Figure 3 is clarifying product categories, where Estonian millennials are the most sad if the product is missed out.

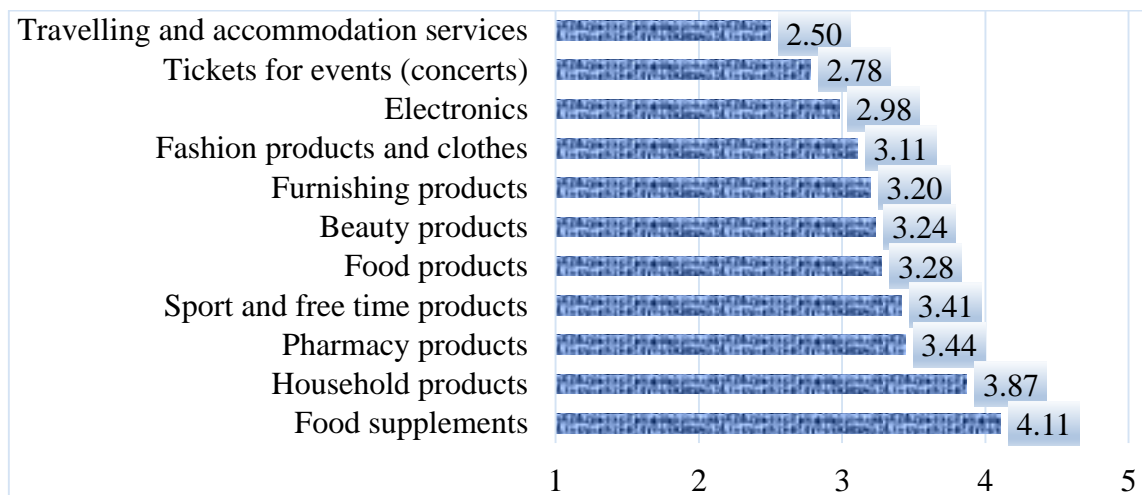


Figure 3. Estonian millennials' sadness toward different product categories if the product is missed out (Scale 1 very sad until 5 not at all sad)

According to current study respondents were most sad if they would not get desired travelling or accommodation services, tickets for events or favourable electronics. If the Likert type scale value is nearer to 1 in this question, then the consumer is more sad about missed out

product or service. Consumers are more sad if they would miss more expensive product compared to cheapest ones. There are also differences inside the product category. For example, travelling services and accommodation is most desirable in this study, but this does not mean that consumer feel sadly in every missed out offering. This is also dependent on concrete offer or a product in travelling and accommodation service category. Consumer sadness about FOMO is also influenced by subjective perception an emotional situation, what consumer is feeling when seeing or not seeing desired product in the outlet or in e-shop at the time making his/her purchases. Consumers are also keen on making the tension if they wish to receive something very much and when the product is already missed out in the shop where they usually would make their shopping (41% respondents agreed totally).

5. CONCLUSION, IMPLICATIONS AND FUTURE RESEARCH

Current research about Estonian millennials showed that respondents do not very much afraid the possibility for the fear of missing out a product. All the FOMO statements from Przybylski (2013) were evaluated less than scale average (look Table 1), thus it can be concluded respondents attitudes to FOMO are neutral, except the age group 25 until 29 years, who are the most influenced by it from the millennials.

Results showed that consumers are influenced by different reference groups like friends and close people and somehow also by influencers' opinions when making purchasing decisions. Respondents are not feeling this impact from other people, but probably this is related with consumer unconscious. Consumers who are more affected by discounts and sales, they are usually more impulsive in their shopping behaviour and they afraid more the possibility of missing out a product.

From the marketers point of view, it is good that respondent attitudes to the possibility of fear of missing out are not negative, because this shows to marketers that consumers do not feel companies have manipulated with them, therefore FOMO can be used successfully in marketing campaigns, especially in social media. For creating the fear for FOMO, it should be done in Facebook, Instagram, Youtube and in the product promoting process can be good idea to use influencers' ideas as well. Consumers usually trust influencers more than brands and their suggestions sometimes are not giving even relevant information.

FOMO is connected with discounts, impulsive buying and campaigns and consumers admit discounts will influence their shopping behaviour. Consumers who are more affected by discounts and sales will buy more impulsively and they usually feel the higher risk for FOMO occurrence. Usually this type of consumers are feeling themselves anxious and badly after the FOMO has really occurred in limited time and limited quantity offerings (mostly here respondents in the age groups 25 until 29 years).

According to millennials study results revealed, there is a suggestion for launching FOMO related campaigns mainly to people in the age group 25 until 29, because they react more emotionally compared to other millennial age groups.

In FOMO context all suggestions can be applied also in the e-shops (limited time and limited quantity offerings, also product exclusivity). Popular products should be put as separate category in the e-shop, this should help to show product acceptance among different consumers. FOMO should be used in these product categories, where consumers can be most sad if the product is missed out (according to this study especially in travelling and accommodation services, tickets for events and electronics categories). FOMO works well with expensive and hedonic products and services.

For measuring FOMO in the future studies, the authors suggest to have larger sample for measuring this shopping phenomenon and also to widen the respondent group in Estonia

(18 until 74 years old consumers). FOMO country to country comparison in Europa can give also important input for international marketing activities.

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PREDICTING EFFECTS OF ORGANIZATIONAL COMMITMENT AND CHANGED WORKING CONDITIONS ON EMPLOYEES TASK PERFORMANCE DURING COVID-19 PANDEMIC

Ana Tomovska – Misoska, Dimitrinka* Jordanova Peshevska, Kate Trajkova
University American College Skopje, North Macedonia

Abstract: This Changes in work processes during the pandemic are believed to remain an integral part of the new normal in post pandemic world. The pandemic forced numerous changes in work processes with significant impacts on task performance. Namely, the literary perspective refers to significant impacts of changed working conditions such as: workload, social (physical) isolation and distance among employees and remote work as potential determinants of task performance. Considering the spectrum of organizational commitment structural dimensions, the interest in the predictive potential effects of commitment and its change during the pandemic on the employee task performance is imposed. The aim of the study is to identify the predictive potential of these determinants: organizational commitment and changing working conditions on employee task performance during the COVID-19 pandemic. Methodology: The study includes 297 employed adults from the general population in North Macedonia. The sample is based on a snowball recruitment of the participants. The questionnaire, designed for the purposes of this study, was structured to measure changes in workplace practices and organizational commitment. A questionnaire was distributed online using Google Form. Results obtained by regression analyses show the predictive potential of organizational commitment and workplace variables on the employee job performance. The research provides important theoretical and practical implications for improving employee's performance based on the changes in workplace dimensions and organizational commitment.

Keywords: task performance, organizational commitment, working conditions, COVID-19.

1. INTRODUCTION

One year after the outbreak of the COVID-19 pandemic, the business world faces a number of challenges of a technical, physical and socio-psychological nature. Human Resource Management practitioners were under intense pressure to generate measures to quickly adjust the workforce to the "new normal" in work performance and social environment, and the style of work without organizational preparation (Gallup, 2020; Donthu & Gustafsson, 2020; Carnevale & Hatak, 2020). Namely, the pandemic affected the intervention and rapid change of working conditions in the business world. Thus, for example, there is an increase in the number of employees who use remote working environment (telecommuting) due to the measures undertaken to curb the spread of the virus. In addition,

* Corresponding author: jordanovap@uacs.edu.mk

the rapid organizational preventive measures against COVID-19 caused positive and negative changes in employee behavior (emotional, cognitive and physical well-being), and working on achievements (deliverables) and performance (Graves & Karabayeva, 2020; Boichenko & Tymchenko, 2020). Employees work performance in terms of a pandemic is the focus of interests of both practitioners and science. The question is what has changed during the pandemic that affects employee performance? The literature acknowledged long list of predictors with organizational, social and individual nature that significantly affect the employee task performance. In this context, Graves & Karabayeva (2020) in a study conducted during the pandemic pointed out stress, inadequate infrastructure, remoteness of the working environment/colleagues, unrealistic expectations in operation, distorted relationship between the manager and staff and difficulties in establishing trust with colleagues as factors with a negative impact on employees work performance during a pandemic versus positive impacts from remote work. Working remotely or working from home (WFH) in COVID and post- COVID time has obviously become the biggest challenge for job related issues. The design of work from home consequently entails changes in communication, workload or overload of staff, changes in the modes of communication and changes in the balance between work and private life (Carnevale & Hatak, 2020). Thus, Golden & Gajendran (2019) found that the positive relationship between remote working intensity and job performance was stronger for employees low in social support at work. Received social support during the period of working away from office, for instance, can help remote workers to overcome social isolation (Bentley et al., 2016).

According to the theory of action and job performance (Boyatzis, 2008), three main factors determine the performance in an organization: individual (the vision, values, philosophy, knowledge, nature, competencies, career path, style and interests of the workers organizational environment, and job demand); organizational environment (the culture and climate, structure and systems, industrial maturity, organizational strategic position, core competencies and the greater context) and the job demand (duties, functions and roles of each member in the organization). Founder of this theory Boyatzis (2008) indicated that the best performance (best fit) can be realized through the individual factors, the environment and the roles and tasks carried out by human resources. In this context, commitment, style and knowledge supported by the working conditions can push an employees to fulfil their role in completing tasks and functions aimed towards achieving the best organizational performance. Since COVID-19 made impactful changes in the organizational environment and job demands, an exploration of the effects of such changes is needed. In this terms, identification of potential organizational and individual factors on employee performance is a serious challenge for management researchers in the context of modern post-covid history. The theoretical explanation for the relationship between organizational commitment and different working relate variables with employee task performance can be referred to the Social exchange theory (Blau, 1964) and theory of action and job performance (Boyatzis, 2008) and Goal setting theory (Locke & Latham, 1984). These theories accentuate that employees invest energy in the work performance expecting mental, social and psychological rewards from the organization. According to Blau, (1964) and Aryee et al. (2015) employees' satisfaction about the relationship with the organization depend on their perception of the balance between what employees invested in the relationship, what they receive, the type of relationship the workforce deserves, and opportunities for better relationships with other organizations. Resilience has been conceptualized as capacity to recover after undergoing negative emotions, and flexibly adapt to the changing demands of stressful experiences, effectively respond and adapt to changing circumstances and challenges (Niitsu et al., 2017; Caniels et al., 2018; Ojo et al., 2021). There are many resources regarding the relationship of this individual dimension

and relatedness with employee performance. Therefore the current study, tries to explore the link between work related variables such as: changes in the work condition, organizational commitment and task performance and as well resilience.

1.1 TASK/ JOB PERFORMANCE AND CHANGES DURING COVID-19

Individual employee performance can be identified as job performance, work outcome, or task performance, consider it as an action. The definition of work performance represents net effects of individual actions that are due to the skills and knowledge of the work (tasks) that affect the level of accomplishment and fulfillment of the purpose of individual tasks (Alsheikh & Sobihah, 2019; Kasale et al., 2020). For Hamdan et al (2021) work performance is the result of three factors: the capacity, commitment and nature of working conditions, including the experience, expertise and competencies that brought the worker to the organisation, the commitment is the degree of hurry to complete the work of the employee, and the nature of working conditions and suitability to promote and improve the development. Most notably the concept of remote work is recorded as a significant change in working conditions or as Wang et al. (2021) say it has become the “new normal,” almost overnight during COVID-19. Gajendran and Harrison (2007) described telecommuting as “an alternative work arrangement in which employees perform tasks elsewhere that are normally done in primary or central workplaces, for at least some portion of their work schedule, using electronic media to interact with others inside and outside the organization,” notably, they indicated that “elsewhere” refers to “work from home (WFH)” (p.1525).

The effect of WFH on job performance of employees remains debatable thus creating a research gap (Allen et al., 2015; Susilo, 2020). Wang et al. (2021) identified four key remote work challenges (i.e., work-home interference, ineffective communication, procrastination, and loneliness), as well as four virtual work characteristics that affected the experience of these challenges (i.e., social support, job autonomy, monitoring, and workload) and one key individual difference factor (i.e., workers’ self-discipline). Their study is in line with previous studies. Extensive list of studies proclaimed the beneficial effects from telecommuting for employers and employees such as: increased motivation, improved gender diversity, healthier workforces with less absenteeism and turnover, higher talent retention, job satisfaction, (Collins & Moschler 2009; Delanoeije & Verbruggen 2020; Mello, 2007), increased job engagement (Collins & Moschler, 2009; Delanoeije & Verbruggen, 2020) increased flexibility and job satisfaction, including reducing work-life conflict and commuting (Grant et al., 2019) and increase in productivity and job performance (Collins and Moschler 2009; Delanoeije & Verbruggen, 2020; Grant et al., 2019; Mello, 2007; Robertson et al., 2003). Moreover, literature acknowledged that telecommuting also has disadvantages. Susilo (2020) discussed limited separation between work and personal time, and indicate home as a boring work environment. As a result of telecommuting can create negative impact on employees’ performance. The WFH concerns are related to electronically mediate communication. Recent studies of Nisar et al (2019) the main weakness of electronic communication is the level of its information richness. On the other side Wang et al. (2020) argued that many of the interpersonal processes are mediated by ITC in current digital workplaces and therefore, communication quality is an important experience to consider for remote workers.

1.2. COMMITMENT AND TASK PERFORMANCE

Organizational commitment is noted as a recurrent subject of numerous extensive researches in the last decade. Theoretically is perceived as “a psychological state that (a) characterizes the employee's relationship with the organization, and (b) has implications for the decision to continue or discontinue membership in the organization” (Meyer & Allen, 1991, p.67). For Toban et al. (2014) organizational commitment is about how far an employee stands on the side of the organization and the objectives including a feeling to maintain his membership within organization. According to Aghalari et al. (2021), organizational commitment has been identified as variable that increases performance effectiveness, productivity, and reduces the tendency to leave service and commitment at the individual and organizational levels during pandemic. The results of meta-analyses (Jaramillo et al., 2005; Riketta, 2002; Wright & Bonett, 2002) report positive relationship between commitment and performance. Numerous studies of the commitment-performance relationship reflected a commitment as a construct of affective and calculative dimensions (Hunter & Thatcher, 2007). Related to these two dimensions, some studies indicate that job performance should be influenced profoundly by affective commitment, “the relative strength of an individual's identification with and involvement in a particular organization” (Siders et al., 2001). Committed people use all their power to advance their goals and the goals of the organization and do not limit themselves to do things within the framework of existing laws and structures (Aghalari et al, 2001).

1.3. RESILIENCE AND TASK PERFORMANCE

Application of resilience in context of organizational setting is demarcated as the “positive psychological capacity to rebound, to ‘bounce back’ from adversity, uncertainty, conflict, failure, or even positive change, progress and increased responsibility” (Luthans, 2002). For decades, research demonstrates the importance of resilience in the workplace regarding employees' well-being and performance. Employees demonstrate resilient behavior when they utilize their personal and job-related resources to respond swiftly to uncertainty and change. Relate to employee behavior on the workplace, several studies have confirmed a weak to moderate relationship between resilience and job performance (Krush et al., 2013; Luthans et al., 2005; Luthans et al., 2007). Recent study conducted by Ojo et al., (2021) in period of pandemic demonstrated the impact of resilience in lessening job-related stress, psychological stress, burnout, and attrition. Resilience empowered employees to effectively respond and adapt to changing circumstances and challenges. Vinkers et al., (2021) argued that resilience is also pivotal to coping with stress and vital to staying in balance, most especially during the COVID-19 pandemic.

2. METHODOLOGY

The research was conducted in March and April 2021 in the Republic of North Macedonia using a convenient sample of employees from different sectors. The questionnaire was distributed electronically using Google Forms and was filled by 310 people, but only 297 were usable answers as some were erased due to incomplete data or being filled from the same e-mail address. Table 1 presents the demographic data for the sample. As can be seen in in the Table there is almost equal distribution of answers between various demographic categories. The average age of the respondents was 30 years of age, there were more female

respondents, most of the respondents held a Bachelor degree closely followed by those with high-school degree, and most of the participants have a work experience between 1 and 5 years and the majority of the participants work in small and medium enterprises.

Table 1. Demographic data

Gender	Percentage of respondents
Male	45.5
Female	52.5
Non-binary/Prefer not to answer	2
Level of education	
Non-completed high school	2.4
High-school degree	33.7
Bachelor degree	37
Master and above	26.9
Work Experience (duration)	
Less than 1 year	23.6
1 to 5 years	38
6 to 10 years	6.7
Above 10 years	31.6
Size of company	
Less than 10 employees	30.7
11-50 employees	34.1
51 – 250 employees	20.9
Above 251 employees	14.2

To test the hypothesis and explore the link between various work related variables and task performance during the current pandemic a regression analysis was performed. This section will now outline the variables used in the regression analysis. The outcome variable was Task Performance for the last three months. The variable was a composite variable consisted of 5 items taken from Koopmans et al (2014) and used in the research for work-related consequences of COVID-19 in Europe (Prochazka et al., 2020). The questions are related to the appraisal of the participants of their successfulness in planning and performing work tasks using minimal time and effort as well as separating main from side issues at work. The items were on a 5 point Likert type scale with 1 meaning seldom and 5 meaning always. Lower result means perception of less successful Task performance.

The predictor variables were also used in the research for work-related consequences of COVID-19 in Europe (Prochazka et al., 2020). The composite variables were: Change in task performance in the last three months, Organizational commitment in the last three months, Change in task performance in the last three months, Change in organizational commitment in the last three months and Resilience. All variables had items measured on a 5 point Likert type scale. The variable Change in task performance in the last three months, consisted of 5 items and adapted from Koopmans et al (2014) referring to change in successfulness in planning and performing work tasks using minimal time and effort as well as separating main from side issues at work. Higher results mean appraisal of better Task Performance in the last three months compared to previously. The variable Organizational commitment in the last three months was composed of 4 items taken from Klein and Cooper (2014) with questions care and dedication to the organization. Higher results mean higher

levels of organizational commitment. The variable Change in organizational commitment in the last three months consisted of 4 items adapted from Klein and Cooper (2014) with questions related to change in feelings of care and dedication to the organization. Higher results mean perception of higher organizational commitment in the last three months compared to previous organizational commitment. The variable Resilience consisted of 9 items taken from Connor et al (2003) with questions related to appraisal of dealing with stress, change, failure and negative feelings. The Cronbach Alpha values for the composite variables are given in Table 2 and they all have acceptable values for reliability above 0.7 as defined by Nunnally and Bernstein (1994). In addition a number of specific work related changes as a result of the pandemics were used as predictors: change in workload (with higher levels meaning more workload in the pandemic), increase in difficulty of work (with higher levels meaning more difficult work during the pandemic), change in meeting other people during work and change in telecommuting were also used as predictors. These variables are used as ordinary level variables. These variables were measured on a 10 point scale. The change in the meeting other people and change in telecommuting were calculated as a difference in absolute numbers between meeting people before and during the pandemic and frequency of telecommuting before and during the pandemic where all four variables were measured on a 10 point scale with 1 meaning not at all and 10 meaning all the time. The higher numbers in the result variables mean bigger difference in meeting people and telecommuting prior to the pandemic and during the pandemic.

Table 2. Cronbach Alpha results

	Cronbach Alpha
Actual task performance	.826
Change in task performance	.879
Organizational commitment	.928
Change in organizational commitment	.958
Resilience	.932

3. RESULTS

Prior to testing the main assumptions of the paper, an exploratory analysis was performed for the variables task performance exploring the differences between different demographic categories for their appraisal of task performance. Table 3 displays the results of the analysis. When it comes to the gender, the results of the t-test show that there is statistically significant difference in the appraisal of the Task Performance in the past three months between males and females with males appraising their task performance at higher levels in comparison to females ($t(289)=2.69$, $p=.008$). When it comes to the level of education those with non-completed high-school degree appraise their task performance at lowest level compared to other educational levels. The ANOVA analysis show that there is a significant main effect for the different levels of education ($F(3,293)=6.65$, $p=.00$) with statistically significant differences found between all other levels of education and those with uncompleted high-school and there is a statistically significant different between those with high-school and those with either bachelor level of master and above level of education. When it comes to work experience those with less than one year work experience appraise their task performance at lowest level compared to the other workers with more experience. The results of the ANOVA analysis show statistically significant main effect for different

duration of work experience ($F(3,293)=4.75$, $p=.003$) and the post hoc test reveals only a statistically significant difference between those with less than one year of experience and all other groups. The other differences are not statistically significant. When looking at the results for the appraisal of Task Performance in the last three months by the size of the company it can be seen that those working in companies that have between 51 and 250 employees appraise their task performance at lowest level. The results of the ANOVA reveal statistically significant main effect for different sizes of company ($F(3,292)=4.59$, $p=.004$). The post hoc test reveals statistically significant difference between those working in large companies (above 250 employees) and all other sizes of companies.

Table 3. Differences between demographic categories and task performance

Demographic variable	Task Performance (Mean)
Gender	
Males	3.65
Females	3.37
Level of education	
Non-completed high school	2.46
High-school degree	3.4
Bachelor degree	3.73
Master and above	3.45
Work Experience (duration)	
Less than 1 year	3.2
1 to 5 years	3.39
6 to 10 years	3.57
Above 10 years	3.68
Size of company	
Less than 10 employees	3.44
11-50 employees	3.5
51 – 250 employees	3.35
Above 251 employees	3.95

To test the assumption of the paper and the hypothesis a regression analysis was performed. The outcome variable was Task Performance in the last three months and the predictors variables were: Change in task performance in the last three months, Organizational commitment in the last three months, Change in organizational commitment in the last three months, Resilience, change in workload, change in difficulty of work, decrease in monthly income, change in meeting other people during work and change in telecommuting. The results of the regression show that 34% of the variance of the variable Task Performance in the last three months can be explained by the predictor variables and that the model is statistically and that the overall model is statistically significant ($R^2 = .34$, $F(8,211)=13.59$, $p=.00$). The results are presented in Table 4. As can be seen from the table there are four statistically significant predictors of Task Performance in the last three months. Two of those have positive link with the appraisal of Task performance: Change in task performance ($\beta=.345$, $p<0.01$) and Resilience ($\beta=.31$, $p<0.01$). Two of those have negative link with the appraisal of Task Performance: Change in telecommuting ($\beta=-.16$, $p<0.01$) and Increase in difficulty of work ($\beta=-.15$, $p<0.01$).

Table 4. Regression results for Task Performance

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.703	.299		5.700	.000
Change in task performance	.308	.055	.348	5.567	.000
Organizational Commitment	.027	.061	.028	.446	.656
Change in Organizational Commitment	.002	.041	.004	.059	.953
Resilience	.290	.059	.306	4.960	.000
Change in Meeting People	.016	.017	.058	.931	.353
Change in Telecommuting	(.042)	.016	(.164)	(2.676)	.008
Change in workload	.013	.015	.052	.898	.370
Increase in difficulty of work	(.038)	.014	(.154)	(2.674)	.008

4. DISCUSSION

The results from the study show that when it comes to the Task performance in the last three months, males appraise their task performance as being higher than the task performance of females. The reasons for such difference in the appraisal are worth investigating. The appraisal of task performance is also tied to the level of education with those with lower levels of education (non-completed high-school and high-school degree) appraising their Task performance as being lower than those with higher levels of education (Bachelor and above). Those with less than one year of work experience also report lowest levels of work performance compared to the other groups, which might be attributed to their adaptation to the work life. Interestingly the study also found that those in large companies appraise their task performance at higher level compared to those in micro companies and the SME sector. The reasons for such results are also worth investigating.

The results of the testing of the assumptions of the paper show that the appraisal of the Task performance which means appraisal of how successful the participants feel they are accomplishing their work tasks during the pandemic show that there are four variables that can statistically significantly predict the results. The findings show that those participants who appraise that their Task Performance was improved in the last three months also appraise their Task performance in the last three months as being better. It is important to note that those employees who perceive greater change in their telecommuting pattern also show lower appraisal in the Task performance. This important finding is in line with some of the previous studies (Susilo, 2020). Another interesting finding is that the employees that perceive that the difficulty of their work has increased due to the current pandemic also perceive that their Task Performance suffered in the situation. This finding further reiterates the profound changes of the pandemic on the work conditions and their link with work performance and is in line with other studies (Graves and Karabayeva, 2020; Boichenko and Tymchenko, 2020). One variable that is important for dealing with difficulties in life in general - Resilience was also connected to appraisal of task performance. Those workers that appraised themselves as more resilient also appraised their task performance as better during

the pandemic, which is also in line with previous studies (Krush et al., 2013; Luthans et al., 2005; Luthans et al., 2007; Ojo et al., 2021; Vinkers et al., 2021).

Although the current study has been done on a convenient sample the results are valuable as it is one of the first studies to address the issue of the current pandemic in the country and the region. The findings are generally in line with other studies and deserve a further exploration. Namely future studies should focus on exploring more the link between resilience, working from home and how the changed working conditions contribute to the changes in employee performance. In addition the work should concentrate on exploring the factors such as resilience that can contribute to mitigating the negative effects of the pandemic on employee performance and extend the research to include not only individual factors, but organizational and work design variables as well. The research should focus on helping companies, employees and managers adapt to the situation as much as possible and maintain the performance levels and standards as well as protecting the well-being of workers and organizations. When it comes to the practical implications this paper accentuates the need for companies to explore how they can help the employees mitigate the negative effects of the increased difficulty of their work during the pandemic and establish the social links for those using teleworking arrangements. Special attention should be paid to launching programs to boost the resilience of the employees and help them adjust to the changing work environment and work design.

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THE ENHANCEMENTS OF MANAGEMENT PRINCIPLES IN THE ROBOTIZED INDUSTRIES PRACTICE

**Zamaldinova Aigul Azitovna, Suraeva Alina Andreevna, Vorontsov Dmitry Petrovich*,
Khranov Yuri Vladimirovich, Khamidullina Gulnara Rafkatovna**

Kazan (Volga) Federal University, Russian Federation

Abstract: An actuality of the paper theme is concerned with the fact that the robotization in the different spheres of industries could be estimated as the one of the main factors for the survival and evolution in the face of fierce competition and increased uncertainty in the modern world for many firms. If these subjects want to succeed it's necessary to realize the business competently and based it on the relevant management principles. Accordingly, due to the famous decrease in the effectiveness of some classic management paradigms application and the growth of the firms/enterprises impact which widely realize robotization opportunities in the various activities it is necessary to implement the following tasks. In our research were reviewed the classical principles of management, and then we tried to identify its aspects relating to modern companies. Also we briefly looked at the modern researches in the industrial management sphere and analyzed it as well as the practice of robotized companies. Based on reviews and analyses were proposed the enhancements to the management principles (formulations) in the industrial robotization processes.

Keywords: Management (modern) paradigms and principles, industry, robot, robotization, automation.

1. INTRODUCTION

The robotization which is based on industrial robots and robotic systems using that could physically replace human labor (this usually promote an increase in productivity, higher product quality, exception of various kinds of errors, etc.) is presented for our purposes as the one of the main component of production automation. The management system is the one of the major things in the production relationships. The typical management process could be estimated as the permanent action with the aim to increase the production efficiency. The main purpose of such process is the effective satisfaction of the priority market actors requests and in this process are usually possible some corrections and adjustments of proposed strategies. The problem here could be formulated as the estimation of the opportunities for the real application of management principles and the (possible) efficiency of these principles which are using in the process of modern industrial robotization and in the robotized firms practice. Basing on this the main aim of the paper could be represented as to identify, refine and (if it's possible) some enhancement in the management principles formulations for the robotized enterprises. The object is the basic principles of management of the modern organization, and the subjects are the famous and also used in the real practice different

* Corresponding author: 128_dmitri@mail.ru

management principles which determine the management systems in the robotized enterprises. Theoretical importance of the research is concerned with: a) to replenish and expand the existing management principles in relation to modern enterprises; b) in revealing (and improving) management principles formulations basing on the robotized enterprises practice. Other significance of the research is that the results obtained in the study could be used as a methodological instrumentality for the further management on the modern enterprises, and also could be further refined and practically developed in the robotized enterprises activities. Management in the modern science is often interpreted as the synonym of “control” (in the studies of some quality management classics, etc.) or “direct ruling” but at the same time this word is reflecting the most complex aspect of noticed term, i.e. the impact on people to achieve the certain goals (Asheylova, 2013). That’s why within this study these terms i.e. “management” and “control” etc. will be used as the synonyms.

2. SOURCES AND METHODS

This study uses the results of the theoretical analysis from different types of documentary sources, i.e. from the scientific publications, books and monographies, periodical and professional editions, conferences proceedings, firms and factories reports on the local, regional and international levels, published expert commentaries and other verified resources. The various scientific researches of such authors as F. W. Taylor (1967), H. Fayol (Wren et al., 2002), P. F. Drucker (2007), J. A. Schumpeter (1942), M. P. Follett, G. E. Mayo (Kyle & Nyland, 2011), L. Newman, A. Peterson, A. Chandler (Sridhar, 2016), Lawrence D. Handerson, W. G. Scott (Smirti, 2017), F. I. Herzberg, D. M. McGregor, H. A. Simon (Abey, 2010), P. R. Lawrence, J. W. Lorsch (Raksha, 2015), F. Fiddler, T. Peters, R. Waterman (Peters & Waterman, 1982) etc. were analyzed for these purposes. Also were studied different scientific articles from the specific journals in the management and economic fields, mainly which are concerned with the scientific management, general management development, organizational behaviour and management of the organization (business management) like the *Journal of Policy Analysis and Management* (for ex., Fountain, 1998, etc.), *Total Quality Management & Business Excellence* (Steiber, 2013, Mashhadi et al., 2016, Suárez-Barraza & Ablanedo-Rosas, 2014), *European Management Journal* (Robledo, 2014, Kaplan, 2014), *Journal of Management* (Heyden et al., 2015), *Benchmarking: An International Journal* (Vijai et al., 2017), *Management Science* (Jordan & Graves, 1995), *Organization Science* (McEvily et al., 2003, Levine & Prietula, 2014), *Journal of Management Studies* (Six & Sorge, 2008, Reed, 2005, Lewin & Volberda, 2003), *Management Decision* (Smith & Boyns, 2005, Rodrigues, 2001), *Journal of Management History* (Wook et al., 2006), *British Journal of Management* (Le Roy & Fernandez, 2015, Ullrich et al., 2007, Rink & Ellemers, 2007), *California Management Review* (Frishammar & Parida, 2018, Chatterjee & Matzler, 2019, Appleyard et al., 2020), *International Journal of Management Reviews* (Campagnolo & Camuffo, 2010, Graetz & Smith, 2008) and *Journal of Economics & Management Strategy* (Finkle & Shin, 2020). Basing on the sources noted above and using the comparative analysis as one of the main methods here we have started with the management principles from the “classical theory” and from the modern management concepts (and practice). Firstly, the basic principles of management in the modern organizations could be briefly summarized as: a) self-monitoring and self-governance of employees; b) freedom of actions; c) creation of good working conditions with the focus on human’s social needs; d) friendly and trustworthy relationships between supervisors and staff; e) an involvement of the all employees (i.e. to pay more attention to the implementation of employees to the serious decisions preparation

and working processes, which will lead to more effective current operations, etc.). The following management concepts were chosen as the basis for the first (and next) short analytical reviews: scientific management, administrative management, management from the psychology and human relations point of view (“Human-Relations School”), empirical or pragmatic school of management, social system school or system approach to the management, behavioral (in some classifications it’s as the closest variant to the HRS) and situational approaches, the culture of management, innovative approach and the concept of management by objectives. Such management concepts comparison could make it possible to construct the conclusions about the typical principles of the modern management (even outside the specific school) and to analyse the situation for the robotized industries.

3. MODERN MANAGEMENT PRINCIPLES: SHORT ASSESMENT

Modern management principles have been forming for decades and are not a certain true and fully fixed positions as the society is constantly changing. The full original basis of the modern scientific approach to management was the classical management and its principles which were created at the turn of the 19th-20th centuries. The main schools of management were formed in this historical period. As the result of the brief management concepts analyzing from this period to the modern times study we prepared the Table 1.

Table 1. Management concepts (by time periods)

Periods	Authors	Management concept	An essence & elements of management concept
1870 – 1910s	Frederick Taylor	Scientific management	The scientific basis development and formulization for the specifying of the best ways for organizational purposes achievement, close cooperation of workers and enterprise managers, careful selection and employees training based on scientifically ascertained attributes, equal distribution of work and responsibilities between the company's managers and workers.
1920s	Henri Fayol	Administrative School (Bureaucratic Management)	The concept is concerned with the general problems and management principles developing for the organization as a whole. The concept of the firm organizational structure as the interconnected system with a certain hierarchy was formulated. Fayol defined 14 basic management principles.
1930s	M. Fallet, M. Mayo	Psychology and human relations point of view (“Human-Relations School”)	The researchers proposed that if the managers show the bigger care for the employees than the employees’ level of satisfaction should increase which will lead to an increase in productivity.
1940s	A. Peterson, P.	Empirical or pragmatic school	Management begins with the goals development and only then moves to the functions and interaction system formation.

	Drucker, L. Newman, A. Chandler		An emphasis is making on studying the content of work and the function of the manager.
1950s	Lawrence J. Henderson, W. N. Scott.	System approach to management	Organization as an open system consisting of interacting and interdependent parts (subsystems). The small activities in one part of the organization will have a significant impact to the other parts.
1960s	F. Herzberg, D. McGregor, H. Simon	The behavioral (school of) management	It focuses on psychological and sociological processes (relations and dealings, motivation and group dynamics) which could have an influence to the employees' work efficiency.
1970s	P.R. Lawrence, J. Lorsch, F. Fiedler and others.	Situational (approach to the) management	The management process has solely an ad hoc character (depends from the rapidly changing conditions). Everything here is based on the specific situation (i.e. the organizational structure type, centralization or decentralization philosophy, management style, motivation system, an approach to the control, etc.).
1980s	T. Peters and R. Waterman.	Management culture	An improving of the organization's efficiency as a result of increased productivity in its human resources using through the study of various aspects like the social interaction, motivation, the authority, leadership and communication nature, work content changes, working lifetime and career development quality. An emphasis is making to the organizational culture importance.
1990s (earlier in the West, he misp.)	J. Schumpeter, etc.	An innovative approach	Focus here is on the constant renewal and innovations. The innovations implementation is profitable when using the employee's creative potential advantages. Each organization must have a vision and innovation culture and processes.
2000s	P. Drucker and others	Management by objectives	It is based on performance management which achieves to reach the balance between the employees and organization goals (which must be compatible or defined jointly), also with the feedback support and ensuring.

As a special case here could be considered M. Porter's results not just in the competitiveness theory, but in the many others management fields (see an example of linkages with the classics in Wook et al., 2006). The analysis of the authors' researches and modern publications in the noted journals above with the famous current practices (local, regional and international) in this sphere make it possible to define and highlight the modern principles of organization management especially in the robotized industries, which will be described further in the next parts.

4. MANAGEMENT PRINCIPLES IN THE ROBOTIZED INDUSTRIES

In the practice the robotization process consists in the robots application at the enterprises and factories in the industrial scale. Industrial robots could be equipped with automatic lines which will have a positive impact on the whole equipment functioning. Such mechanisms also could be incorporated into the flexible automated production lines (FMS or FCMS). The main task of the industrial robots using is to replace the monotonous human labor and humans in the hazardous industries. Moreover, a feature of such robots is the flexibility of changeover and readjustment, i.e. for the new details (or products) production beginning it could be enough to simply enter another program. The industrial lines robotization allows reducing the time for products creation, to save the raw materials with the rational organization of manufacturing, etc. (other modern production technologies as the 3D-printing are not so efficient with the big scale of production, see Mingafina et al., 2019). The main tasks which the production robotization could solve: a) manipulation – the robot's function here is the human hands replacing (like the moving the parts, diestocks, preformed blocks and blanks; loading, unloading and packaging); b) processing (welding, cutting, etc.); c) assembling and mating - the majority of the work on the robotized manufacturers is concerned with the mating, assembling and fitting (partially with the erection) operations.

According to the statistical data (see Fig.1) the most common manufacturing sector where robotization is applied in the worldwide size is the automotive industry (Executive Summaty World Robotics, 2018).

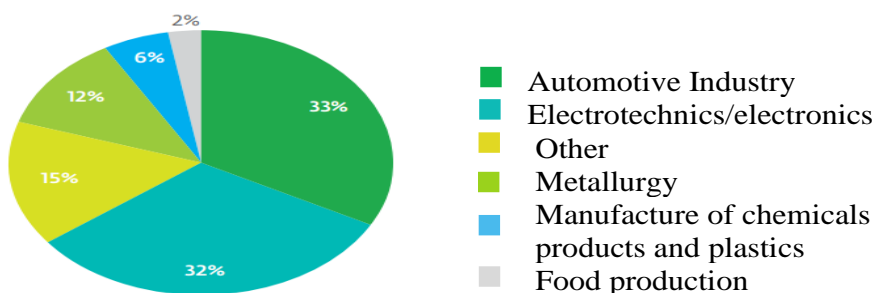


Figure 1. Distribution of robot shipments by manufacturing sector in 2018

The automotive industry (analyzing as an example here) consumes about almost one-third of all industrial robots produced realized in the whole world. As we could propose here for the safe and effective work in the production sector the factor of the industrial robots number growth is becoming the most visible. For this proposition checking is also possible to review some management production systems based on the concrete examples.

In the present times the management principles of the “Ford Motor Company” have no big differences from its management principles at the period of company creation and early development. The following examples could be noted here (Belchik, 2015): a) an efficient organization of the production process; b) innovations in the production process; c) an efficient work organization; d) specific financial policy realization; e) networks of service stations; f) financial stimulation for the workers, etc. All this could illustrate our thesis above. But now also at the “Ford Motor Company” there are other examples, too: in the Germany plant “KUKA” robots are working with people to install shock absorbers in “Ford Fiesta” cars, etc. which could be considered not as the just cited earlier principles realizing. Another famous illustration are the fundamental principles of “Toyota Motor Corporation”, which allow to realize the concept of lean production at the enterprise and are also seriously concerned in the modern conditions with the possibilities of the industrial robotization: the «Just-in-time» system, «Kanban» system and the «Genchi Genbutsu» (Ohno, 1988), “5S” system, 14 management principles (Liker, 2013). Similar examples could be found at “Mercedes-Benz” (“Daimler AG”), “BMW AG” and other leading car manufacturers plants. Basing on the comparative and practical management (literature) sources and summarizing the information contained in it it’s possible to refer as the German management style (maybe mostly for the “BMW AG” and “Mercedes-Benz” companies) the following features: a) focus on high quality and customer satisfaction; b) commitment to innovations; c) employees support and a well-developed training and education system (Asaul et.al., 2006, Dracheva & Yulikov, 2016, Travin & Dyatlov, 2015); d) two-level management system (see “Personnel Mix”, 2003, 1); e) an allegiance to the company's long-term prospects; f) high professional level and technical qualification and readiness of managers (Nink, 2009). For the Russian case we could find partially comparable examples with the “KAMAZ PTC”, on which the number of multiple production robots per 10000 of workers will be 402 to 2025, see the “Tibet project” description in the references (an example of quantitative analysis for the management features from another Russian regional branch of industry leader is available in Shikhalev et al., 2014 for the petrochemistry and in Shikhalev et al., 2015 for the oil branch).

The direct interaction of robot and human in the modern uncertainty conditions becomes an attribute of successful and advanced production processes organization (Efimov, 2019). Generally, at the heart of the production process organization in every plant and workshop is a rational combination of management principles in the space and time. In our opinion, the modern robotized enterprises and factories could be generally characterized with the following principles: 1. The multifunctionality and flexibility in the transition to the new products, parts and elements production; 2. Creation of favorable working conditions for the employees (hard and dangerous work is replaced by robots); 3. The principle of specialization as to assign to each production unit, site and workplace a limited number of jobs and/or the minimum possible number of different operations. 4. The principle of continuity i.e. the minimum of interruptions and distractions in production process. 5. Automatic data collection which propose no need for an employee to collect, process, register and transfer information to his specific department, managers, etc. 6. Principle of rationality i.e. the reasonable resources using; 7. The priority of intellectual labour and its promotion; 8. The human psychological resilience orientation as the ability to quickly and efficiently process and understand the information about the technological process (even) in the changing situation, and on this timely basis to make and realize the correct decisions. 9. Selection, education and training the qualified personnel. 10. Unification principle (for the messages, documents forms, standards, algorithms, programs and procedures, etc.). It is possible to use formally the whole set of the management principles mentioned above, but at the same time to follow really only to some selected principles. In this case it could be possible to improve some (performance)

indicators for a while, but it's reasonable to propose that these results will be short-lived. But if the company in the process of competent principles implementing with the serious understanding of all the features and possibilities of robotization (and automation) will adhere to all its elements, it will most probable achieve a sustainable competitive advantage.

5. RESEARCH CONTINUATION AND DISCUSSION: FIRST RESULTS

Basing on the short analytical review of the classical theory management principles (MP), modern management principles and the MP of the leading robotized enterprises and factories cases we could prepare a comparative table (Table 2) showing the main distinctive features of the preceding analyzed management principles.

Table 2. Distinctive features of the analysed principles

Classical management principles	Modern management principles	Management principles for the robotized enterprises
Specialization and division of labour	Self-control and self-management of employees	Multifunctional and flexible processes
Motivation of employees (not only financial stimulation, but also the personal initiative incentive)	Freedom of action (wide discretion)	An orientation to innovations
Delegation of authority	Conducive environment for the work, focusing on human social needs	The priority and encouragement of intellectual labour
Strict discipline, single command and hierarchy	Friendly, trusting relations between the management and subordinates	Orientation on the human psychological resilience; situational approach
Centralization/decentralization of power	Universal (total) participation and involvedness of employees	An automatic data collection, processing, registration, transfer of information between departments, etc.

The results of the study could be considered as the relatively reliable because the theoretical analysis of the different kinds of scientific management sources is added with the review of such large machine-building robotized enterprises practices as “Mercedes-Benz” (“Daimler AG”), “BMW AG”, “Ford Motor Company”, “Toyota Motor Corporation” (and briefly “KAMAZ PTC”), etc. The management principles identified (and formulated) by the authors are applied everywhere in the noted above enterprises.

Let's argue why the management principles of (modern) robotized enterprises could be more effective than the classical principles and even modern principles of non-robotized enterprises: a) The multifunctionality and flexibility of processes means that for the new products and its parts production it is enough simply to enter another program, moreover industrial robots are able to perform a large set of functions and work with the several programs synchronously; b) Orientation to innovations: enterprises work only with such (completely) new technologies, new management methods, etc., which could significantly improve labor and production activities. Enterprises are improving the brand as keeping up with the times and reaching the proposed results of the works in a shorter time; this also

attracts more young professionals, etc.; c) The priority of intellectual labour and its promotion which means that the creative activity (based mostly on logical thinking) replaces the primitive and routine physical work. As a result we have the opportunity to realize the fullest potential (or talents) of the employee, his or her capabilities and rising the work attractiveness; d) The orientation to the human psychological resilience is the ability to quickly and efficiently work with the information about the technological process (especially) in the changing situation, and on this basis to realize timely the correct decisions; e) Automatic information collection, processing, registration and transfer between the departments which could significantly reduce the of work time due to industrial robots and computer systems using. Moreover, the management principles identified above proposed as the basis which could be successfully used in (other) enterprises where there is a complete or partial robotization of production processes like the automotive industry, electrical and electronics manufacturing, metallurgy (in some cases of smelting industry), chemical and plastics production, and also food industry. A brief study of management principles above (with some comparison) also showed that modern enterprises have a rising commitment to innovations. The robotized enterprises very often strengthen positions on the market with innovation realizing and preparing it through the patent purchase, investments in R&D, cooperation with research institutions, etc., but this could be not enough to achieve the maximum production efficiency. Therefore, some additional statements (in the recommendation form) for the robotized enterprises management processes also have been proposed in the final part here.

6. CONCLUSIONS

In this study we realized an analytical review of various authors' scientific researches which made a valuable contribution to the management theory development. Basing on the classical management principles review it was possible to single out the new (modern) principles which are significantly different from the classical base and currently are applied in many organizations. Then in the brief research of leading robotized enterprises management specific elements (and activities) we defined the principles on which such kind of production is effectively controlled with the potential of using in other robotized cases.

For the forming an effective management policy in robotized enterprises it is important not only to understand correctly the essence of industry branch and particular case details but also to realize fully the specific character of robotization (and automation). That's why authors after the management principles defined above added here some positions for the robotized enterprises (and activities) which could give the additional opportunities for more efficient work, partially already known but are still necessary for realizing: 1) The attainability of the result: robotization should realize human functions faster and with the higher quality without the simply work imitation or nominally humans replacing; 2) Complexity or integrated approach: it is necessary to realize robotization also in the supporting (secondary) processes together with the main processes in production; 3) Necessity: robotization needs to be introduced and integrated not where it will be easier to do but where there it is a real need. A fairly common mistake is to put industrial robots on such manner (even in the production line) that it will be involved mostly in a process of human actions imitation; 4) Modernity: to implement robotics only where a person cannot work better; 5) Risk assessment - additional security measures must be provided when we propose an interaction with the industrial robots. In order to prevent a collision with unexpected situations it is important to understand the potential danger i.e. to identify, analyze and assess

(specific industrial) risks; 6) Continuous updating: it is necessary to constantly develop the level of using methods and approaches, knowledge base quality, etc. So, the goal of this paper now is achieved. Its usefulness (also for the practice) is also concerned with the possibility that the proposed and developed recommendations could be used in the future by the robotized enterprises as a basis for the production management in such industry branches like the automotive, electrical and electronics manufacturing, metallurgy (in some cases of smelting industry, etc.), chemicals and plastics production, and also food industry.

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FORWARD-LOOKING STANDARDIZATION IN POST-CONSUMER PRODUCT AND INDUSTRIAL WASTE MANAGEMENT

**Yalalina Veronika Arturovna, Vorontsov Dmitry Petrovich^{*}, Zakirova Alfia Ravilievna,
Sadykov Zufar Baryevich, Khananova Adelina Faridovna, Shikhalev Anatoly
Mikhailovich**

Kazan (Volga) Federal University, Russian Federation

Abstract: In our study we explored the issues of the product life cycle last stage i.e. the utilization and / or recycling (reprocessing). The relevance of these aspects determines the priorities in the Russian Federation standardization development and the management tasks on this stage. The industrial wastes include products and substances, the secondary use of which is not profitable at this firm; among the methods of its disposal is the burial at specialized landfills, burning in incinerators, pyrolysis, etc. Standardization in the specified high-potential sphere is necessary; it is expected to solve a number of problems, including the problems of resources limitation (in all ways), i.e. the processing, utilization, recycling. In the article we analyse the Russian Federation technical committees activities which realise the implementation of this direction and propose the ways for its enhancement. Special attention here should be paid to the development of such types of standards like the GOSTs standards.

Keywords: standardization, disposal, technical committee, resource saving, standards

1. INTRODUCTION

The term “waste” means the residues of products or an additional product formed during or after a certain activity and not used in direct connection with that activity (see GOST 30772-2001). The wastes from the people’s activity are formed in the two types: production (industrial) and consumption wastes. The industrial wastes include products, materials, articles and substances formed as a result of human production activities, the secondary use of which is not profitable at this firm; among the methods of its disposal are the burial at specialized landfills, burning in incinerators, pyrolysis, processing into secondary raw materials with subsequent use and recycling. The disposal are based on the types of works ensuring the resource saving, during which are carried out the processing and/or secondary use of long-term and/or rejected products, materials, packaging, etc., as well as wastes [2].

On the official website of Russian Federal Agency on Technical Regulating and Metrology «Rosstandart» by the "Standardization" direction in the tab "Technical Committees" (TC) we could search the committees which are working on the theme. On the request like the "Disposal of products and production wastes" TC were not found. On the request word "Environment" 10 results are revealed from which the main or partial activity of

^{*} Corresponding author: 128_dmitri@mail.ru

4 committees are the areas of standardization in the sphere of environmental protection (or projects on environmental protection), and only the TC 409 "Protection of the surrounding environment" from this list mostly works with the Standard 13.030.01 "Waste" from the Russian Classification for Standards. Then we realised the search by the word "Waste" and from the 5 received results only the TC 113 "The best available technologies" (BAT) is conditionally suitable. As a result only 2 TC have been identified i.e. which have the right to work, develop and create in the standardization sphere concerned with the disposal of products and production wastes, with the next national codes of standardization fields (CSF): 13.020.01 "Environment and environmental protection in general" and 13.030.01 "Waste in general". Let's look at these activities with the more details.

2. METHODOLOGY: THE ELEMENTS OF QUANTITATIVE ANALYSIS

The specific structure of subordination and management in this sphere has the technical committee 409 "Environmental protection," under the supervision of Federal State-Funded Institution (FSFI) "All-Russian Research Institute (ARRI) Ecology". Chairman of this TC is Nedre A. Yu., the Director of this Research Institute; Secretary is Butovsky R. O., the Head of the Technology Center in the same institute. The effectual documents of the National Standards body concerned with this TC organization and functioning are: Order No. 3004 from 24.06.2011 "About the creation of the TC on standardization "Environmental Protection"" (in fact repealed); Order No. 29 (About the amendments) from 20.01.2014 ("Legal Russia", an official Internet resource); Order No. 1430 dated 20.11.2015 "About the reorganization of TC on Standardization "Environmental Protection" ("Regnews", an official Internet resource, for the Russian Federation). TC realizes the functions of the standing member of the similar Interstate Standardization Committee 508 "Environment Management", and also participates in the work of ISO/TC 207 "Environment Management." ISO/TC 207 is responsible for the creation of ISO 14000 standards for the environmental management development. One of subcommittees is sub-committee (SC) 2 "The waste management" which was created 20.11.2015 (see the Federal Agency on Technical Regulating and Metrology web-site, in ref.).

Similar is the situation with the sectoral relations and management for TC 113. It's activity is regulated here by the Federal Agency "Rosstandart" order No. 1236 from 01.08.2014 "About the creation of TC for standardization "The Best Available Technology (BAT)" ("Regnews", an official Internet resource, for the Russian Federation); by the "Rosstandart" order No. 765 dated 01.07.2015 (Amendments and additions), see the Russian BAT bureau web-site, in ref.; by the order No. 1561 dated 14.12.2015 (On Amendments and Additions), see "Regnews", an official Internet resource, in ref.; the order No. 432 from 02.03.2017 (the Structure of TC 113 - see the Russian BAT bureau web-site, in ref.). The Technical Committee operates in 27 groups and 36 subgroups of the Russian Classification for Standards (the Federal Agency on Technical Regulating and Metrology web-site, in ref.), the work is concerned with the developing a regulatory framework for the coordination of environmental and industrial policies. The web-site of TC 113 gives an opportunity to evaluate it basing on the estimation of the developed standards/draft documents status for 2015-2018 period. The "approved" status is belonged to the next documents on the topic: 1.0.113-1.003.16 "BAT. Resource-saving. Strategies and Methods for Thermal Treatment of Waste"; Project ITS BAT 15 "The waste disposal and neutralization (other than thermal disposal (waste incineration)); Project ITS BAT 17 "The production and consumption wastes placement". With the "voting" status are marked the next documents: 1.0.113-1.004.16 "Best

available technology. Resource-saving. The effective waste management aspects in the lime industry"; 1.0.113-1.005.16 "BAT. Resource-saving. The effective waste management aspects in the cement industry"; 1.0.113-1.006.16 "BAT. Resource-saving. The waste treatment methodology for the secondary material resources"; 1.0.113-1.007.16 "BAT. Resource-saving. The waste treatment methodology for the secondary energy resources"; 1.0.113-1.015.16 "BAT. Resource-saving. Strategies, principles and methods for environmentally oriented waste management"; 1.0.113-1.016.16 "BAT. Resource-saving. The quality control of waste which is entering to the incinerators"; 1.0.113-1.018.16 "Resource-saving. BAT. An hierarchical order of waste management"(the Russian BAT bureau web-site, in ref.). There are 50 working groups in the technical committee, 3 of them are concerned with the waste disposal: technical working group (TWG) 9 "Thermal waste disposal (waste incineration)"; TWG 15 "Waste disposal and neutralization (other than thermal disposal (waste incineration)"; TWG 17 "An emplacement of production and consumption wastes".

3. QUALITATIVE ANALYSIS. FIRST FINDINGS AND DISCUSSION ELEMENTS

Starting with the qualitative indicators of the technical committee's activity analyzing we could note that the Russian Federation Government approved the concept of the national standardization system development in 2006. According to it by the Federal Agency "Rostechregulation" (from 2010/2011 short title was renamed as "Rosstandart" Federal Agency) was organized the Technical Committee "Waste Management" No. 349, which prepared and introduced the GOST standards (regional standards for all the CIS countries) of the next series: "Solid fuel from the household waste" i.e. in 2010 were fully prepared 14 standards; in 2012 – 13 standards, and in 2013 - 4 (31 documents in total); on "Resource Saving" theme were prepared: in 2009 – 10 standards, in 2010 – 25, in 2011 – 6 standards; in 2012 – 17; in 2013 – 14; in 2014 - 3 standards (75 documents in total); on the "BAT" theme were also prepared: in 2009 – 1 standard; in 2010 – 9; in 2012 – 5 standards; in 2013 - 9 and in the 2014 - 3 preliminary national standards (total number is 27).

In the design of all these standards were implemented the norms of the European Union Manuals (or the "cover method" was used), when the international standard after a qualified translation is practically accepted mostly unchanged as the national variant; in the case of minor modifications (additions) to the international document was used the "modification method". The "the cover replacing" method (i.e. changing from the international to national cover) which was well-adopted in a number of countries for the Russian Federation is problematic in its using for a number of famous reasons, mostly as the international norms in this case are not adapted to Russian conditions. Thus, for solid municipal waste in the analysed international compare there is a significant difference in the waste composition and density which affects the requirements for the equipment and process assembly itself for both waste processing and combustion.

In the paragraph 2 of Article 3 Federal Law N 458 of the Russian Federation from 29.12.2014 the directions of state policy in the work with waste have the priorities in the following order: maximum use of initial raw materials and materials; the prevention of waste generation, etc. Most of these standards (marked above) are based not on the maximizing use of waste as the secondary resources but on the incineration, and the same case is concerned with the BAT Handbooks: the first one which was submitted to the BAT Bureau for the discussion is about the waste incineration, as there is no direct correspondence in the EU materials for the Handbooks of the secondary materials using. According to the economic component of standardization we must note that the rise of waste processing using could gives

according to various estimates up to 4.5% for the Russian Federation GDP (the contribution of the waste treatment and disposal industry to the national GDP amounted to 0.08% in 2016, Fesenko, 2011), at least due to the difference in prices for primary and secondary raw materials (plastic, wood, textiles, etc. in Volkova, 2018), and the burning give energy which is only below the cost-effective and not accepted by energy companies for the power grid. TC 349 worked until 20.11.2015 (see above).

4. SUPPLEMENTARY ANALYSIS

Basing on these priorities let's analyse the standardizing of this direction as a whole using the GOSTpdf.ru official web-site ("GOST" is the acronym of "State Standards" in Russian language: "GOST" for all the CIS countries as the regional standards and "GOST R" as the Russian national standards) where standards are sorted in the folders which are concerned with the all-Russian classification of standards. In the folder 13.30 "Waste" there are 96 GOST standards with the main names like "Resource saving. Waste (general)" and "Resource conservation. BAT" but not all of them establish rules, recommendations and processes for the industrial and waste consumption processing/recycling, just 5 from this number i.e. 5.21% ("Resources saving. Waste treatment" group): GOST R 54533-2011 "Resources saving. Waste treatment. Guidelines and methods for the polymer waste disposal"; GOST R 55087-2012 "Resources saving. Waste treatment. Requirements for the transboundary movement control of waste intended for disposal (utilization) operations"; GOST R 55090-2012 "Resources saving. Waste treatment. Recommendation of the council on waste paper recovery"; GOST R 55091-2012 "Resources saving. Waste treatment. Recommendations for beverage packaging recycling and reuse"; GOST R 55838-2013 "Resources saving. Waste treatment. Environmental keeping of write off production beside their utilization. General technical requirements". The standards of waste management including the radioactive have been actively appeared since 2011, now there are 23 standards.

5. SHORT RESULTS AND SOME OPPORTUNITIES FOR FUTURE RESEARCH

Standardization in the specified promising direction is really needed: it is necessary to solve a number of problems, including the limitation of resources problem in all the ways i.e. including processing, utilization and recycling. Basing on the analysis above to our opinion the current technical committees are quantitative productive and formally fulfilling main formal task but its area of activity is factually huge. As we have seen it could be relevant and necessary to create a separate technical committee and to include to its area of development the "Waste" group from the Russian National Classification for Standards and its sub-groups. Such technical committee was already existed as the TC No. 349 "Waste management," but its work in the new version as we noted previously should be significantly reorganized also on the another basis (see the Federal Agency on Technical Regulating and Metrology web-site, in ref.; also in Shikhalev et al., 2017, Shikhalev et al., 2019a, 2019b). The special attention must be paid to the creation and development of GOSTs standards which will help to use resources with the clear social (Mingafina et al., 2019) and economic benefits (De Angelis, 2020).

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BALANCE BETWEEN THE EUROPEAN UNION AND BULGARIAN LEGISLATION AS REGARDS THE AGRICULTURAL LAND VERSUS FOOD SOVEREIGNTY

Dafinka Grozdanova, Minko Georgiev*

Agricultural University, Plovdiv

Abstract: The article analyzes the relations between the legislation on agricultural lands in Bulgaria and the European Union (EU) and the impact of the doctrine on food sovereignty of the country (de lege lata). Attention is paid to the EU infringement procedure against Bulgaria based on Art. 258 of the Treaty on the Functioning of the European Union (TFEU) as regards the restrictions on the acquisition of agricultural land. The European Commission (EC) has established a case of non-compliance with EU law as regards the acquisition of agricultural land not only against Bulgaria but also against several other EU Member countries. The main argument of the EC is the violation of EU principals as regards the free movement of capital and non discrimination of the EU citizens which may harm some groups of national investors or investors from the EU. On hand, the legislative change undertaken by the Bulgarian authorities does not create conditions for discrimination between Bulgarian and foreign individuals or legal entities. On the other hand, Bulgaria has not made any attempt to establish a balance between the EU acquis on the acquisition of agricultural land and the food sovereignty of Bulgaria. At the end, this result has led to too many legal changes by which the conditions for "legal error" have to be taken into account. In order to address this issue (de lege farenada) some conclusive normative proposals are made.

Keywords: agricultural land, food sovereignty, EU legislation

1. INTRODUCTION

Food sovereignty is a political, economic and legal policy framework/doctrine which publically appeared at the World food summit in Rome 1996 for the first time and introduced by the FAO[†] in 2007. In order to distinguish between Food Security and Food Sovereignty the latter was defined as the right of people to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their rights to define their own food and agriculture systems. According to this definition and amongst others, the farmers should have the power to determine the policy and mechanisms for food production and distribution.

Bulgaria is a member of the FAO (1961) and through its right as such, introduces its strategic documents on food sovereignty[‡] along the lines given by its obligations as regards its EU Membership.

* Corresponding author: m_georgiev@au-plovdiv.bg

[†] FAO – Food and Agricultural Organization of the United Nations

[‡] Food and Agriculture Organization of the United Nations, Rome (2012): Voluntary guidelines on the responsible governance of tenure of land, fisheries and forests in the context of national food security (1-40)

Since 1991, the European Union (EU) is also a member of the FAO and influences the policy framework/doctrine on food sovereignty through its Common Agricultural Policy (CAP) and Common Organisation of the agricultural Markets (CMO). Food sovereignty is a component of a mix of efficiency, food security (Article 39, item 1 "a" of the TFEU), the income of farmers (Article 39, item 1 "b" of the TFEU) and the harmonious development of rural areas (Article 39 item 2 "a" of the TFEU). However, the CAP highlights, without a doubt, the benefits of consolidating resources and ubiquitous vertical and horizontal integration through international production (manufacturing) and other interbranch associations (EU Council, 2020).

Agricultural land is a primary factor of production and a major resource for agriculture, which is why the EU should "reverse" the theoretical dualism arising from the distribution of property rights on farmland. Negative consequences are possible for some groups of farmers who will not be able to produce their own food due to lack of access to land. Thus, the EU has a reason to strike a balance between food sovereignty and land policies. Through a historical review and institutional analysis, the dynamics of the legal framework for agricultural land in Bulgaria in relation to that of the EU are presented. As regards the direction of agriculture in Bulgaria the EU law, national legislation and atypical acts (Atanasov, 2019) are taken into account. The trajectory of change as regards legislation on agricultural lands (Fig. 1 below) has been studied[§] in the context of the idea of "bioeconomy" of EC (EC, 2018).

2. AGRICULTURAL LAND - THE BASIS OF FOOD SOVEREIGNTY

The challenge of explaining the need for food sovereignty lays in the theoretical and even ideological dualism in the sense of the international dispute over free trade or protection regarding agricultural and food production. In addition, the question is about the specific powers that determine access to resources: what is the effect of the coordination mechanisms, and who should benefit from the goods produced. (Aerni, 2011; Wittman, 2009; McMichael, 2009).

The theory of land mobility leads to a discussion on the consequences regarding problems related to rights accessing and conquering agricultural land. Next to its ecological characteristics, the sustainability of the organizational forms within which property transfers take place (Conway et al., 2020; Hartvigsen, 2014) play a key role. It is important to clarify that efficiency is a direct consequence of property consolidation. However, efficiency cannot be automatically equated with increased productivity. Some entities take the subsidy as a key element for maximizing operating profits.

Thus, more efficient companies may have it as a type of sustainable annuity (Stiglitz, 1974). There is no evidence that in the integration of organizations, the positive role of competition remains unaffected (Glick, 2019). The same is true for resource-based consolidation (Norer, 2019). Discrimination through different levels of the resource-product chain is possible (Gray, 1960), which is likely to affect the ability of certain groups of people to produce their own food. The number of freedoms can be distorted by the argument that the lack of restrictions, e.g. agricultural land does not pose a danger in the distribution of exhaustible resources. The concentration of agricultural land (Kay, 2016) as a primary factor of food production is not considered as being fundamental, although it is not clear whether

[§] The EU's bioeconomy concept has been established in 2012 and developed since then. It relies on efficiency through integration and economies of scale, without taking into account the role of agricultural land and food sovereignty.

consumers receive a higher value (Bork, 1978; Honvencamp, 2010) by such a distribution of agricultural land.

It is realistic to assume that legislation on acquisition or access to agricultural land is a policy tool. Ownership is one of the categories of absolute rights. For this reason, some modern legal systems use a constitutional approach to impose the link between agricultural land and food sovereignty (Szilágyi & Raisz and Kocsis, 2017).

3. INSTITUTIONAL CHANGE IN AGRICULTURAL LAND

During the attempt for a "new" codification regulating public relations in agriculture in Bulgaria the legal change have not stopped. As shown in Fig. 1 below the total number of normative acts having a direct and indirect relation to the agricultural lands in the period 1989 - 2021 sum up to 50 normative acts. Tewnty six of them are of laws; 5 - regulations; 8 - ordinances, 5 - tariffs and; 6 - of other acts having the character of instructions.

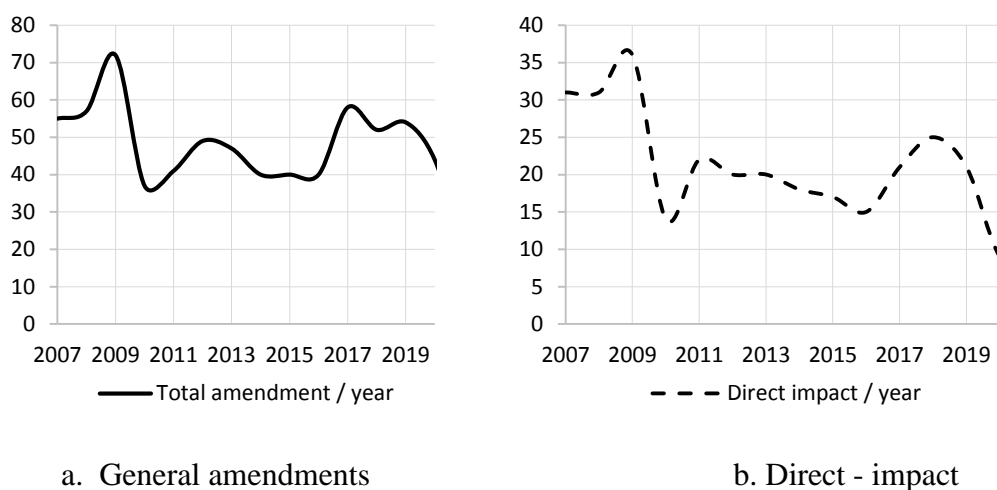


Figure 1: Amendments of legal acts related to agricultural lands

From Fig. 1 a. it can be seen that the total number of changes in the period (2007-apr.2021) related to agricultural land sum up to 705. Analysing the acts with direct effect on the agricultural lands (Fig. 1 b) it becomes clear that the former have been changed 308 times.

An institutional analysis presents this "segment" of legislation as the most dynamically changing part of Bulgarian law.

The diffusion of new policies affecting agricultural land should affect every legal act. The changes are lagislative acts fading. Questions are asked about the role of change and whether food sovereignty is introduced in the country with its help.

4. IS BULGARIAN LEGISLATION ON AGRICULTURAL LAND VIOLATING THE EU LAW?

According to Annex VI, No.3 to Article 23 of its Accession Treaty to the EU, Bulgaria had a five-year period for harmonization of its national legislation on the acquisition of

agricultural land. Due to the direct effect of the provision of Art. 4, para. 5 of the Constitution of Bulgaria (CRB) as well as the "principle of supremacy" of EU law, a contradiction of Bulgarian legal acts with the founding Treaties of the EU was inadmissible.

Bulgaria could not continue to restrict the acquisition of its agricultural land. However, referring to the FAO basic document (2012) on agricultural land, the country's Parliament decided to extend the restriction on the purchase of land by foreign nationals. Thereafter however, the Constitutional Court of Bulgaria (CCB) ruled that such a decision contradicted the CRB^{**}. In response, the legislator made a change in Art. 3 to 4c of the Agricultural land ownership and use Act (ALOUA), which introduced new restrictions, but with a different philosophy. The acquisition was possible, but only after a residency period of the buyer in the country. Individuals and legal entities as potential buyers of agricultural land had to prove the origin of their capital.

In 2015, the EC reviewed the compliance of Bulgarian legislation on the acquisition of agricultural land^{††} with the EU Acquis. According to an extract from the infringement database of the European Commission dated January 2, 2021 there is a pending infringement case against Bulgaria for violation of Art. 258 TFEU.

The exchange of official correspondence shows that the EC was concerned about the Bulgarian requirement for a long-term residency of potential buyers interested in investing in agricultural land in Bulgaria as a primary source for feed/food production. Although this requirement had not only to be fulfilled by non Bulgarian investors but also by Bulgarian nationals the EC assumed that both groups were not able to effectively exercise their rights and were violated working in Bulgaria. Both groups which are not in the position to proof the required longterm residency were considered to be discriminated and disadvantaged according to the EC's opinion.

After the infringement process had started a year earlier, the EC sent a reasoned opinion to Bulgaria^{‡‡} on 27.05.2016, in order to follow up the situation of the legal dispute. Being in charge of the process the Ministry of Agriculture and Food (MAF) of Bulgaria presented arguments to the EC, which had been established on the case by an interdepartmental working group analyzing the corresponding legislative framework of Bulgaria at that time.

This group concluded that it was necessary to amend the ALOUA by deleting its Article 3c. However, this would have had a strong socio-economic impact on the Bulgarian society. Thus, Bulgaria's first plan was to amend the law on Agricultural Land, which provided for the deletion of Article 3c. Envisaged by December 1, 2016. the draft for this amendment should have been ready, although the necessary parliamentary procedures and deadlines for this were not specified. Also MAF did not commit itself to precise the specific deadlines for its adoption and entry into force.

In parallel, the EC published a guideline on restrictions regarding the acquisition of agricultural land in October 2017 (Table 1, column IV below), thus explaining in a new context the objectives layed down by Art. 39 of the TFEU following up a corresponding Resolution of the European Parliament (EP) of April 2017 (see table 1, column III below). The EC pointed out as well what should be the incentives for reduction of concentration of agricultural land and how countries could regulate their agricultural land markets, related goods and labor markets in line with EU law.

^{**} Case of the Constitutional Court № 22 of 2013, Decision № 1 of the Court on 28.01.2014 (SG, issue N 10 of 4.02.2014, p. 2)

^{††} EC website: Infringement procedure against Bulgaria - General Directorate Financial Stability, Financial Services and Union of Capital Markets - "Acquisition of Agricultural Land". <https://tinyurl.com/5bsz3pvm>

^{‡‡} EC 27.03.2015 Request No 6810/14/MARK through EU Pilot System of the Commission and EC SG - Greffe (2016)D/6952 and attachment 2015/2018 – C(2016) 3061 final.

5. EU AND THE CONCENTRATION OF AGRICULTURAL LAND

As early as 2014, the European Economic and Social Committee (ECOSOC) drafted an opinion on “Land grabbing – a wake up call for Europe and an imminent threat to family farming” (2015 / C 242/03) published in January 2015, suggesting amongst others that the EU Member States should have certain rights to restrict access to farmland such as setting upper limits for the acquisition, a system of preemptive rights or official authorisation procedures.

In this context, ECOSOC also referred to Bulgaria's decision to extend the Moratorium of its EU Accession Treaty regarding the acquisition of farmland up to 2020, seeing this decision as an anticipation of direct threats to farmland (ECOSOC: 2015/C 242/03). One month later in February 2015, numerous national and international organizations as well as EU citizens submitted a petition on "Preserving and managing European farmland as our common wealth: A CSO call for sustainable and fair EU governance of farmland "to the EP (Petition No. 187/2015).

In May 2015, the EP published a study on the "Extent of farmland grabbing in the EU", which was critically analyzed by the Directorate-General for Agriculture and Rural Development of the EC in September 2015^{§§}. Meanwhile, the EC "had threatened" also 5 other countries: Hungary, Slovakia, Lithuania, Latvia and Poland with possible lawsuits before the Court of Justice for non-compliance with Community law as regards their national legal restrictions on acquisition of farmland in their countries.

Making an assessment of the difficulties that farmers have in accessing agricultural land and referring to all of the opinions and petitions presented the EP adopted a Resolution in April 2017. Titled “On the state of play of farmland concentration in the EU: how to facilitate the access to land for farmers”^{***} the EP Resolution described the magnitude of the farmland concentration in the EU and concluded that Member States have both, exclusive and shared competences for rules on access to agricultural land. The Member States were called upon maintaining a family-based agricultural model, but also to focus their domestic land use policies by improving the available taxation instruments, support schemes and financing through CAP-derived. Calls were also made on the EC to publish a clear set of criteria for measures to regulate the land market, as well as for restrictions which are relevant for the public interest and in line with the EU Acquis, in particular respecting the four freedoms of the EU.

6. THE EC'S GUIDANCE ON CONDITIONS FOR THE ACQUISITION OF THE AGRICULTURAL LAND IN COMPLIANCE WITH THE EU ACQUIS

On the request of the EP in October 2017, the EC has issued guidelines^{†††} on the acquisition of agricultural land in the context of EU law and the case law of the Court of Justice.

^{§§} European Commission, Directorate for Agriculture and Rural Development, Brussels, 28.09.2015, DDG2.E.1/RR/NBA(2015) 418012-Ref.ARES (2015) 3989524 on the study initiated by the European Parliament on “The extent of farmland grabbing in the EU” (IP/B/Agri/IC/2014-069)

^{***} European Parliament Resolution of 27 April 2017 on the state of play of farmland concentration in the EU: how to facilitate the access to land for farmers (2016/2141(INI)).

^{†††} Commission Interpretative Communication on the Acquisition of Farmland and European Union Law (2017/C 350/05) Official Journal of the European Union, 18.10.2017.

Contrary to the previous doctrine that agricultural land does not fall within the scope of EU law due to the lack of regulations in secondary law, the EC concluded that the acquisition of agricultural land is part of Community law. In particular, agricultural land is subject to fundamental freedoms for the movement of capital. It is a kind of absolute right and established in the founding treaties and the rules of the internal markets. The Commission acknowledged that the specific nature of agricultural land regulations is covered by EU primary law, which in turn determines the link to possible restrictions on investment in agricultural land.

The proportional protection of the public interest is linked to the prevention of land speculation on one hand and the preservation of agricultural communities on the other, as well as the maintenance of developed, viable agriculture. The latter however, is impossible without a guarantee of foreign investment in agricultural land. In the interpretative document, the EC addressed all aspects of the functional consequences following restrictions on land acquisition. Part I justified the need for a European legal act to address the allocation of this important resource at the EU institution level in relation to concentrations and land grabbing. In Part II the EC analyzes the applicable law. Part III presented the approach of the Court of Justice concerning the interpretation of the legislative framework related to agricultural land. In Part IV the specific interpretations were formulated as a hypotheses which shows how the rules should be applied and how far the restrictions on land acquisition should be extended. In Part V the tools for acquiring agricultural land were set.

The EC concluded that the objectives of the CAP cannot justify restrictions on fundamental rights and freedoms. Restrictive measures may be imposed only if they are proportionate. A balance between interests is mandatory, and agricultural land rules cannot be a precondition for direct or indirect discrimination. At the same time the EC did not justify direct measures to protect the productive interests of small farmers and their families as regards access to farmland. Thus, it could be assumed that a balance in support of the policy framework/doctrine on food sovereignty was not achieved.

7. DRAFTS FOR LEGISLATIVE CHANGE – NATIONAL LEGISLATIVE ACTS

Draft Law deleting Article 3 c of the ALOUA / 2017.

Following step two of the infringement procedure against Bulgaria by the EC in 2016, the Bulgarian Ministry of Agriculture and Food tabled a draft law on amending Article 3c to the Council of Ministers for public consultation on the 12th July 2017. After the deadline of this procedure it seems that this MAF initiative has gone nowhere, because the draft text got many negative comments and was not supported by the majority of the Bulgarian Parliament, the National Assembly (NA) .

The NA tasked the Ministry of Agriculture and Food with presenting a report containing an analysis of the normative regulation of public relations in land use and a Strategy for land management and development by 31 December 2017 (MAFF Bulgaria, 2017). MAF should present a draft of a unified legal framework governing land relations related to land use within the next 10 months. This period has been extended twice - once until 28 February 2019 and a second time until 31 December 2019.

A legislative draft for amending ALOUA / 17.12.2018.

After a debate in the National Assembly, it was decided to expand the scope of the bill on agricultural land to include: ownership, rental relations and rent. It was stated that the Law on Land Acquisition and the its corresponding Regulations have been amended and

supplemented many times, due to which the whole legal framework has lost its sacred systematic and substantive and procedural legal norms were mixed. Numerous changes have made the framework fragmented and inconsistent, and the "insertion" of really important issues into the Rules of Procedure has made them unbalanced and ill-founded. Another part of the provisions of the Act could not exercise their legal effect or had completely lost their applicability due to a new reorganization of public relations after 1989 and during the Transition period. Restitution as an institution has been played out and at present should not be subject to current legislation in the field of land relations. Of course, the matter of restitution cannot be completely excluded, but it should be put in a separate normative act. This act may continue to be the ALOUA. A specific new act should be drawn up for the remaining "urgent issues".

On December 17, 2018, the Council of Ministers published on its website for public consultation until January 16, 2019, a new Draft Decision on the adoption of a draft Law on Property right, Land Relations and Protection of Agricultural Land. The reasons given for this draft law stated that it refers only to the permanently regulated relations. For those which do not meet this criterion a legal delegation was envisaged through by-laws according to the Law on Normative Acts (LNA).

The original approach of unifying the Regulation on the use and protection of agricultural lands had been kept. The main argument was that the provisions of the ALOUA and the Law for protection of agricultural land (LPAL) were amalgamated, because the regulated the public relations arising from the same subject "agricultural land". The project provided new legitimate definitions of basic concepts, such as: "use of agricultural lands " and "land relations".

Draft for a new legal framework on land relations/5. 11. 2019.

On November 5, 2019, a new Draft Law on Agricultural Land was published on the portal for public consultations of the Council of Ministers. In synchrony with the texts of Articles 19 (2), 20 and 21 of the CRB it was argued that the provisions of the bill consider agricultural land as a "national treasure". The envisaged financial restrictions for companies⁺⁺⁺ as regards the origin of their capital remain. The ideas of the new CAP (2021-2027) for change in agriculture were incorporated through four types of land use measures: (1) user protection; (2) protection of the owner - user; (3) assisting the owner, but with the aim of preventing the fragmentation of agricultural land (4); assistance to the owner - for environmental purposes.

The project continued with the idea of merging the two laws: the ALOUA and LPAL. The transitional and final provisions of the draft also foresaw the repeal of Art. 3c of the ALOUA. According to MAFF this new draft was in line with the Property Act (PA) and resolved the issue of EC infringement procedure against the Bulgaria. Another key tool foreseen was the instrument of voluntary land consolidation for which the administrative approach was laid in detail. However questions were raised whether this tool would lead to success of land consolidation as regards the effect on private property and on surviving/ disadvantaged possibilities for smaller entities in this context. The balance between the different interests in the management and distribution of farmland from the State and Municipal Land Fund, as well as still some remaining land from former agricultural cooperatives had not been found yet. There is a lack of proportionality of the registered transfer acts regarding the use of agricultural land under the EU direct payment scheme compared with others regulating the ecological balance. The bill has received much criticism^{§§§}.

⁺⁺⁺ Law on Economic and Financial Relations for companies registered in jurisdictions with preferential taxes treatment, the persons controlled by them and their beneficial owners.

^{§§§} Critique of the legal act by: the Bulgarian Association of the Owners of Agricultural Land (BAOAL), National Rural Network (NRN), agricultural producers, scientists and others.

However, as this draft Single Act on Agricultural Land could yet not reflect the rules of the forthcoming CAP 2021-2027 according to the opinion of the Agriculture Committee of the NA expressed on the 6th Dec. 2019, the view was to postpone the parliamentary debate in the NA of Bulgaria and await another new draft.

Table 1: Synopsis of possible restrictions

Nº	General list of possible restrictions	EP Resolution Apr. 2017 Calls on	EC Guidelines Oct. 2017	BG Draft Nov. 2019
I	II	III	IV	V
1	Requirement on Residence/residence period (RR/RP) in the country for non-national EU buyer	Maintaining a family-farm-based agricultural model with diverse residence based on agricultural structure with traditions (5, W)	RR/RP is incompatible with freedom of free capital movement and right of establishment (4f)	RR will be repealed (§ 38 of the Transitional and Final Provisions)
2	Prior authorisation (PA)	Farmland transactions to be subject to an ex-ante procedure for checking conformity with national land legislation (21) and State licensing of sales and leases (22)	Schemes involving PA could be acceptable under some circumstances (4a)	PA is not foreseen except for land in possession of the State or Municipality
3	Pre-emption rights (PR)	Priority in purchase of land for SM local producers, new entrants, young farmers including pre-emptive rights (12) and use of this instrument to regulate the land market (22)	PR could be considered as proportionate restriction being less restrictive than prohibition of acquisition (4b)	PR are not foreseen
4	Price controls (PC)	Permit access to land ownership/tenure under financial conditions appropriate to farming (21) and indexation of prices with preference to farm incomes (22) and use tax legislation to avoid speculative land transactions (24)	PC could be justifiable to prevent excessive land speculations (4c)	PC are not foreseen
5	Self-farming obligation (SO)	Use obligations for tenants to engage in farming and preference for farmers (22)	SO is disproportionate because less restrictive conditions could be applied (4d)	SO is not foreseen
6	Qualifications of the acquirer as farmer himself (QA)	---	QA not justifiable because farmer is not a regulated profession and proper cultivation of land could be achieved by less restrictive conditions (4e)	QA are not required
7	Prohibition on sales to legal persons (PS)	Use restrictions on the right of purchase of farmland by legal persons (22)	PS is not justifiable proper cultivation of land could be achieved by less restrictive conditions (4g)	PS are not foreseen
8	Acquisition caps (AC)	Use ceilings on the number of hectares that may be bought (22)	AC could be suitable and compliant with EU law and rights to prevent excessive land ownership concentration to support family farming and medium-sized farms provided each case is justified in the national, factual and legal context (4h)	AC are not anymore in place
9	Privileges in favour of local acquirers (PLA)	Involve local communities on decisions on land use (18) and Regulate sales, use and lease of agricultural land in coordination with local authorities and farmers' organisations (37)	PLA and other privileges for local buyers have to pursue legitimate objectives in the public interest reflecting socio-economic aspects (addressing land fragmentation, viable farms at local level, permanent agricultural community), otherwise they are not justified (4i)	PLA are not foreseen
10	Condition of reciprocity (CR)	---	CR is incompatible with EU law (4j)	CR are not foreseen
11	Other tools	Create a legal framework to tackle the problems of small-scale family farms and a broad distribution of land ownership (14). Use of taxation, aid schemes, CAP funding to maintain family-farm-based agricultural model (5) and proper instruments for new entrants and young farmers facilitating	See measures 1-10 above by which the Member States could combine those, which are - compatible with the EU law, - proportionate to reach the objectives and - justifiable in each case to achieve the goals of the policy.	Acquirer can't change the purpose of the land for seven years after the acquisition (Art.5 (1))

		their entry into farming by ensuring fair access to sustainable credits (17)		
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Note: The figures in brackets refer to the paragraphs in the analyzed original documents

Table 1 below shows a comparative analysis of the restrictions on the acquisition of farmland being the primary factor for the production of food. If legally possible restrictions are well chosen by a national legislator they could not only guarantee food security but also national food sovereignty. In case of Bulgaria as EU Member State the EU food sovereignty would be supported. At present however, no evidence could be found in the Bulgarian drafts reconciling the relationship between restrictions on access to agricultural land supporting the policy framework/doctrin on food sovereignty and bioeconomy (Tab. 1, col. V). In early 2021, after the decline in agricultural production accelerated by the “Covid-19 crisis”, Bulgaria needs legal changes, including food sovereignty.

8. CONCLUSIONS

A). The EC released in 2020 its new “Farm to Fork Strategy” for a fair, healthy and environmentally-friendly food system. The management and access to farmland plays a key role for the realisation of this strategy safeguarding food safety and security. In addition with the recently adopted policy of the EU called “Open Strategic Autonomy (18th February 2021)” the EU could also develop a longer term vision on an EU policy framework regarding food sovereignty. Every producer must have access to agricultural land, which will allow him to produce enough food to feed himself and his family. At the same time, the rules must help to maintain sustainability as a production and social / organisational unit.

B). The political challenge is to preserve the rights related to economic freedoms concerning the distribution of market and investment opportunities for all groups of economic players, which are directly dependent on the distribution of resources such as agricultural land. For the EU the EC has provided guidelines on the restrictions to the access of farmland which are compliant with the EU Acquis and which could support the doctrine on food sovereignty at the time.

C). Legal change (de lege farendam) must respect an absolute right related to free movement and the right of people to be able to produce their own food. The use of any property right should take into account the opposing interests. Advantages in terms of access to agricultural land should take into account the opposite needs of groups of people arising not only from their rights but also from their food needs. The opposite would mean reversing the meaning of the notion of public interest. The proposed changes to the idea of a new “bioeconomy” in the EU do not take into account the risks arising from the integration of organizations and resources in relation to the possibility of harming the viability of small agricultural units with specific adaptation. The Bulgarian legal framework is also linked to the formal “legal subordination” of international law. When adopting any new Bulgarian legal act in agriculture, the “impact assessment” according to Art. 28 para. 2, item 5 of the LNA should take into account the forthcoming changes in legal measures of the EU secondary law referring to rural support, direct funding, competition, organisation of agricultural producers, environmental format of the CAP for the period (2021-2027) and the balance between the doctrines/strategies on food safety, security, bioeconomics and food sovereignty. Despite the “systemic” nature, the current legislative framework creates a clear hierarchy between sources of law. A new codification in Bulgaria would make sense when, as a result, legal certainty

increases and the balance between disparate legal interests does not pose problems of a social or political nature.

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THE COMPARATIVE ANALYSIS OF HEALTH SAFETY ACROSS SEE COUNTRIES IN PANDEMIC CONDITIONS USING THE GHS INDEX

Marija Panić, Aleksandra Fedajev*

University of Belgrade, Technical faculty in Bor, Engineering Management Department, Bor, Serbia

Abstract: The COVID-19 pandemic has dramatically impacted the countries worldwide and caused not just health, but also economic and social crises. In many countries, due to health threats, governments have intervened by restricting basic human rights. Namely, to deal with the emerging problems, they have implemented quarantine measures and closed their borders. As a result of such measures, the economies have experienced a crisis whose effects many economists compare to the Great recession of the XX century. Taking widespread effects of the pandemic crisis, in this paper, the comparative analysis of health safety in 10 South Eastern European (SEE) countries was performed using the PROMETHEE II method in combination with the entropy method based on six dimensions of health security that is used for calculation of GHS index. Usage of such approach enabled assessment of the differences in health security across these countries and identification of countries with favorable conditions in this respect and those faced with serious problems in obtaining a sufficient level of healthy security during the COVID-19 pandemic.

Keywords: health security, pandemic, GHS index, SEE countries, multi-criteria analysis.

1. INTRODUCTION

For centuries, humanity has struggled with various and numerous epidemics that have not only affected human lives, but also the economy and the state. The outbreak of a COVID-19 pandemic has been one of the greatest global health threats of the XXI century. This pandemic has significantly affected health systems in all countries worldwide (WHO, 2020). The globalization process, which has been intensified during the last two decades, has led to the speed spreading of the virus and, thus, posed a serious risk to global health. Therefore, countries must be able to immediately recognize and respond to such public health emergencies (Coronavirus Resource Center, 2019).

The pandemic is the newest challenge for all nations, most of them eager to learn from countries that are successful against the virus (Gomes da Silva, 2020). In managing the COVID-19 pandemic, several compelling narratives seem to have played a significant role in the decision-making processes regarding which risk mitigation and management measures to implement. Many countries were unprepared for such a situation, even though predictions about a significant probability for a pandemic to occur existed, which resulted in many inconsistencies in the disaster risk reduction processes (Ekenberg et al., 2021).

* Corresponding author: afedajev@tfbor.bg.ac.rs

Very detailed medical studies on COVID-19 were done, and government efforts to deal with the disease (del Rio & Malani, 2020; Gostin et al., 2020; Hoopman et al., 2020; Merchant & Lurie, 2020). Besides that, a lot of studies on the risk management of COVID-19 were performed from a non-medical perspective (McAleer, 2020; Yang et al., 2020). Despite the volume of research on the health, medical, economic, financial, and political aspects of COVID-19, it is essential to enquire if an outbreak of the epidemic, which was classified as a global pandemic by the WHO in 2020, might have been anticipated, given the well-documented history of SARS and MERS (WHO, 2020; Chang & McAleer, 2020).

In order to boost considerable changes in national health security and improve the international capacity to address increased global health risks, like the outbreak of infectious diseases, the Nuclear Threat Initiative, Johns Hopkins University Center for Health Safety and Economist Intelligence Unit developed Global Health Security (GHS) index (Ravi et al., 2020). This index covers 195 countries that were involved in defining international health regulations (2005) and it represents a tool for measuring national capacities for prevention, detection, and capability of countries to respond to natural phenomena, based on 140 questions, related to the existence of functional, tested, proven capabilities to stop sources of threats at the outset. These issues are grouped into six categories: a) prevention, b) detection and reporting, c) rapid response, d) health system, e) compliance with international standards and f) risk environment (GHS, 2019; McAleer, 2020). If various issues directly related to health security risks could have been predicted accurately, public health and medical contingency plans might have been prepared and activated in advance of an epidemic such as COVID-19. Therefore, it is possible to evaluate how countries might have been prepared for a global epidemic or pandemic and acted accordingly in an effective and timely manner (Chang & McAleer, 2020).

The GHS index has been widely applied to identify areas of weakness and opportunities to collaborate across sectors, strengthen health systems, and achieve public health goals. The GHS Index framework is the first comprehensive assessment tool that evaluates a country's capacity to prevent, detect, and respond to public health emergencies. In addition, the GHS Index considers national political and socioeconomic risks and adherence to international norms, which can influence a country's ability to stop outbreaks (Ji et al., 2021). Health systems can be defined as comprising all the resources, organizations, and institutions, which produce interdependent actions aimed principally at improving, maintaining, or restoring health. Health system responsiveness displays the strength and preparedness of nations to prevent, protect against, respond to, recover from health emergencies, help them cope, and not be overwhelmed by the sudden and disproportionate increase in the demand of health facilities (Neogi & Pretha, 2020).

The ongoing COVID-19 pandemic has devastated many countries with ripple effects felt in various sectors of the global economy. In November 2019, the GHS Index was released as the first detailed assessment and benchmarking of 195 countries to prevent, detect, and respond to infectious disease threats. Abbey et al. (2020) try to do the first comparison of Organization for Economic Cooperation and Development OECD countries' performance during the pandemic, with the pre-COVID-19 pandemic preparedness as determined by the GHS Index.

Taking into account that GHS index data obtain a good basis for analysis of health safety, this database served as a starting point for this research. The aim of this paper is to perform a comparative analysis of health safety in SEE countries using the PROMETHEE and entropy method. The lack of staff and medical equipment and poor crisis management in the majority of these countries led to severe challenges for health systems. In order to keep the pandemic under control, there have been massive locking and social distancing measures,

causing significant financial losses to individuals, companies, and governments threatening a recession in these countries (Nicola et al., 2020).

2. FISCAL MEASURE RESPONSES OF SEE COUNTRIES

Fiscal support measures have different implications for public finances in the near term and beyond the COVID-19 pandemic (Li & Liang, 2021). A lot of papers examined the determinants of fiscal policies during the COVID-19 pandemic (Benmelech & Tzur-Ilan, 2020; Bredemeier et al., 2020; Faria-e-Castro, 2020; Kaplan et al., 2020; Siddik, 2020). In order to overcome the pandemic crisis, most SEE countries invested a significant amount of budgetary finances to support the economy, as well as the health sector. Table 1 enables the assessment of financial support in each considered country.

Table 1. Fiscal support to the economy and health sector in SEE countries during the COVID-19 pandemic

Countries	USD Billion			% of GDP		
	Above the line measures			Above the line measures		
	Additional spending or foregone revenues			Additional spending or foregone revenues		
	Subtotal	Health sector	Non-health sector	Subtotal	Health sector	Non-health sector
Greece	25.34	1.06	24.28	13.73	0.58	13.15
Slovenia	3.82	0.46	3.37	7.24	0.86	6.37
Albania	0.31	0.13	0.15	2.03	0.86	0.99
Bosnia and Herzegovina	0.48	0.13	0.36	2.50	0.66	1.84
Bulgaria	3.08	0.91	2.16	4.49	1.33	3.16
Croatia	3.01	0.17	2.84	1.50	0.30	1.20
Montenegro, Rep. of	0.12	0.03	0.09	2.47	0.60	1.87
North Macedonia	0.47	0.02	0.45	3.81	0.16	3.65
Romania	5.42	2.54	2.87	2.19	1.03	1.16
Serbia	2.99	0.71	2.28	5.64	1.34	4.30

Source: IMF, Fiscal monitor, published on March 27, 2021, <https://www.imf.org/en/Topics/imf-and-covid19/Fiscal-Policies-Database-in-Response-to-COVID-19>

The data presented in Table 1 indicate that Greece has invested the largest amount of financial assets in absolute (25.34 billion USD) and relative terms (13.73%). However, most of these assets were invested in supporting the economy, while only 4.2% of the total amount or 0.58% of GDP was invested in the health sector. Romania invested almost 5 times less sum, but it was the country with the highest amount of money invested in the health sector if the absolute amount was considered. This country invested even 2.54 billion USD in risk bonuses for the medical and social assistance staff, emergency spending on health programs, purchases of medical and protective equipment, sick leaves, and financial support to quarantine centers. This country also supported the health sector by capping the fee on medicine sales and suspending VAT for medical imports. If the fiscal support is presented as a share of GDP, then Serbia is a country with the greatest support to the health sector. Even 1.34% of GDP in this country was invested in the 10 percent wage increase for the public healthcare sector and healthcare spending (IMF, 2021).

The somewhat lower relative amount of financial support but still high in relation to other countries is recorded in Bulgaria. The Bulgarian government invested 0.91 billion USD or 1.33% of GDP in form of purchase of vaccines and medicines, support of personnel on the frontline of the fight with COVID-19, additional financing of medical activities, provision of PPA and other equipment to the medical establishments, and state administration, subsidies and capital transfers to medical establishments, health expenditures in education, and remuneration in healthcare. The remaining amount of support is expressed in the form of foregone revenues, like exemption from VAT and customs duties of import of key medical supplies. On the other hand, the country with the lowest relative amount of financial support is North Macedonia (0.16% of GDP) in the form of abolishing the import duty on medical supplies (IMF, 2021).

Hosny (2021) argue that the amount and design of the COVID-19 fiscal response are to a great extent result of initial conditions. They emphasized that fiscal packages were greater for higher-income economies, especially below-the-line measures, while lower-income economies spent more on health given their weaker initial health infrastructure and readiness to respond. Other health-related variables, such as cases per population and the share of the elderly population, have a significant impact on the health fiscal response. So, the evaluation of initial conditions in this paper was performed by usage of GHS index data.

3. DATA AND METHODOLOGY

The evaluation of health safety across SEE countries (Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Greece, Montenegro, North Macedonia, Serbia, Slovenia, and Romania) is based on the scores related to different index categories: (a) prevention, (b) detection and reporting, (c) rapid response, (d) health system, (e) compliance with international standards, and (f) environment which are considered in the calculation of the overall GHS index for 2019. The data is collected from the official GHS index website (GHS, 2019). The collected data was used for ranking of observed countries using the combination of the PROMETHEE method and entropy method. The aim of using this methodology is to evaluate the readiness of each country to respond to the impact of a pandemic.

3.1. PROMETHEE METHOD

The PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluation) method has been developed by Brans (1982) and it was further improved by Brans & Vincke (1985). It is one of the most commonly used multi-criteria methods. The aim of this method is to rank a final set of alternatives (in this case, SEE countries) based on a number of criteria that need to be maximized or minimized. In order to perform ranking, this method calculates the value of each alternative expressed in the level of preferences.

The PROMETHEE method requires the definition of certain parameters for each criterion (Brans & Vincke, 1985; Brans & Mareschal, 2005):

1. the direction of preference, which implies whether certain criteria should be minimized or maximized,
2. weight coefficients, which indicate the importance of each criterion,
3. the preference function, which converts the difference between two alternatives at the preference level (Linear, Usual, Level, V-shape, U-shape, and Gaussian),
4. the preference threshold (p), which represents the minimum deviation that a decision-maker considers as important for decision-making;

5. the indifference threshold (q), which represents the maximum deviation that a decision-maker considers as irrelevant for decision-making;
6. the s threshold, which represents the value between q and p , is used for the Gaussian preference function.

After the definition of these parameters, the PROMETHEE method can be applied. The application of this method includes the following steps:

Step 1. The calculation of deviation based on comparison of a pair of alternatives for the j criteria

$$d_j(a, b) = g_j(a) - g_j(b) \quad (1)$$

where $d_j(a, b)$ represents the advantage of the alternatives a and b according to each criterion.

Step 2. The application of chosen preference function

$$P_j(a, b) = F_j[d_j(a, b)] \quad (2)$$

where $P_j(a, b)$ represents the preference of the alternative a in comparison with the alternative b according to all of the observed criteria as a function of $d_j(a, b)$.

Step 3. Calculation of the preference index $\pi(a, b)$, which represents the intensity of preference of alternative a in relation to alternative b .

$$\pi(a, b) = \sum_{j=1}^n w_j * p_j(a, b) : \left(\sum_{j=1}^n w_j = 1 \right) \quad (3)$$

Step 4. Calculation of positive and negative preference flows for each alternative:

* positive preference flow:

$$\varphi^+(a) = \frac{1}{m-1} \sum_{x \in A} \pi(a, x) \quad (4)$$

*negative preference flow:

$$\varphi^-(a) = \frac{1}{m-1} \sum_{x \in A} \pi(x, a) \quad (5)$$

Step 5. The calculation of a net preference flow, based on calculated positive and negative preference flows.

$$\varphi(a) = \varphi^+(a) - \varphi^-(a) \quad (6)$$

Taking into account that the application of the PROMETHEE method includes the definition of weight coefficients for each criterion, the entropy method is used for their calculation.

3.2. ENTROPY METHOD

The weight coefficients can be defined subjectively and objectively, according to the aim and type of research problem. The objective methods have an advantage over the subjective, which is reflected in the fact that they eliminate the influence of the human factor on the assigned weight, which ensures greater objectivity of research (Zhu et al., 2020). One

of the most commonly used methods for the objective definition of weights is the entropy method. This method is applied in several steps:

Step 1. A data normalization, based on the defined decision table:

$$p_{ij} = \frac{x_{ij}}{\sum_{i=1}^m x_{ij}}, i = 1 \dots m; j = 1 \dots n \quad (7)$$

Step 2. The calculation of the entropy value for each criterion k_j :

$$H_j = -k * \sum_{i=1}^m p_{ij} * \ln p_{ij}, i = 1 \dots m, j = 1 \dots n \quad (8)$$

where k is:

$$k = \frac{1}{\ln(m)} \quad (9)$$

Step 3: The calculation of the degree of divergence:

$$dj = 1 - H_j, j = 1 \dots n \quad (10)$$

Step 4: The determination of entropy weight:

$$wj = \frac{dj}{\sum_{j=1}^n dj}, j = 1 \dots n \quad (11)$$

After the calculation of weights, using the entropy method, there are all necessary input data for the application of the PROMETHEE method. In this paper, Visual PROMETHEE software was used for the application of the PROMETHEE method.

3.3. THE MULTI-CRITERIA MODEL FORMULATION

The application of the PROMETHEE method using the Visual PROMETHEE software requires the definition of an evaluation matrix for importing the data. Besides data on considered criteria, the parameters of multi-criteria analysis should be defined. The parameters for this research problem are presented in Table 2.

Table 2. The multi-criteria analysis parameters

Parameters	PREV	DETECREP	RAPRESP	HESYS	COMP	ENVIR
Direction of preference	max	max	max	max	max	max
Weight coefficient	0.1376	0.1723	0.1811	0.1761	0.1598	0.1728
Preference function	V-shape	V-shape	V-shape	V-shape	V-shape	V-shape
P	9.60	14.36	12.46	9.43	8.79	6.48

Source: Authors' calculations

The first parameter is the direction of preference. As it can be seen from Table 2, all observed criteria should be maximized. The presented weights are those calculated by the entropy method. Considering that this method gives higher importance to criteria where differences among alternatives are higher, it could be concluded that analyzed countries differ mostly according to their ability to respond rapidly to the health crisis. It should be mentioned that differences regarding detection and reporting, health system quality, and environment are also high. On the other hand, the lowest differences are recorded for prevention measures. To all observed criteria, the V-shape preference function is assigned with a preference threshold equal to the standard deviation for each criterion. It means that if the difference between two alternatives is higher than the standard deviation, the maximal value of the preference function (amounting to 1) is assigned to a better alternative.

4. RANKING RESULTS AND DISCUSSION

The definition of multi-criteria analysis parameters enabled the application of the PROMETHEE method, using the Visual PROMETHEE software. Table 3 shows the ranking results for observed countries.

Table 3. Ranking of considered SEE countries

Country	Φ^+	Φ^-	Φ	Rank
Slovenia	0,9114	0,0106	0,9008	1
Croatia	0,5042	0,2484	0,2558	2
Serbia	0,4430	0,2780	0,1650	3
Greece	0,4144	0,2865	0,1279	4
Albania	0,3798	0,3158	0,0640	5
Bulgaria	0,3858	0,4308	-0,0450	6
Romania	0,3092	0,3794	-0,0701	7
Montenegro	0,1912	0,5295	-0,3384	8
Bosnia and Herzegovina	0,1611	0,6175	-0,4563	9
North Macedonia	0,0651	0,6688	-0,6037	10

Source: Authors' calculation.

According to the results presented in Table 3, it can be concluded that the best-ranked country is Slovenia, followed by Croatia, Serbia, Greece, Albania, Bulgaria, Romania, Montenegro, Bosnia and Herzegovina, and North Macedonia. The five top-ranked countries have a positive net preference flow, indicating that the advantages of these countries are greater than the disadvantages while the remaining countries have considerable limitations that are overcoming their positive sides. In order to explain obtained ranking results, they are presented in Figure 1 in the form of the so-called "PROMETHEE rainbow diagram".

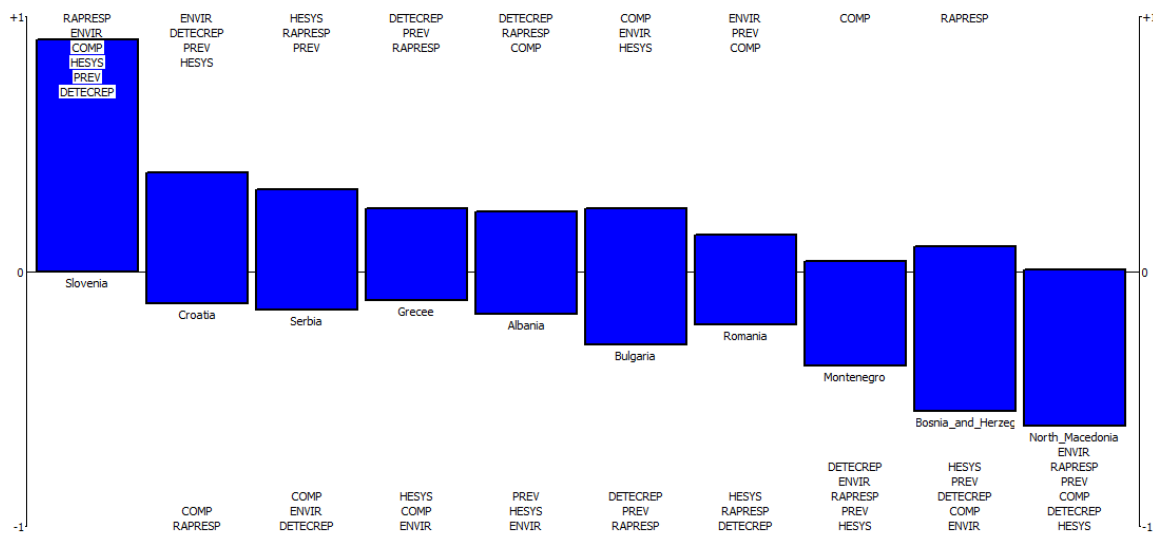


Figure 1. PROMETHEE rainbow diagram

The rainbow diagram shows countries in the form of histograms in the order in which they are ranked with their advantages (above histograms) and disadvantages (below histograms). It is evident from Figure 1 that Slovenia, as the best-ranked country, doesn't have any disadvantage in comparison to other considered countries. Croatia has two disadvantages and they are related to compliance and rapid response to a health crisis. Serbia, as a third-ranked country, has three disadvantages (compliance, environment and detect and report). The next ranked countries, namely Greece, Albania, Bulgaria, and Romania) has the same number of disadvantages, but they have a worse position in comparison to Serbia, due to the fact that their advantages are not so pronounced, while their limitations are much more pronounced. Montenegro and Bosnia and Herzegovina have more disadvantages than advantages, resulting in the poor ranking of these countries. On the other hand, North Macedonia does not have any advantages in relation to other observed countries and this is why this country is bottom-ranked.

5. CONCLUSION

The Covid-19 pandemic is one of the greatest challenges worldwide. The efficiency and resilience of health systems have received considerable attention since the pandemic emerged. This paper contributes to the body of knowledge on health safety during a pandemic crisis. The obtained results indicated that Slovenia has the highest level of health safety and it was followed by Croatia, Serbia, Greece, and Albania, which have positive preference flow or, in other words, have more pronounced advantages than disadvantages of their health systems. The countries with a negative value of preference flow are Bulgaria, Romania, Montenegro, Bosnia and Herzegovina, and, at the very bottom North Macedonia. These countries should improve the efficiency of their health systems to obtain an efficient and prompt response to this and eventual future health crises.

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ANALYSIS OF FINANCIAL MANAGEMENT PRACTICES DURING THE COVID-19 PANDEMIC CRISIS IN SEE ECONOMIES: THE EVIDENCE FROM THE WORLD BANK'S ENTERPRISE SURVEYS

Aleksandra Fedajev*, Sanela Arsić

*University of Belgrade, Technical Faculty in Bor, Engineering Management Department,
Bor, Serbia*

Abstract: The COVID-19 pandemic has severely hit all economies worldwide, especially South-Eastern European economies (SEE economies). The most significant drop in economic activity since the Great Depression is the result of its intensity (massive economic downturn), comprehensiveness (it affected all EU economies) and dynamics (a few million jobs have been temporarily or permanently closed). Considering pandemic crisis impact and the fact that its end is not yet in sight, it is important to analyse its effects. Hence, in this paper, the business practices of 1939 companies from five SEE economies has been evaluated (Serbia, Bulgaria, Romania, Croatia, Slovenia), based on the data collected within World Bank's Enterprise Surveys. The aim of paper is to investigate the development of corporate finance strategies of companies in observed countries and the state's role in the economy during the pandemic crisis. Hence, the purpose of this paper is to assess the key factors that influenced sales trends in three different groups of countries in Europe during the COVID pandemic. The multinomial logistic regression was employed to access factors influencing sales trend using the SPSS version 22. The research has an important empirical and practical contribution. The policymakers in analysed countries could use these findings to investigate a roadmap to implement appropriate supporting measures to improve the financial sustainability of companies operating in their country and, accordingly, to achieve sustainable economic growth and development. Also, the obtained results can be very useful for the managers of the companies operating in these economies considering that they can identify strong points and limitations in their operations and benchmark good practices from other countries.

Keywords: sales, pandemic crisis, companies, government support, corporate finance

1. INTRODUCTION

Pandemics have dramatic consequences, resulting in both taking human lives and global economic crisis. It has also been the case with the COVID-19 pandemic, which was spread at the beginning of this year from China to all economies worldwide. The outbreak of the crisis has triggered worldwide and multiple concerns, whose consequences will be felt in the post-pandemic world (Arežina, 2020). Due to the pandemic crisis, almost all European countries recorded negative growth rates, with considerable variations across countries regarding the depth of the recession (Randelović, 2021). A strong fiscal policy response was

* Corresponding author: afedajev@tfbor.bg.ac.rs

needed in such an unpredictable business environment, and governments had different answers, resulting from other initial conditions and dynamics of pandemic spreading.

In the last decade of the XXI century, the SEE economies experienced both economic divergences and convergence to Western Europe and within the region. Various financial systems, pre-conditions, and inherited institutional settings (Regional Cooperation Council, 2020) have caused diverse economic reactions to the pandemic crisis. Countries from the region have several advantages in dealing with the impending financial crisis. Still, one of the most important is that most of them had a relatively low level of public debt before the emergence of a pandemic. Such state in the public finances has allowed SEE countries to implement comprehensive economic measures to support businesses and individuals without putting too much pressure on public debt.

The precise duration of the pandemic crisis is unpredictable, but only those enterprises who succeeded to adapt and recognize the new needs of the market quickly managed to survive. These companies can overcome the crisis only if government provide support to this sector to maintain a satisfactory level of liquidity. The most commonly used measures to support liquidity included a moratorium on loan repayments, compensation for part of the losses during the pandemic postponing the deadlines for payment of taxes and contributions, more accessible access to loans, direct assistance to SMEs (Marjanović & Đukić, 2020). The banks were ready and the first to react and help preserve the liquidity of companies because when you are not liquid, there is no planning or budgeting. The companies differ between those ready to transform their business operations and those who made short-term plans, thinking that pandemic will be over soon and remain in big trouble.

In the previous period, there was no research on this topic. To comprehensively investigate this topic, the main aim of the study is analysis factors influencing the business sales of companies in SEE economies in the context of the COVID-19 pandemic, using the multinomial logistic regression. The paper is structured as follows: Section 2 presents a brief literature review on this topic, Section 3 explains used data and methodology applied, Section 4 presents and discuss obtained results and Section 5 is focused on concluding remarks and recommendations for overcoming the crisis.

2. LITERATURE REVIEW

The outbreak of the novel coronavirus (COVID-19) represents a global health threat that disturbed all aspects of everyday life, such as economy, health, transportation, education, politics and other fields in different industries and regions, severely

(Baniamin et al., 2020). Countries imposed tight restrictions on movement to halt the spread of the virus, which is why it came to bringing economic activity to a near-standstill, which resulted in brought to weakened spending power and led to stagnation in economies (Shen et al., 2020). The COVID-19 pandemic caused the worst economic downturn, which has not been seen since the Great Depression in the 1930s and far worse than the Global Financial Crisis 2008. According to the International Monetary Fund (IMF), the COVID-19 pandemic has had a more negative impact on activity in the first half of 2020 than anticipated, according to The World Economic Outlook (WEO). The OECD (2020) predicted that GDP was declined by 4.5% in 2020 and to pick up by 5% in 2021 with a highly uncertain outlook.

The COVID-19 pandemic was severely impacted on international supply chains. The supply chains scope many countries in a region or beyond the area (Mitsuyo & Kazunobu, 2021). During the pandemic period, governments imposed restrictions on import and export to prevent transmission of the COVID-19 virus, which powerfully hit export-oriented and import-oriented companies in SEE countries. Consequently, the volume of exports of goods

and services and imports in SEE economies decreased. In Serbia, there was the smallest decline in exports of only 4.56%, while in Croatia the percentage was much higher, as much as 26.85, in the remaining analysed countries there was a decline in exports of about 9%. When is a word about exports, there has been a decline compared to the previous year in the analysed economies. The most significant drop in exports was suffered by Croatia (16.21%), then follows Slovenia with a decline of 10.23%. At the same time, the most minor decrease was recorded in Serbia (3.85%), then follows Romania (4.57%) and Bulgaria (5.90%) (IMF, 2020). Mitsuyo and Kazunobu (2021) determined that the diversity of inputs in import played a significant role in partially mitigating the harmful supply-side effects of COVID-19, particularly during the initial period. The consequences of supply chain disruptions also affected the Gross Domestic Product (GDP). The gross domestic product growth rate is an essential indicator of a country's economic performance. However, within the analysed SEE countries in 2020 compared to the previous year, a decrease in GDP value in all surveyed countries. Namely, the most significant decline in GDP was recorded in Croatia and amounted to 23.17%. The minor decrease in GDP was recorded in Bulgaria at 9.25%, then in Serbia 10.88%, while in Romania and Slovenia it was 11.70% and 16.97%, respectively (IMF, 2019, 2020).

The COVID-19 pandemic has imposed an emergency globally and has raised numerous issues with financial management practices. Zubair et al. (2020) indicate that the leading causes of the economic decline in recent years are internal factors of the financial system. Feyen et al. (2021) analysed different authorities response to the COVID-19 pandemic in the financial sector in 154 countries, including SEE economies. The COVID-19 pandemic also affected employment (Blustein et al., 2020). Employment and total hours worked declined at fast rates.

On the other hand, Unemployment increased more slowly because enterprises applied job retention schemes or workers are transitions into an inactivity state (Sjoquist & Wheeler, 2021). According to data from the International Monetary Fund, in 2020, the unemployment rate among considered SEE economies was highest in Serbia 13.32%, followed by Croatia with 9.19%, while in Bulgaria, Romania, and Slovenia, the unemployment rate was approximate and amounted to 5.21%, 5.13%, and 5.0% respective (IMF, 2020). The empirical analysis on EU countries by Perugini and Vladislavljevic (2021) shows that even the intermediate levels of lockdown significantly can impact increase poverty and inequality and that the magnitude of the change is more prominent in more unequal countries.

OECD (2020) investigated the impact of COVID-19 on finance SME and government policy responses and determined that the financing environment for Small and medium-sized enterprises (SMEs) and entrepreneurs before crises were broadly favourable. Policymakers worldwide were implemented different measures to mitigate financial consequences caused by the spread of the virus. These measures support the real economy and relate to public health, monetary, fiscal, macroprudential, and economic measures (Altmann et al., 2020).

3. DATA AND METHODOLOGY

Economies across all Europe different responded to the effects that arose from the pandemic's appearance, therefore, achieved different levels of economic development. Companies from five SEE economies have been analysed to determine the impact of critical factors that influenced sales trends during the COVID pandemic time. This study employs the most current World Bank Enterprise Survey data released for 2020, consisting of 1939 enterprises from the manufacturing and service sectors. Namely, the research included

companies from Serbia, Bulgaria, Romania, Croatia, and Slovenia. These surveys use standardised survey instruments and a uniform sampling methodology which used in all analysed countries. The surveys employ the stratified probability/random sampling technique, affording every subset of a statistical population an equal chance of being chosen. This way minimises measurement error and yields data comparable in all economies. Because World Bank's Enterprise conducts research every year, the questions in the survey conducted in 2020 were in a slightly modified form, i.e. the questions were adjusted to the current COVID-19 situation. All questions in the survey were divided into several groups: control information and introduction, sales, production, labour, finance, policies, and expectations. From all analysed groups of questions, the 12 most important variables that influence sales trends were selected. The defined research model is depicted in Figure 1.

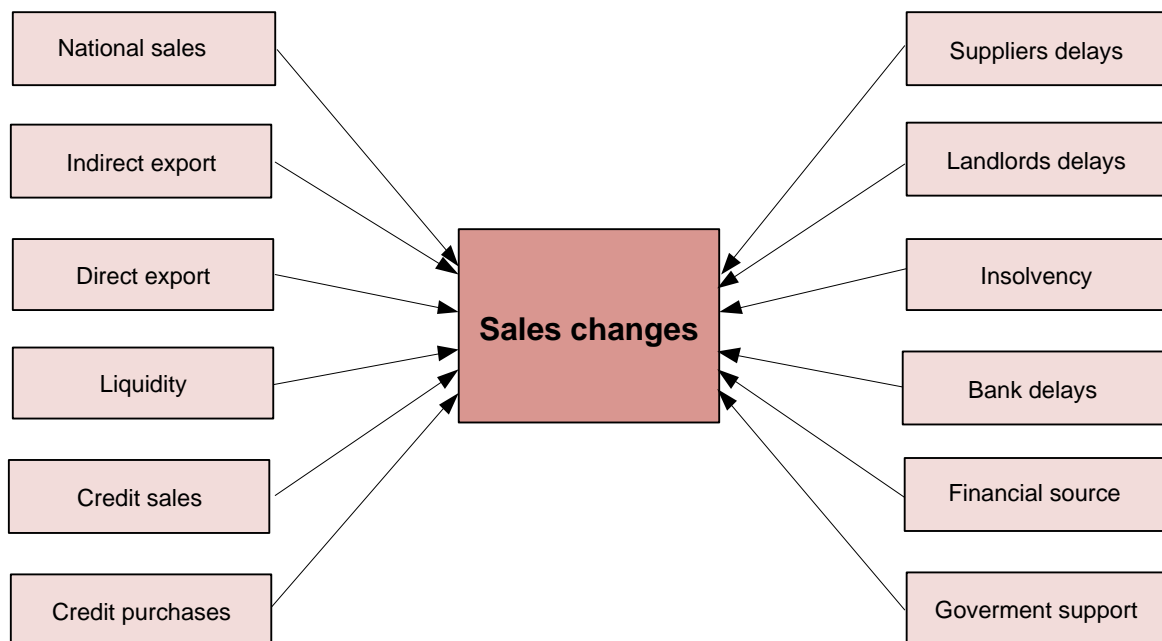


Figure 1. Research model

The dependent variable in the defined research model, i.e. dependent variable for this study, is sales trend, measured in three categories: increase, decrease, and remain. The independent variables, i.e. explanatory variables used in this study, include national sales, indirect export, direct export, liquidity, credit sales, credit purchases, supplier delays, landlords delays, insolvency, bank delays, financial source, and government support. Since the dependent variable was measured on a nominal scale and had multiple categories, Multinomial Logistic Regression (MLR) model was used for empirical analysis. MLR method is widely applied in practice, especially in social science, and the methodology of analyzing such models is well established (Hao & Yang, 2020).

3.1. THE MULTINOMINAL LOGISTIC REGRESSION MODEL

To model the relationship between independent variables and a dependent variable that can have more than two outcomes $J(>2)$, the Multinomial Logistic Regression method (MLR) is used, which is a variant of logistic regression analysis (McCullagh & Nelder, 1989; Chan et al., 2019) and both models depend mainly on logistic regression or logit analysis (El-

Habil, 2012). MLR is used when the dependent variable has more than two categories (El-Habil, 2012; Agresti, 2013; Hao & Yang, 2020; Chan et al., 2019; Fávero & Belfiore, 2019). Considering the dependent variable, MLR compares the probabilities of belonging in each of the dependent variable categories to the baseline category. Therefore, the regression coefficient of the baseline category can be calculated (Long, 1997). Suppose the dependent variable can have J of different values. In that case, multinomial logistic regression can be considered as implementing J-1 binary logistic regressions where we compare all categories with the baseline. Hence, multinomial logistic model theory is similar to logistic model theory. To analyze the ratio of occurrence to nonoccurrence (the odds ratio), a logistic model uses binary data (event vs nonoccurrence). A dependent variable is paired with the baseline category within the MLR model to calculate the baseline category's odds ratio. Additionally, the model does not presuppose normality, nor linearity, nor homoskedasticity. This model for probability estimates uses the maximum likelihood method. If category J is the baseline category, the baseline-category logit defined as follows (Chan et al., 2019):

$$\lambda = \log \left(\frac{\pi_j}{\pi_j} \right) = \alpha_j + \beta_{1j}k_{1j} + \dots + \beta_{ij}k_{ij} \quad (1)$$

where $j = 1, \dots, J-1$; λ shows the logit value of the baseline category; α shows the intercept; β shows the independent variable, and κ shows the regression coefficient. The MLR model can be depicted in the following form of probability (Chan et al., 2019):

$$P_j = \frac{\exp(\lambda_j)}{1 + \sum_{i=1}^{J-1} \exp(\lambda_i)} \quad (2)$$

$$P_j = \frac{1}{1 + \sum_{i=1}^{J-1} \exp(\lambda_i)} \quad (3)$$

where P_j shows the probability of a certain category of the dependent variable and P_j shows the probability of the baseline category.

SPSS statistical software package, version 22 was used to perform the multinomial logistic regression model, and obtained results are present below.

4. RESULTS AND DISCUSSION

To take an insight into the characteristics of analyzed companies from SEE countries, Table 1 presents the structure of the sample regarding the key demographic characteristics.

Table 1. Demographic characteristics of samle

Characteristics		Percentage
Country	Bulgaria	26.9
	Romania	26.5
	Croatia	17.6
	Slovenia	12.8
	Serbia	16.1

Sector	Manufacturing	49.3
	Retail	18.5
	Other Services	32.2
Status	Open	98.9
	Temporarily closed	1.1

The data presented in Table 1 indicate that sample consists of 26.9% of Bulgarian companies, 26.5% of Romanian companies, 17.6% of Croatian companies, 12.8% of Slovenian companies and 16.1% Serbian companies. Also, it can be noted that 49.3% of them are from the manufacturing sector, 18.5% are from the retail industry, while 32.2% of them operate in the services sector. Considering that some of the companies were temporarily or permanently closed due to anti-pandemic measures, authors excluded permanently closed companies because of data unavailability. So, the used sample consists of 98.9% of companies that were opened during a pandemic and 1.1% of them were temporarily closed.

Before the presentation and discussion of the obtained results, the model fitting should be accessed. Table 3 provides measures that are usually used to assess how well the model fits the data. They indicate whether the added variables statistically significantly improve the model compared to the intercept alone (with no variables added).

Table 3. Model fitting

Model	Model Fitting Criteria			Likelihood Ratio Tests		
	AIC	BIC	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	1941.337	1951.793	1937.337			
Final	1101.527	1310.634	1021.527	915.810	38	0.000

The measures of fitting presented in Table 3 indicate that the entire model statistically significantly predicts the dependent variable better than the intercept-only model alone (considering that $p = .000$). To access the quality of the derived model, Pseudo R-square measures are obtained (Table 4). These indicators measure the model's usefulness and indicate the proportion of variation in the dependent variable being explained by the model.

Table 4. Pseudo R-Square

Cox and Snell	0.486
Nagelkerke	0.584
McFadden	0.374

Considering that these measures take values from 0 to 1 and that higher is better, the model is a relatively strong relationship between all of the predictor variables and the multinomial response variable. According to Cox and Snell, Pseudo R-Square obtained model explain 46.8% of variability; Nagelkerke Pseudo R-Square points out that the model explains 58.4% of the variability and, according to McFadden Pseudo R-Square it amounts to 37.4% of the variability. Of much greater importance for accessing the model, quality is the results presented in the Likelihood Ratio Test (Table 5).

Table 5. Likelihood Ratio Test

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	1021.526 ^a	.	2	.
National_sales	1022.445 ^a	.917	2	.632
Indirect_export	1021.891 ^a	.363	2	.834
Direct_export	1022.421 ^a	.894	2	.640
Liquidity	1289.318^a	267.791	2	.000
Credit_sales	1033.697^a	12.170	2	.002
Credit_purchases	1024.197 ^a	2.670	2	.263
Financial_source	1049.479^a	27.952	2	.000
Suppliers_delays	1022.204 ^a	.676	2	.713
Landlords_delays	1022.181 ^a	.654	2	.721
Tax	1022.642 ^a	1.115	2	.573
Bank_delays	1023.420 ^a	1.893	2	.388
Insolvency	1022.416 ^a	.889	2	.641
Government_support	1027.602^a	6.075	2	.048
Cash_transfers	1022.971 ^a	1.444	2	.486
Deferral_payments	1022.854 ^a	1.327	2	.515
New_credit	1022.265 ^a	.738	2	.691
Fiscal_reductions	1021.924 ^a	.397	2	.820
Wage_Subsidies	1028.462^a	6.935	2	.031
Other_measures	1025.094 ^a	3.567	2	.168

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. Unexpected singularities in the Hessian matrix are encountered. This indicates that either some predictor variables should be excluded or some categories should be merged.

According to p-values presented in Table 5, it can be concluded that Liquidity, Credit sales, Financial source, Government support and Wage subsidies are statistically significant independent variables.

After accessing the model fitting and quality, the parameter estimations are obtained and presented in Table 6. The answer remains the same is used as a referent category. So, the values of β coefficients for those companies who experienced an increase and decrease in sales are observed.

Table 6. Parameter estimates

Predictor	Increase					Decrease				
	B	SE	Wald	Exp(B)	Sig.	B	SE	Wald	Exp(B)	Sig.
National sales	-0.148	11.724	0.000	0.862	0.990	-0.046	0.003	303.108	0.955	0.000
Indirect export	-0.138	11.724	0.000	0.871	0.991	-0.038	0.007	26.850	0.963	0.000
Direct export	-0.148	11.724	0.000	0.862	0.990	-0.045	0.000	/	0.956	/

Liquidity	-2.482	0.275	81.222	0.084	0.000	2.378	0.258	85.056	10.785	0.000
Credit sales	0.919	0.334	7.580	0.399	0.006	0.336	0.255	1.728	1.399	0.189
Credit purchases	-0.249	0.423	0.346	0.780	0.557	0.372	0.285	1.700	1.451	0.192
Financial source	-0.636	0.126	25.582	0.529	0.000	-0.281	0.083	11.383	0.755	0.001
Suppliers delays	0.206	0.362	0.323	1.228	0.570	0.165	0.230	0.516	1.180	0.473
Landlords delays	-0.501	0.611	0.672	0.606	0.412	-0.109	0.359	0.092	0.897	0.762
Tax	-0.112	0.457	0.060	0.894	0.807	-0.293	0.280	1.094	0.746	0.296
Bank delays	-0.407	0.722	0.317	0.666	0.573	-0.537	0.402	1.787	0.584	0.181
Government support	-0.557	0.243	5.253	0.573	0.022	0.055	0.170	0.012	1.056	0.746

Referent category - Remained the same.

Based on the data from Table 6, it can be concluded that by comparing companies that recorded sales growth and that maintained the same sales volume as statistically significant predictors, only Liquidity, Credit Sales, Source of Financing, and State Support appear. It can be concluded that the companies that had increased sales used cash transactions less and sold more on credit than those where sales remained the same. Also, these companies used loans more as sources of financing and less state support than the companies from the reference group. Let's compare the companies that recorded a decrease in sales and the companies whose sales remained unchanged. It can be concluded that those that experienced a decline in sales sold fewer products on the domestic market and through indirect exports than was the case with companies whose sales remained unchanged. In addition, these companies used cash transactions more but also loans to finance their business.

5. CONCLUSION

The emergence of the pandemic crisis at the beginning of 2020 has hurt economic activity across European countries through various channels. It is both the supply and the demand side shock. The governments and companies find themselves in a significantly changed environment, with very unpredictable prospects. To overcome this global economic shock, companies changed their way of doing business and financing their operations. However, some of them were not able or willing to change, requesting comprehensive government support. SEE countries that have entered the crisis with relatively favourable public finances managed to obtain the necessary support to economic entities. As the results of multinomial regression suggested, the companies who succeed to increase their sales increased their credit sales and reduced their cash transactions. In financing their activities, they relied more on credits than on government support. The banking sector in these countries was ready to obtain enough liquidity for the economy and maintain economic activity in the industries that were not significantly affected by the crisis.

To overcome the crisis's adverse effects soon, the government in SEE economies should help the most vulnerable sectors, and special attention should be put on SMEs. To effectively overcome the constraints imposed by the pandemic, governments in the observed countries need to define an appropriate program to recover and improve the economy's

competitiveness. The schedule for improving the economy's competitiveness should aim to encourage investment, boost innovation, encourage clustering, introduce international standards, improve the business climate for start-ups, support internationalization of companies and their penetration in new markets, support for digital business transformation, etc.

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INNOVATIVE APPROACHES TO THE FORMATION OF REAL ESTATE VALUATION IN RUSSIA

T. V. Dubrovskaya¹, L. N. Riedel¹, A. A. Stupina^{1,2,3*}

¹*Reshetnev Siberian State Aerospace University of Science and Technology;*

²*Siberian Federal University;*

³*Krasnoyarsk State Agrarian University, Russian Federation*

Abstract: The unstable nature of the market requires the use of innovative approaches and methods that will help to effectively manage the studied objects. The primary task is to develop an innovative mechanism for a comprehensive real estate valuation, and, first of all, this applies to commercial real estate, as one of the most active market segments. The purpose of the study is to determine the features of traditional methods in the conditions of the modern crisis economy caused by the pandemic, and the main disadvantages for traditional methods of real estate valuation, to suggest directions for using innovative approaches. To achieve this goal, the need to improve and supplement existing valuation methods to obtain a reliable result is justified. The amount of information currently available is limited, which limits the ability to conduct a comprehensive analysis of the main trends for the studied market, to evaluate the level and prospects of its development. The solution to this problem is possible by implementing a system that helps to automate the main technological procedures and market research, and will also help to use innovative approaches to the formation of real estate valuation. The proposed schemes of information changes in the standard evaluation procedures are presented. Geographical information systems are proposed for use in the practice of evaluating commercial real estate objects to form an information space, as an element of improving the approaches used, will improve the information base, increase the objectivity of the valuation, quickly obtain information about the main parameters of the object, determine trends in the development of the commercial real estate market, form a bank of up-to-date information and a single information base of commercial real estate objects.

Keywords: methods, crisis, innovative approach, geo-information system

1. INTRODUCTION

One of the main areas of the Russian economy is the real estate market, which currently requires significant changes both in the field of real estate management and in the use of certain valuation methods. The unstable nature of the market requires the use of innovative approaches and methods that will help to effectively manage the studied objects. The primary task is to develop an innovative mechanism for a comprehensive real estate valuation, and, first of all, this applies to commercial real estate, as one of the most active market segments.

* Corresponding author: h677hm@gmail.com

The real estate market belongs to the imperfect types of markets, because its objects are original, there are great difficulties with their comparison by quality parameters. One of the defining characteristics of the studied market is its locality and inelasticity, since market characteristics are largely determined by the location of objects. These factors have a negative impact and they are one of the main problems that make it difficult to evaluate objects, so the standard evaluation procedure in most countries with market economies is quite time-consuming and requires automation using modern information technologies.

The object of the study is the existing approaches to the formation of real estate valuation. The following tasks were set and solved in the work:

- main disadvantages of traditional evaluation methods are identified and the features of their use are revealed;
- modern approaches to evaluation have been studied;
- changes to the standard evaluation procedures to improve the reliability and objectivity of the evaluation have been made.

The primary task is to develop an innovative mechanism for a comprehensive evaluation of real estate, and, first of all, this applies to commercial real estate, as one of the most active market segments.

2. RESEARCH

The traditional methods of real estate valuation currently used have certain disadvantages and do not fully meet the needs of the modern market (Kiryukhin, 2010).

The main disadvantages of the cost approach include difficulties in determining the amount of depreciation for long-term use objects and the need for adjustments caused by an unbalanced real estate market.

The main feature of the revenue approach is forecasting, so its disadvantages appear: the possibility of obtaining correct results only if it is possible to accurately predict costs and results, which is quite problematic in an unstable economy.

The use of the comparative approach is associated with a fairly high degree of subjectivity of the evaluation and high labor intensity in the selection of analogues. In addition, when using the comparative approach, the prospects for the development of the evaluated object are ignored.

In the context of the crisis caused by the pandemic, the above disadvantages are further compounded, and in order to obtain a reliable estimate, the real estate valuation process must undergo additional analysis and adjustment. The analysis helped to determine the main features of the using traditional methods in the conditions of the modern crisis economy caused by the pandemic.

When using the cost approach, the following things can be identified: there is a sharp decrease in the cost of land plots, a significant decrease in the profit of entrepreneurs, and a decrease in the cost of new construction.

When using a comparative approach, there is a significant decrease in transactions on the market, the appearance of a significant number of areas intended for sale, a sharp decrease in liquidity and the presence of fairly high discounts.

The income approach is characterized by problems caused by an increase in the occupancy rate, and great difficulties with determining the forecast income, which appear due to the uncertainty of calculating the discount coefficients.

Describing the situation in the modern commercial real estate market, it can be noted that in two to three months the cost of some objects can increase several times, the main number

of transactions on the market is represented by rental transactions, there is a sharp decrease in the total number of transactions, so there is a lack of information.

In addition, it can be noted that the process of adaptation to new conditions has begun, and the study of the current situation helps to note the following points (Dubrovskaya & Nasyrova, 2020a, 2020b, 2020c; Dubrovskaya & Riedel, 2020d):

- there is a decrease in rental applications, and most of them are for the rental of small premises;

- transactions in the commercial real estate market are stretched over time, so now we can talk about extremely approximate results;

- there is an increase in rent;

- there is a decrease of a fairly large number of participants from the market;

- trends of expectation are extremely developed;

- there is a decrease in the purchasing power of the population.

In such a difficult economic environment, there is a need to improve and supplement existing valuation methods to obtain a reliable result.

The analysis showed that the currently available amount of information on the real estate market does not help to evaluate the market trends in the development of both the entire market and its individual segments from the position of a comprehensive analysis. The lack of a comprehensive methodology for the level and prospects for the development of market trends has led to the impossibility of reliable research, monitoring and evaluation. It is proposed to evaluate the development of the studied market using the following stages:

- formation of information bases for commercial real estate broken down into separate segments;

- analysis of the current and retrospective state of the commercial real estate market;

- evaluating the investment attractiveness of the commercial real estate market and its individual sectors.

One of the most significant stages is the first stage – the stage of forming information bases for commercial real estate. Its implementation involves the collection, systematization and processing of the information received. To obtain reliable and complete information, it is necessary to evaluate the state of the external environment and information that helps to characterize the commercial real estate market in the context of individual segments.

The amount of information currently available is limited; therefore, the possibilities for conducting a comprehensive analysis of the main trends for the studied market, and evaluating the level and prospects of its development are limited. One of the main points that hinder the process of further development is the lack of information received. This information is the main source for determining the current state of the market and the basis for identifying opportunities, threats and directions for the development of the future object state.

3. RESULTS

The solution to this problem is possible by implementing a system that helps to automate the main technological procedures and market research, and will also help to use innovative approaches to the formation of real estate valuation (Ridel, L. N. & Dubrovskaya, T.V., 2020e).

The main stages of work or subsystems of this process should be: collection and preparation of initial information on real estate objects; evaluation and calculation of the value of real estate objects; creation of a geo-information system and monitoring the data on real estate objects, maintaining the formed database up to date; creation of a price map; formation of a database for the value of real estate objects.

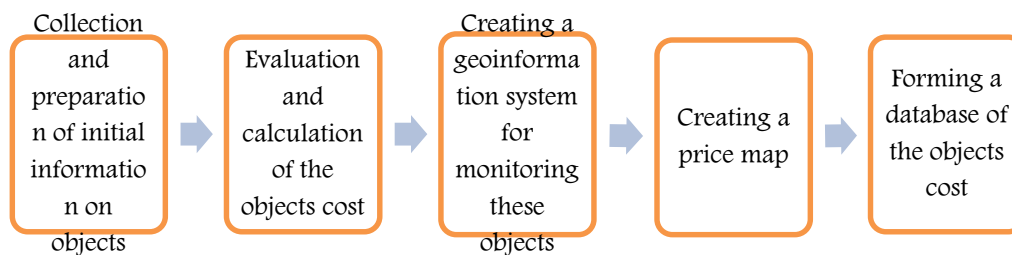


Figure 1. The main stages of real estate valuation work

Geo-marketing will help the most rational allocation of resources, determine the optimal management decisions. The technology of conducting such studies will help for objective strategic decision - making, and will help to identify target audiences in a certain territorial unit and develop concepts for the objects used.

Ayse Can (1998) concluded that geo-information systems (GIS), combined with spatial analysis tools, offers an ideal research environment for processing, analyzing, and modeling housing and mortgage data sets.

Geo-information systems serve as a tool for geomarketing research. The use of geo-information systems provides the use of a systematic approach, and includes the adoption of informed management decisions, the basis of which is spatial analysis, forecasting, evaluation, mathematical modeling, cartographic modeling (Yang Y., et. al., 2015; Glebova, N., 2016).

Geo-information technologies open up the possibility of improving the existing standard approaches to valuation: revenue, cost, and comparative. The proposed software will help to enter and store information about transactions in the real estate market, analyze and forecast it, generate reports, link information to a map of a geographical region.

The need for the use of geo-information systems for the rapid adoption of effective management decisions is justified in the works of such authors as: Baus (2016), Grover & Solovyov (2020).

Here are the diagrams of the proposed information changes in the standard evaluation procedures.

A typical cost-based evaluation scheme includes the following main steps:

- calculation of the land cost, considering the most efficient and rational use of the land plot;
- calculation of the cost for new construction of the estimated objects;
- determination of wear (physical wear, functional wear, external wear);
- calculation of the improvements cost (buildings, structures, etc.), considering determination of the total object cost.

The main direction for the transformation of the cost approach procedure should be the possibility of creating a database of current prices and the possibility of calculating the replacement cost with certain evaluation parameters using modern technologies - 3D modeling. It is proposed to make adjustments to the evaluation procedure at the cost calculation stage. This change will automate the process and increase the objectivity of the evaluation.

The revenue approach evaluation includes:

- calculation of the possible revenue amount from the operation of the object;
- determination of the actual gross income;
- calculation of conditionally constant, conditionally variable expenses and determination of reserves from the operation of the object;

- determination of gross income;
- calculation of the present value of expected earnings, either by direct capitalization or by discounted cash flows.

It is proposed to make automated adjustments at the stage of calculating the amount of possible revenue from the operation of the object, which help to adjust the cost of similar objects when entering the data of the evaluation object.

The standard stages of the comparative approach should be supplemented with the introduction of work on the creation and use of geo-information systems. So, at the stage of market research, geo-statistics will help to take into account spatial and temporal trends. The stages of collecting information on similar objects and their subsequent comparison involve changes by including in the evaluation procedure the possibility of making automated adjustments that will help to enter the data of the evaluation object to adjust the cost.

The introduction of an automated system for making corrections using the income and comparative approaches will help for the introduction of data on a specific property object to adjust the value.

The technologies introduced into the practice of valuation help to obtain information on the average value of real estate objects, compare prices, study their dynamics, and increase the reliability of the valuation. In addition, the availability of special software helps the user to get online information about the value of their property. These statements are explained by the fact that currently there is a high level of capabilities development for geo-information technologies in working with databases. It is expected to reduce the time required to perform procedures for searching and analyzing data on real estate objects, and to improve the quality of performed work. A prerequisite for further development is the development and use of an effective database structure that will help to take into account the necessary information.

The relevance for the problem of combining the capabilities of Internet technologies, marketing and geo-information technologies is undeniable, but at the moment there is a problem associated with the automation of entering data into the database and checking and eliminating poor-quality information.

4. CONCLUSION

The geographical information systems proposed for use in the practice of evaluating commercial real estate objects for the formation of the information space, as an element of improving the used approaches, will improve the information base, increase the objectivity of the evaluation, quickly obtain information about the main parameters of the object, determine trends in the development of the commercial real estate market, form a bank of up-to-date information and a single information base of commercial real estate objects.

The main results of the study can be formulated as follows:

- the authors conducted a study of the existing crisis market of commercial real estate on the example of one of the largest market sectors in the Russian Federation - the Krasnoyarsk Region. According to statistics, it is the Krasnoyarsk Region that for a fairly long period is a reference point and the main trends reflection of possible changes in Russia and can be accepted as a study object;
- the main trends in the development of the modern real estate market are identified;
- the analysis of traditional approaches to real estate valuation is carried out, their main features and disadvantages are identified;
- the improvement directions of traditional approaches taking into account the functioning of the market in a crisis situation are proposed;

- changes to the evaluation algorithms have been made;
- the necessity and timeliness of changing processes through the use of new technologies is justified.

Thus, based on the analysis of modern problems in the commercial real estate market, an innovative approach to the formation of key principles and recommendations for the evaluation of commercial real estate objects is justified. This process should be applied both at the level of the entire system and at the level of individual real estate objects.

The conclusions and practical recommendations obtained from the results of the study will improve the process of evaluating commercial real estate by developing new approaches to the comprehensive evaluation of commercial real estate objects in modern economic conditions.

The practical significance of the conducted research is, in addition, in the fact that its results can be used in the development of predictive nature materials, as well as by the management bodies of social development and urban planning in the development of program measures to improve state programs.

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HELMINTH COMMUNITIES OF *ABRAMIS BRAMA* (LINNAEUS, 1758) FROM THE TUNDJA RIVER AND ECOLOGICAL ASSESSMENT OF THE FRESHWATER ECOSYSTEM

Diana Kirin*, MariyaChunchukova

Agricultural Univesity - Plovdiv, Bulgaria

Abstract: The performed researches results on the helminths and helminth communities of freshwater bream (*Abramis brama* (Linnaeus, 1758)) from the Tundja River, Bulgaria, are presented. Three species of helminths have been identified: *Nicolla skrjabini* (Iwanitzky, 1928) Ślusarski, 1972 (Trematoda), *Caryophyllaeides fennica* (Schneider, 1902) Nybelin, 1922 (Cestoda) and *Pomphorhynchus laevis* (Müller, 1780) (Acanthocephala). The identified helminth species are characterised by complex development cycles and different intermediate hosts' participation. New data of freshwater ecosystem's biodiversity are reported. The structure of helminth communities is analysed. *N. skrjabini* is the core species (27.59%) for the helminth communities of the freshwater bream. The other two species, *C. fennica* (P%=13.79%) and *P. laevis* (P%=17.24%) are component species in this communities. With the highest mean intensity is distinguished *N. skrjabini* (MI=4.63) and with the lowest - *P. laevis* (MI=1.8). The pathways of helminths flow are presented. Bioindication and an ecological assessment are made for the state of the studied river ecosystem.

Keywords: *Abramis brama*, biodiversity, bioindication, ecological assessment, helminth communities

1. INTRODUCTION

Tundzha River is related to the Aegean Water Basin. The river is the third largest river in Bulgaria (390 km; after the Danube and Iskar rivers) and the Maritsa River's largest tributary. The river springs from the 2083 m above sea level in Balkan Mountains, Bulgaria, and flows into the Maritsa River before Edirne, Turkey, at 32 m above sea level. The waters of the Tundja River are used for agriculture, domestic and industrial water supply, electricity, etc. The freshwater ecosystem and its adjacent territories are distinguished by great biological diversity, related to the declaration of a number of protected areas and zones. Helminths and helminth communities reflect the state of the habitats. The helminth infection indices largely reflect the integrity of food chains, biodiversity, etc., because most helminths have complex developmental cycles. Helminths and helminth communities of freshwater bream have been studied by a number of authors (Kakacheva-Avramova, 1977; Kakacheva et al., 1978; Sobecka & Słomińska, 2007; Pazooki & Masoumian, 2012; Abdybekova et al., 2020, etc.).

* Corresponding author: dianaatanasovakirin@gmail.com

However, the *A. brama* from the Tundzha River has not been the subject of ecologoparasitological research. The study presents data on the endohelminths and helminth communities of freshwater bream from the Tundzha River and discusses the condition of the communities from the studied part of the river.

2. MATERIAL AND METHODS

In 2019, 29 specimens of freshwater bream (*Abramis brama* (Linnaeus, 1758)) from the Tundja River, Bulgaria, were examined for helminths. The fish were caught by angling according to permission to the Ministry of Agriculture, Food, and Forestry of the Republic of Bulgaria. The scientific name of the fish was present, according to Fröse & Pauly (eds.) (2021). The fish were caught in the section of the river with coordinates: 42°33'12"n, and 25°38'21" e; 309 m altitude, located between the Balkan Mountain and the Mountain range Sredna gora, about 20.5 km far away from the town of Kazanlak, Central Southern Bulgaria. According to Zashev & Margaritov (1966) and Bauer (ed.) (1987) the helminthological studies were carried out. Helminth specimens were fixed in 70% of ethyl alcohol. Species diversity was determined on temporary slideS according to Petrochenko (1956) and Zashev & Margaritov (1966). Helminth community structure was analysed on two levels: on the level of component community (prevalence (P%); mean intensity (MI) for the determined species) and on the level of infracommunity (total number of fish species; total and mean number of fish specimens; Brillouin's diversity index (HB)). In the component community, the found species were divided into core species (P% > 20), component species (P% > 10) and accidental species (P% < 10), according to the criteria of Magurran (1988); Bush et al. (1997) and Kennedy (1997). The obtained results were statistically processed using Statistica 10 (StatSoft Inc., 2011) and MS Exel (Microsoft 2010).

3. RESULTS

3.1. STUDIED FISH SPECIES

Abramis brama (Linnaeus, 1758; Cyprinidae) is a brackish, benthopelagic, potamodromous freshwater fish species. The freshwater bream is naturally distributed in Europe and Asia, including in the Aegean Sea Basin and the Maritsa River Basin. The fish inhabits lakes, large or medium sized rivers with slow-flowing waters, even swamps. The species inhabits the bottom layers of the water. The adult breams are an omnivorous species of fish. Their feeds on algae, benthic small plants, oligochaetes, hirudin, insect larvae and other invertebrates, even small fish. Larves and young specimens prefer still waters where they feed on zooplankton. After one to two years of age, fish migrate to rivers for nutrition. If they cannot leave the standing water, they grow more slowly, reach smaller sizes, but develop as they reach sexual maturity. IUCN Red List status of the species is Least Concern (=LC, IUCN) (Frøese & Pauly, 2021 (eds.)). The species is not protected in the Republic of Bulgaria according to the National Legislation.

3.2. HELMINTHS AND HELMINTH COMMUNITY STRUCTURE

As a result of the conducted ecologoparasitological researches of 29 specimens of *A. brama* from the Tundzha River, an infestation with three species of helminths was established: *Nicolla skrjabini* (Iwanitzky, 1928) Dollfus, 1960; *Caryophyllaeides fennica* (Schneider, 1902) Nybelin, 1922 and *Pomphorhynchus laevis* (Müller, 1776) Porta 1908. They belong to three classes, three families and three genera (Table 1).

Table 1. Biodiversity and ecological indices of helminths and helminth communities of *Abramis brama* (Linnaeus, 1758) from the Tundja River

<i>Abramis brama</i> (N ¹ = 29) Ecological indices Helminth species	n ²	p ³	P% ⁴	MI ⁵	Range (min-max)
Class Trematoda					
<i>Nicolla skrjabini</i> (Iwanitzky, 1928) Dollfus, 1960	8	37	27,59	4,63	1-11
Class Cestoda					
<i>Caryophyllaeides fennica</i> (Schneider, 1902) Nybelin, 1922	4	15	13,79	3,75	2-7
Class Acanthocephala (Rudolphi, 1808) Skrjabin et Schulz, 1931					
<i>Pomphorhynchus laevis</i> (Müller, 1776) Porta 1908	5	9	17,24	1,8	1-2

Legend: ¹N = total number of examined fish specimens; ²n = total number of infected fish specimens; ³p = total number of helminth specimens; ⁴P% = prevalence; ⁵MI = mean intensity.

The three species of helminths are characterised by complex life cycles involving intermediate hosts (Bauer, 1987; Kakacheva-Avramova, 1983). The pathways of helminth flow in this study are:

1. Trematoda

Nicolla skrjabini - First intermediate host (for sporocysts) – *Lithoglyphus naticoides* (Pfeiffer, 1828) (Mollusca) – Second intermediate hosts (for the metacercariae) – *Gammarus balcanicus* Schäferna, 1923; *Obesogammarus crassus* (Sars, 1894) and *Dikerogammarus haemobaphes* (Eichwald, 1841) (Crustacea) - Definitive hosts from Cyprinidae, Percidae, Gobiidae, Siluridae, Gadidae, Esocidae, Acipenseridae, Salmonidae.

2. Cestoda

Caryophyllaeides fennica - Intermediate host *Stylaria lacustris* (Linnaeus, 1767) (Oligochaeta) - Definitive hosts from Cyprinidae.

3. Acanthocephala

Pomphorhynchus laevis - Intermediate host *Gammarus pulex* (Linnaeus, 1758) (Crustacea) - Definitive hosts from Cyprinidae, Salmonidae, Percidae, Siluridae, etc.

3.2.1. Component community

58.62% of examined freshwater bream specimens were infected with intestinal parasites. For each of the three helminth species, prevalences (P%), mean intensity (MI) and range (min-max) were determined (Table 1). *N. skrjabini* is a core helminth species (P%=27.59%) for the helminth communities of the freshwater bream. Other two helminth species (*C. fennica* and *P. laevis*) are component species (P%=13.79 and P%=17.24, respectively). *N. skrjabini* are distinguished also with highest mean intensity (MI = 4.63) followed by *C. fennica* (MI = 3.75) and *P. laevis* (MI = 1.8). *N. skrjabini*, *C. fennica* and *P. laevis* are generalists for helminth communities of freshwater bream. All reported species of helminths are autogenic for the helminth communities of *A. brama* from the Tundja River freshwater ecosystem.

3.2.2. Infracommunity

Of the studied 29 specimens of freshwater bream from the Tindja River, 12 specimens are free of helminths. No mixed invasion was detected. Only one species of helminth was found in each of the infested fish specimens. The number of helminth specimens varies from 1 to 11 as the largest number of fish are infested with 2 specimens of parasites (in 7 fish specimens). Only in one fish specimen, 4 and 11 specimens of parasites are found, respectively. The average number of all endohelminth specimens is low (3.59 ± 2.67), as well as the value of Brillouin's diversity index ($HB = 0.24 \pm 0.08$) (Table 2).

Table 2. Infracommunity data

Number of helminth species							
Total number of examined fish specimens							29
Total number of infected fish specimens							17
Total number of helminth species							3
Number of helminth species						0	1
Number of infected fish						12	17
Number of specimens							
Total number of specimens							61
Number of helminth specimens	1	2	3	4	5	7	11
Number of infected fish	2	7	2	1	2	2	1
Mean ± SD	3,59 ± 2,67						
Range (min – max)	1-11						
HB ± SD (Brillouin’s diversity index)	0,24 ± 0,08						

3.2.3. Discussion

The helminth fauna of *A. brama* found in this study is poor in species (3 species of helminths) compared to the generally established species composition for the country (15 species intestinal helminths; 20%) (Table 3).

Table3. Intestinal helminth species of *Abramis brama* in Bulgaria

Species of helminths	Authors	Locality
Trematoda		
<i>Nicolla skrjabini</i>	1, 2, 11, 12	river Danube
<i>Asymphylogora tincae</i>	6, 7	river Danube
<i>Asymphylogora imitans</i>	7, 8, 9, 11, 12	river Danube
<i>Palaeorchis incognitus</i>	9	river Danube
Cestoda		
<i>Caryophyllaeus laticeps</i>	1, 2, 9	river Danube
<i>Caryophyllaeus fimbriceps</i>	4, 6, 7	river Danube
<i>Caryophyllaeides fennica</i>	1, 2, 11, 12	river Danube
Acanthocephala		
<i>Pomphorhynchus laevis</i>	1, 2, 4, 7, 10, 11, 12	river Danube
<i>Pomphorhynchus tereticollis</i>	5, 8	river Danube
<i>Metechinorhynchus salmonis</i>	1, 2	river Danube
<i>Acanthocephalus lucii</i>	6, 7, 8, 10	river Danube
<i>Acanthocephalus anguillae</i>	4, 6, 8	river Danube
Nematoda		
<i>Contracaecum microcephalum</i>	3, 6, 7	lake Srebarna river Danube
<i>Raphidascaris acus</i>	3, 7, 8	lake Srebarna river Danube
<i>Rhabdochona denudata</i>	9	river Danube

Legend: 1. Kakacheva-Avramova (1977); 2. Kakacheva et al., 1978; 3. Shukerova, 2010; 4. Atanasov, 2012; 5. Kirin et al., 2014; 6. Chunchukova et al. 2016; 7. Chunchukova, 2017; 8. Chunchukova et al. 2017; 9. Chunchukova & Kirin, 2020; 10. Chunchukova et al. 2020; 11. Zaharieva & Zaharieva, 2020; 12. Zaharieva & Zaharieva, 2020a.

The helminth species identified in the study were reported for the parasite fauna of *A. brama* in Bulgaria (lake Srebarna and various habitats of the Danube River). In addition, *C. fennica* and *P. laevis* have been found in other fish species from the Tundzha River. *C. fennica* was reported as helminth species of *B. cyclolepis* from the river (Kakacheva – Avramova, 1972 as helminth species of *B. cyclolepis*; Kirin et al., 2013 as helminth species of *Sq. orpheus*).

The Tundja River is new habitat for *N. skrjabini*. The three species of helminths (*N. skrjabini*, *C. fennica* and *P. laevis*) were reported for the first time as parasites of the freshwater bream from the Tundja River.

According Sobecka & Słomińska (2007); Kennedy & Guegan (1994), the structure of parasitic communities is closely related to the conditions of specific habitats, and the number

of parasite species is less than that described in general for the host species, as obtained in this study results.

The species richness and structure of helminth communities are closely related to both the presence and abundance of intermediate hosts and the intensity of *A. brama* populations. Species diversity, the state of biological elements and their communities is a reflection of the conditions in the habitat. Lower rates of invasion with *C. fennica* and *P. laevis* indicate the lowest numbers and intensity of *G. pulex* populations, followed by those of *St. lacustris*. *G. pulex* is a bioindicator for χ - β -mesosaprobity. *St. lacustris* is a bioindicator for β -mesosaprobity. The highest numbers and intensities are indicated for the intermediate hosts of *N. skrjabini*. From them, *G. balcanicus* is a bioindicator for χ -saprobity. The three intermediate species refers to the relatively tolerant forms (Group C) of environmental conditions in habitats (Rusev, 1993; Peev & Gerasimov, 1999; Belkinova et al., 2013).

4. CONCLUSION

As a result of studying 29 specimens of freshwater bream, three species of helminths were found. They are autogenous species for the helminth communities of *A. brama* from the Tundja River. The three species of helminths were reported for the first time as parasites of the freshwater bream from the river. *N. skrjabini* is a new species for the fauna of the freshwater ecosystem. *N. skrjabini* is a core helminth species ($P\%=27.59\%$) for the helminth communities of the freshwater bream. Other two helminth species (*C. fennica* and *P. laevis*) are component species. *N. skrjabini* are also distinguished with the highest mean intensity. The species richness and structure of helminth communities are closely related to the presence and abundance of intermediate hosts, the intensity of fish populations, and ecological conditions in the habitats.

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CHALLENGES IN THE FUNCTIONING OF SUPPLY CHAINS IN THE CONTEXT OF THE EPIDEMIC OF COVID 19 VIRUS

Vijoleta Vrhovac¹, Goran Vujasinović¹, Stevan Milisavljević^{1*}, Nebojša Brkljač¹, Nikola Paskaš¹

¹ Faculty of Technical Sciences, Novi Sad; ² Faculty of Economics, Subotica,
Serbia

Abstract: Unpredictable business conditions inevitably lead to disruptions in the functioning of companies and consequently in supply chains. The outbreak of the Covid 19 epidemic affected the dynamics of behavior and habits of the customers, which required higher level of company flexibility and adaptability as well, but the biggest challenge, was in the functioning of supply chains. This paper will present the results of research on the functioning of service and production companies in Republic of Serbia during the period of epidemics caused by Covid 19 virus. The research was conducted using the questionnaire method with targeted questions in order to identify the most significant distinctions between functioning in normal business conditions and business in crisis conditions. Special attention will be given to the following aspects in business: costs, inventory level, delivery time, lead time and organization of human resources. The results of the research will be used as a good basis for improving existing business models in those aspects of business where it has been shown that there has been an optimization of the functioning of supply chains and other processes in terms of efficiency and effectiveness. In addition to the above, the results of the research will be a good basis for companies how to behave in future crises of a similar type, in order to adequately prepare for challenges in supply chains with minimal business loss as possible while maintaining end-user service quality at the same level

Keywords: Supply Chain, COVID-19, Logistics

1. INTRODUCTION

Supply Chain Management is the management of the flow of goods and services and includes all processes that transform raw materials into final products. It involves the active streamlining of a business's supply-side activities to maximize customer value and gain competitive advantage in the market place. The definition of "supply chain" seems to be more common across authors than the definition of "supply chain management" (Cooper et al., 1993; La Londe et al., 1994; Lambert et al., 1998). At the core of supply chain management is the conversion of materials and components into finished products as well as the logistics activities to get those products to the market (Srivastava et al., 1999)

In this paper will be presented results of survey in companies placed in Serbia. The COVID-19 impact survey on Supply Chain processes included manufacturing companies, distributors, logistics providers, as well as retail chains. The survey was conducted in the

* Corresponding author: steva@uns.ac.rs

period May-July 2020 on 25 companies from the territory of Serbia. The questions were related to specific situations, and the work of individual departments within the Supply Chain, such as procurement, warehousing, transportation, planning, human resources. The survey was an anonymous type, due to fact that some companies were not in the mood to publish the results, in order to protect their business.

All companies in Serbia face similar challenges with COVID-19 in different, positive and negative ways, as is the case worldwide. Famous Fortune journal, in a report published on 21 February 2020, indicated that 94% of the companies listed in the Fortune 1000 list were facing SC disruptions due to the COVID-19.

2. SURVEY RESULTS

In terms of lead-time from suppliers, both finished products and raw and packaging material from abroad suppliers, they have increased significantly. On the example of products from Italy, as one of the largest foreign trade partners of the Republic of Serbia in general, the delivery time was extended from 2 days to 7-9 working days (350-450%). This was caused by additional controls at borders, and to some extent and non-synchronized measures of individual states, in terms of transport and human security. On the other hand, on the example of transport from Spain, there was a significant increase in the price of transport by 20-30%. Demand for transport services was significantly higher than available capacity for Spain routes and suppliers

Perhaps the biggest impact in terms of logistics in this crisis was reflected in retail chains, as demand for certain foods increased by over 200% (for example sales of flour in March 2020 is 250% higher than in March 2019), which can be seen in the following chart, which shows the percentage growth in sales in 2020 compared to 2019 (approximately).

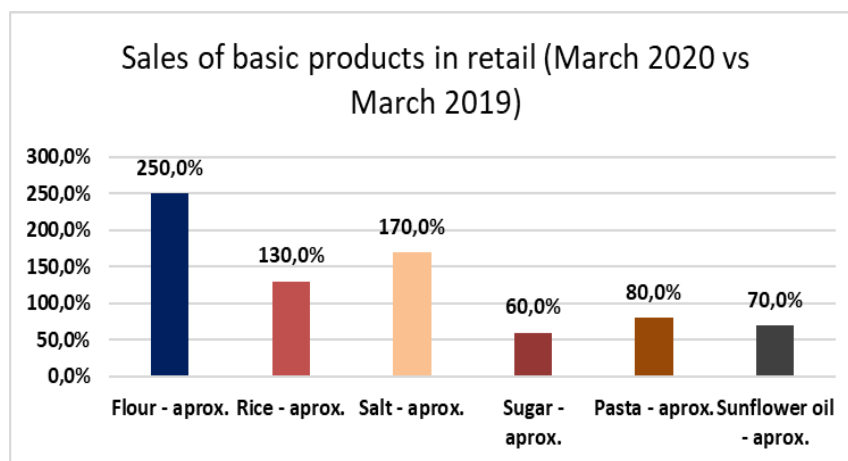


Figure 1. Approximately sales of products in retail chains (2020 vs 2019)

Due to the unplanned and increased demand, some food sellers increased prices to final consumers, and in that sense the government reacted and introduced restrictions on this issue, made a decision on 15.3.2020. that the prices of basic products must be maintained at the level before 5.3.2020. As an illustration in terms of price increase, we can take the example price of lemon, as an imported product, whose price increased by 300% in just a few days.

Due to lockdown, large losses were generated in the HORECA industry (Hotel/Restaurant/Cafe), not only cafes and restaurants, but also all the functions that servicing this sales channel, especially in terms of logistics, consequently, and there was a surplus of small transport companies. This situation was particularly negative for distributors of food products which serving this sales channel, and there were losses in terms of writing off products that have a relatively short shelf life, such as cheese and meat products. Due to lockdown HoReCa sales channel income was zero, actually, they were closed

As for stock levels, the survey results show contradictions. In companies engaged in the production, sales and distribution of food products, the level of stocks was stable or declining due to increasing demand, while in companies that have products of a technical nature in the portfolio, there was an increase in stock levels for 10-15%, due to lower sales of these products, and due to ongoing purchase of this products (goods transport were already in progress and contracted). This situation is very similar worldwide - While some sectors have seen a decline in demand, other have seen a sudden spike in demand (Amalesh et al., 2020).

Transport between major cities in the Republic of Serbia is accelerated by over 15% in terms of delivery time, due to lower traffic density, a lot of employees worked from home. Specialized logistics companies were able to transport goods during lock-down, which also helped shorten delivery times. The only limit in deliveries was the working hours of points of sales, ie the time and possibility of goods receiving.

The turnover of employees in the companies was practically reduced to zero, due to fact the employees were afraid for their future in terms of job security, and did not even think of moving to work for another company. Sick leave among employees was at a record low. A small number of companies decided to reduce the number of employees, because they estimated that there was less risk of operating at a loss for several months, and on the other hand to keep their employees. If there was a reduction in the number of employees, it referred to workers who were engaged in temporary jobs. An interesting fact is that due to the drop in turnover, some companies have decided to reduce the salaries of TOP management, so that the salaries of workers in operations remain unchanged. In certain retail chains, employees also received bonuses due to increased turnover and effort during the state of lockdown. Also this bonus motivation approach we could see in USA. Amazon on Monday said it will provide warehouse, delivery, Whole Foods workers, as well as some Flex drivers, with a one-time "Thank You" bonus for working during the corona virus pandemic.

The results of the survey show that the costs of warehouse operations increased by 5-6% due to the procurement of protective equipment and disinfectants. In addition to this, some companies introduced work in 3 shifts due to the safety of employees (and until then they worked in 2 shifts), they also had additional costs, due to the simple fact that night work is extra paid. This impact ranges from 2-3% of the additional cost within the warehousing.

On the other hand, there was a drop in the price of oil on the world market, and therefore in Serbia in the range of 20-30%, and some companies had savings in transport costs and managed to compensate for the growth of warehousing costs, so that the total the cost of logistics does not exceed the budgeted values.

All surveyed companies adhered to the valid recommendations for the work of employees from home, and this primarily referred to administrative positions, and additional savings were generated in financial terms, namely energy and water consumption. In addition to this, savings were generated in terms of less usage of company cars for management. The surveyed companies could not give an estimate of how much savings were achieved in this way.

When it comes to online (web) sales within retail chains, the companies stated that online sales increased between 30-35% compared to the period before the COVID-19 crisis,

and that the estimate that growth would be over 100%, but companies were limited by logistics capacities, such as: number of vehicles, number of drivers and commissioning workers. It is interesting to note that the structure of online sales in retail chains has changed radically, and that now the dominant customers are individuals (B2B) and not legal entities, ie companies (B2C), as was the case before.

The growth of online sales is supported by the fact that the number of deliveries through professionalized parcel delivery companies, has significantly increased, and in some companies of this type, the number of deliveries has increased over 1000% in very short time, and at one point there was a delay in deliveries, so the delivery time was 48 or 72 hours instead of 24 hours

3. CONCLUSION

The survey concludes that the outbreak (lockdown) of the epidemic due to the COVID-19 virus significantly affected all processes within the Supply Chain, of course in a negative sense, generating additional costs, such as the purchase of protective equipment, work in 3 shifts, emergency procurement, etc.

We conclude that in the future it is necessary to plan these additional costs and include them in the department budget. Also, it can be concluded that there is a lot of space for improvement, as we have seen in the example of company savings when working from home, and this trend of work will certainly continue to be applied in the future in much greater sense.

We saw that some retail chains did not have enough logistics capacity to meet increased demand for online sales, and on the other hand, we had an example of excess logistics capacity in the domain of HoReCa sales (transport capacities were practically unused). There was no obstacle for HoReCa and online sales channels to come together and react agilely to the new situation, in order to meet the increased demand for final consumers.

The conclusion regarding online (web) sales is that this situation in Serbia has practically brought a significant progress for this sales channel, and that it will never return to the old level, but will continue to grow in all industries, following world trends. In this context, some companies are already working on the formation of an online customer service, which would practically replace the classic sales force in the field, which would generate additional savings for the company.

Given that the second pickof COVID-19 virus appeared at the beginning of July on a much larger scale than in March-June 2020, companies face dissatisfaction of employees at the operational level (warehouse workers, forklift drivers, drivers, traders, whose jobs do not can be performed from home) due to the increased risk of infection. A proposal for further research on this issue could be the motivation of employees in emergency situations such this, as well as the development of a higher level of health protection of employees themselves.

This article shows the real problems caused by the mentioned virus and can be a good basis for deeper research of the impact in this, or similar epidemy on the supply chain, especially considering that very few articles are available on this topic. Accord-ing to Annals of Operation Research (Querioz et al., 2020), only 32 papers are covering relation between epidemic (in general sense) and supply chain, on the proper way. Certainly, further research should focus on the possibility of a higher level of digitalization of business processes and employee safety, in order for business systems to be adaptable to similar challenges.

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RISK TRANSMISSION BETWEEN THE STOCK AND BOND MARKETS IN NIGERIA DURING PERIODS OF RECESSION AND ECONOMIC DISRUPTIONS

Ibrahim Mohammed*

*Department of Banking and Finance, ABU Business School, Ahmadu Bello University Zaria,
Nigeria*

Abstract: This paper examined co-movement and transmission of volatility between return on the Nigerian Stock Exchange (NSE) All-Share Index (ASI) and 3-Month, 10-Year and 20-Year Bond yields around the 2016 Economic Recession. The paper employed Multivariate GARCH (MGARCH) models based on the symmetric and asymmetric Baba, Engle, Kraft and Kroner (BEKK) parameterization to examine evidence of risk shifting in the form of variances and co-variances among the markets at the height of the economic disruption induced by the 2016 recession. Daily returns on the NSE ASI and Bond yields were computed for the period 19th July 2012 to 26th February 2020 and partitioned into pre-recession and post-recession. The pre-recession period was from 19th July 2012 to 31st March 2016, while the post-recession period covered 1st April 2016 to 26th February 2020. Results from the symmetric model supported evidence of significant ARCH innovations for the stock market and all the bond yield returns for the pre-recession period. The paper also found significant volatility transmission and spillovers among the stock and bond markets in the pre-recession period. However, ARCH innovations in the post-recession period were not found to be significant, even though the coefficient of volatility persistence was positive and significant. This notwithstanding however, volatility spillover between the two markets in the post-recession was significant, even though not higher than in the pre-recession period. Results from the asymmetric model on the other hand also supported the finding of significant ARCH innovations and volatility spillovers in the two markets in the pre-recession period; and significant volatility persistence, and higher volatility transmission and spillovers in the post-recession period. However, the coefficients of asymmetric volatility were significant in the pre-recession period, but insignificant in the post-recession period. It was thus concluded that evidence of significant ARCH innovations for the two markets is suggestive of the risky nature of returns in the markets, while the lower rate of volatility transmission and spillovers in the post-recession period indicates that portfolio diversification became the order of the day as investors took passive positions to hedge against risk of the recession.

Keywords: Volatility, stock market, bond market, spillovers, Nigeria

* Corresponding author: imohammed@abu.edu.ng

1. INTRODUCTION

Finance theories such as the mean-variance portfolio theory, the CAPM and the APT have long settled the issue that risk is an important consideration when contemplating investment. One of the ways investment risk becomes typically manifest is through the nature of volatility. Since the works of work of Engle (1982), the importance of volatility in explaining market risks associated with investments and portfolios has astronomically increased. The generalization of volatility models by Bollerslev (1986) has shown that volatility models are robust in capturing the time-varying nature of return instability (modeled by the conditional variance) in financial markets. Subsequently, a variety of GARCH family models sprang up such as the E-GARCH, T-GARCH and the GJR-GARCH. However, the univariate nature of this family of GARCH models made it difficult to account for the temporal dependence in second-tier moments of asset returns. As a consequence, the Multivariate GARCH (MGARCH) models emerged as extensions of their univariate counterparts. MGARCH models have the ability to model and succinctly capture time-varying autoregressive second moment of the distribution of asset returns (Worthington & Higgs, 2004). According to Bauwens, Laurent and Rombouts (2006), volatility tends to move together across financial assets and markets over time. Thus, modelling such behavior using MGARCH models reveals the stylized facts regarding the nature of volatility spillovers and transmission across different class of financial assets and markets. The MGARCH model with parameterization based on Baba, Engle, Kraft and Kroner (1990) has received widespread application because of its perceived robustness in accounting for such time-varying nature of volatility spillovers and shock transmission (Mohammed, 2016). The use of MGARCH framework therefore provides a robust and more reliable framework for portfolio selection, options pricing and risk management to investors in financial markets. While there exist a number of studies that explored global financial markets using univariate models, such in-depth analysis of cross-assets and cross-markets using MGARCH models is yet to be achieved especially in emerging markets such as Nigeria.

In Nigeria, developments over the last decade since the banking sector bailout of 2010 point strongly towards investors' realignment of risk between the stock and bond markets. The Nigerian bond market has assumed increased importance to investors, and such importance is underscored by the tremendous growth of the market over the year. In addition, significant chunk of foreign portfolio inflows into Nigeria are allocated between the stock and bond markets. According to the Nigerian Stock Exchange [NSE] (2020), foreign portfolio inflows for 2020 alone stood at NGN510.25 Billion. Analysts have argued that the interconnectedness between the Nigerian stock and bond markets has recently been accentuated by the economic recession of 2016 where investors reportedly moved their assets across the two markets to hedge. It is thus surprising that the existing Nigerian studies on volatility spillovers have ignored the interconnectedness of these markets and the possible shock transmission and spillover effects that may exist between them. Studies such as Kalu (2014), Riman, Offiong and Ibi (2014), Kalu and Ali (2014), Kalu (2016), Adi (2017), Salisu, Isah and Assandric (2019), Fasanya and Akinde (2019) and Udejaja (2019) examined volatility spillovers among the various sectors of the Nigerian stock market or between the stock market, forex market, and money market only. There is no known study that has examined volatility spillovers between the Nigerian stock and bond markets. In addition, despite the fact that the scope of some of these studies covered periods of economic disruption such as the 2008 global financial crisis, the banking sector bailout of 2009/2010 and the economic recession of 2016, none of the studies specifically paid attention to evaluating whether or not such important economic

incidents redefined the nature of volatility spillovers among various financial markets in Nigeria.

Bearing the foregoing in mind, the objective of this paper is to examine shock transmission and volatility spillovers between the stock and bond markets in Nigeria during around period of the 2016 economic recession. A study of this nature becomes important to investors as it can serve as a veritable risk for asset reallocation within the Nigerian financial market during periods of economic turmoil. The rest of the paper is structured as follows: Section 2 reviews the empirical literature, Section 3 discusses the methodology, Section 4 presents and discusses the results, and Section 5 concludes the paper and makes recommendations.

2. EMPIRICAL LITERATURE

Studies on volatility and shock transmission among financial markets have assumed unprecedented importance over the last few decades and the reasons for this development are not difficult to discern. The high rate of integration among financial markets occasioned by globalization as well as the riskiness of local markets have been considered by many scholars as some of the reasons accounting for volatility transmission across financial markets globally (Mehl, 2011; Mumtaz & Theodoridis, 2012). There exist studies on volatility spillovers and transmission from one developed market to another, one emerging market to another, and from developed market to emerging market.

Fang Lim and Lin (2006) examined market-wide volatility transmission between the US and Japanese stock markets. The study employed daily returns for the stock and bond markets from 1988 to 2004 to investigate spillover effects among the markets using BEKK MGARCH models. The findings established unidirectional transmission from the stock to bond markets domestically while the international cross-market evidence suggests strong transmission among stock markets but weak transmission between the stock and bond markets. The study concluded that while domestic evidence of volatility spillovers in the US and Japanese markets was strong, it was at best mixed for international cross-market spillovers. The findings contrasted to those of Corradi, Distaso and Fernandes (2012) who utilized intra-day returns (in minutes) on the US, UK, Chinese and Japanese stock markets from 2000 to 2005 to evaluate volatility spillovers between stock markets. The study employed non-parametric measures based on computing realized variance to determine the quadratic variation in the series over-time. The study found evidence of significant volatility spillovers among these stock markets. Furthermore, Arouri, Lahiani and Nguyen (2011) investigated volatility transmission and spillovers between oil prices and stock market returns of the Gulf Cooperation Council (GCC) countries of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and UAE using daily data from June 2005 to February 2010. Results from the VAR-GARCH models estimated revealed significant spillovers between the oil and stock markets in the region. Slimane, Mehanaoui and Kazi (2013) investigated the spillovers of volatility among the developed European stock markets of UK, France and Germany using VAR-EGARCH models. The study utilized intra-day data over the period 2004 to 2010, and found that spillovers among these markets have substantially increased during period of the 2008/2009 global financial crisis. In addition, Zhang, Zhang, Wang and Zhang (2013) assessed volatility spillovers among the G7 and BRICS countries over the period December 1988 to December 2012 using the causality-in-variance test. The study found evidence of bidirectional volatility spillovers between the equity and bond markets of France, Brazil and South Africa, and unidirectional spillovers from bond to equity markets in the UK, US and Germany. Saadaoui and Boujelbene (2014) reinforced the evidence

by examining volatility spillovers between the emerging equity and bond markets of Argentina, Australia, Greek, Hong Kong, Hungary, Mexico, Peru, Spain, Turkey and Poland from July 2009 to January 2011. The study utilized the BEKK GARCH model for its analysis, and found significant evidence of volatility transmission between the stock and bond markets. Similarly, Dewandaru, Alaoui, Bacha and Masih (2014) examined volatility spillovers between returns on the conventional and Islamic indexes of the Asia-Pacific region, the Eurozone and the US using daily returns from November 2006 to March 2011. Using the non-decimated orthogonal Maximum Overlap Discrete Wavelet Transform (MOWDWT) for its analysis, the study documented evidence of contagion among the markets, induced by the global financial crisis. In the same vein, Valls and Chulia (2014) investigated effects of volatility transmission and spillovers between the stock and currency markets in the Asian emerging markets of Hong-Kong, South Korea, Singapore, Taiwan, Philippines, Indonesia, Malaysia and Thailand. The study employed MGARCH models to investigate volatility transmission using daily return data for the markets from 2003 to 2014. The results established bidirectional spillovers and transmission of volatility between the stock and currency markets, but found mixed evidence on the effect of the Global Financial Crisis on such transmission. Gencer and Hurata (2017) employed asymmetric BEKK-MGARCH models on daily return data for the US and the world's largest stock markets from 1994 to 2014 to investigate volatility spillover mechanisms. The study established evidence of significant volatility spillovers from the US market to the largest global stock markets and vice-versa for some of the markets. The study also found evidence of significant increase in variances and correlations during the global financial crisis, suggesting that the crisis was transmitted to other markets through these spillovers. Arefin and Ahkam (2017) examined the co-movement between the banking, insurance and non-bank financial institutions sectors of the Dhaka Stock Exchange (DSE) over the period 2009 to 2016 using daily market returns. Results based on Bayesian VAR, EGARCH and GJR-GARCH models supported existence of bidirectional spillovers between the banking and insurance, and between non-bank financial institutions and insurance sectors. On the other hand, a unidirectional relationship was established between banking and non-bank financial institutions sectors. Sari, Achsani and Sartono (2017) employed daily returns on the Indonesian stock market and the stock markets of US, Australia, UK, Japan, Hong Kong and Singapore to investigate volatility spillovers over the period 1990 to 2016. The VAR-GARCH model results revealed that Hong Kong's and Singapore's stock markets have dominant spillover effects over the Indonesian stock market. It was also found that spillovers between the Indonesian stock market and other foreign stock markets have increased tremendously since the global financial crisis of the late 2000s. Thorstensson (2018) employed daily return data from the stock and bond markets of the Nordic countries of Sweden, Denmark, Finland and Norway over the period 2001 and 2018 to determine volatility spillovers using the BEKK-GARCH model. The study could not find any evidence of spillover effects from the bond to the stock markets. However, significant spillover effects were recorded in Sweden, Denmark and Finland but not in Norway. Baykut and Kula (2019) investigated volatility and shock transmission between Turkey's BIST 100 and BIST Sustainability Indexes using daily data over the period November 2014 to July 2017. Findings based on BEKK-GARCH analysis established spillovers of bidirectional nature between the two market indexes, with shocks only flowing from the BIST 100 to the BIST Sustainability Index.

The foregoing studies in developed and emerging markets have largely supported evidence of volatility transmission and spillover effects between stock and bond markets, stock and currency markets and crude oil and stock markets. The studies also provided evidence of heightened volatility transmission and spillovers around periods of economic turmoil, notably the global financial crisis of 2007. The findings further suggest that the BEKK-GARCH models

have over the decades emerged to be the most popular tools for examining volatility transmission and spillover effects across global financial markets.

In Nigeria, studies on volatility transmission and spillovers have been in existence for over a decade, with most of them concentrating on domestic co-movement among the various sectors of the Nigerian stock market. Kalu (2014) examined volatility transmission between the Nigerian stock and foreign exchange markets using daily data from January 1996 to March 2013. The study employed BEKK-GARCH for its analysis, and found that evidence of bidirectional transmission of shocks between the two markets. Riman, Offiong and Ibi (2014) evaluated the relationship between oil price, S&P500 and stock market return in Nigeria over the period 1980 to 2010 using structural VAR. Kalu, and Ali (2014) analyzed volatility transmission among the Banking, Consumer Goods and Lotus Islamic Indexes of the Nigerian stock market from January 2010 to April 2014 using MGARCH models. The study found evidence of significant of unidirectional transmission of volatility from the Banking to Consumer Goods and Shariah-compliant sectors, and bidirectional relationship between the Consumer Goods Index and Lotus Islamic Index. Kalu (2016) investigated volatility spillovers and shock transmission between the Nigerian stock and money markets using monthly data from January 2003 to March 2013. Results based on MGARCH model revealed unidirectional transmission of shock and volatility spillovers from the stock to the money market, and not vice versa. Mohammed (2016) employed BEKK-MGARCH models on daily return data for the Nigerian stock market's Consumer Goods, Banking and Insurance sectors from December 2009 to February 2014 to investigate volatility spillover and shock transmission. The study documented evidence of significant shock transmission between the Consumer Goods and Banking sectors, Consumer Goods and Insurance sectors; and Banking and Insurance sectors. Adi (2017) employed daily return data for the NSE and the Nigerian forex market from May 2002 to November 2016 to examine volatility spillovers. The study used asymmetric VAR-GARCH, and the results revealed inter alia revealed significant unidirectional volatility spillover effects from the stock to the forex market over the period. Salisu, Isah and Assandric (2019) evaluated volatility shock transmission and spillovers between the stock and money markets in Nigeria using monthly data over the period January 2000 to September 2015. The study utilized the VARMA-CCC-GARCH framework and found bidirectional shock and spillover effects between the two markets. Fasanya and Akinde (2019) examined volatility transmission and spillover effects among the Nigerian stock, money and forex markets using monthly data over the period January 2002 to June 2017. Unlike the other studies, results based on the Diebold and Yilmaz model revealed weak spillover effects among the various markets in Nigeria. Udejaja (2019) investigated the interconnectedness between the stock, money and forex markets in Nigeria using the Diebold and Yilmaz framework on monthly data from January 2000 to December 2018. The study documented evidence of significant interconnectedness among the markets, with the degree of dependence increasing during periods of economic downturn and plummeting oil prices.

It is evident from the survey of the foregoing studies in Nigeria that the preponderance of evidence supports the existence of volatility transmission and spillovers among various sectors and markets within the financial system. However, none these studies appeared to contemplate the interconnectedness of the stock market with the bond market in Nigeria.

3. METHODOLOGY

This paper examines volatility spillovers and transmission between the NSE All-Share Index (ASI) and the bonds market around the 2016 economic recession. To achieve this, the

study collected quantitative secondary data in form of daily closing values of the NSE ASI, the 3-Month Bond Yield (which is the equivalent of 91-day Treasury Bills in terms of duration), the 10-Year Bond Yield and the 20-Year Bond Yield from the period 19th July 2012 to 26th February 2020 (the eve of announcement of the first case of COVID-19 in Nigeria). The base period was chosen purely based on data availability and the need to achieve a balanced sample series. In order to account for the effect of the 2016 economic recession on risk transmission and volatility spillovers between the Nigerian stock and bonds markets, the data was split into the period before the recession (pre-recession) and the period after it (post-recession). The pre-recession sample starts from 19th July 2012 to 31st March 2016 while the post-recession period runs from 1st April 2016 to 26th February 2020.

The daily values of the NSE ASI, the 3-Month, 10-Year and 20-Year Bond Yields were converted to continuously compounded return using the approach specified in the following formula:

$$R_{i,t} = \ln \left[\frac{V_{i,t} - V_{i,t-1}}{V_{i,t-1}} \right] \dots \dots \dots (1)$$

Where:

$R_{i,t}$ = Return on asset i at time t

$V_{i,t}$ = Value of asset i at time t

$V_{i,t-1}$ = Value of asset i at time t-1

ln = Natural logarithm

The logarithmic transformation was important in order to control for the effect of outliers in the series. Given the constant time interval inherent in the return series, establishing their stationarity becomes inevitable as the absence of such evidence can render estimated results spurious (Agung, 2009; Greene, 2003). Therefore, the Augmented Dickey-Fuller (ADF) test (Dickey & Fuller, 1979), the Phillips-Perron (PP) test (Phillips & Perron, 1988), and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test (Kwiatkowski, Phillips, Schmidt & Shin, 1992) were employed to test for the stationarity of the four return series.

To establish appropriateness and suitability of the GARCH models for this study, the Engle (1982) model for ARCH effects was employed to test for the presence of innovations in the residuals of an ARMA(1,1) model estimated for each of the four return series. According to Engle (1982), the ARCH-LM test is based on the following model:

$$e^2_t = \beta_0 + \left(\sum_{s=1}^q \beta e^2_{t-s} \right) + v_t \dots \dots \dots (2)$$

Where e^2_t is the square of the residual at time t, β_0 is a constant, βe^2_{t-s} is the coefficient of the lagged residual at time t-1; and v_t is the error term at time t.

The paper examined volatility spillovers and risk transmission in the form of shocks between the Nigerian stock market and the bonds market using the Multivariate GARCH (MGARCH) family models because they have been found to be efficient in the parameterization of conditional cross-moments (Worthington & Higgs, 2004). This is in addition to the models' ability to account for time-varying variances of economic and financial time series. Specifically, the paper utilized the symmetric MGARCH (1,1) model developed by Engle and Kroner (1995). The MGARCH(1,1) model used in this study was based on the Diagonal BEKK (Baba, Engle,

Kraft & Kroner, 1990) parameterization where the variance-covariance relationship of the estimated equation depends on the squares and cross products of innovations (ε_t) and volatility (h_t) for each asset return lagged one period. Unlike the VEC parameterization, BEKK ensures that the condition of a positive semi-definite variance-covariance matrix is met. In addition, Karolyi (1995) argued that the BEKK model does not require the estimation of a large number of parameters. The BEKK parameterization for the MGARCH model as put forward by Baba et al. (1990) is specified as follows:

$$H_t = W'W + A'H_{t-1}A + B'\Xi_{t-1}\Xi_{t-1}'B \dots\dots\dots (3)$$

Where A and B are 2×2 matrices of parameters and W is an upper triangular matrix of parameters. H_t denotes conditional variance-covariance matrix at time t , the diagonal elements in the matrix represent return variances; and the non-diagonal elements denote covariances between asset returns.

Even though the symmetric BEKK-MGARCH model is capable of capturing its own volatility dependence as well as cross-volatility effects, it is unable to account for asymmetric effects in the risk spillover mechanism among financial assets. In order to model and capture this asymmetric effect, the study utilized an extension of the symmetric BEKK-MGARCH model to an asymmetric form developed by Kroner and Ng (1998). The asymmetric BEKK-MGARCH (ABEKK-MGARCH) model can distinguish between positive and negative shocks in both own and cross volatility dependence (Gencer & Hurata, 2017). The ABEKK-MGARCH model for conditional variance is specified as follows (Kroner & Ng, 1998):

$$H_t = W'W + A'H_{t-1}A + B'\Xi_{t-1}\Xi_{t-1}'B + D'\eta_{t-1}\eta_{t-1}'D \dots\dots\dots (4)$$

Where:
$$\eta_{t-1} = \begin{bmatrix} \max(0, -z_{1,t-1}) \\ \max(0, -z_{2,t-1}) \end{bmatrix} \text{ and}$$

$$W = \begin{bmatrix} W_{11} & W_{12} \\ 0 & W_{22} \end{bmatrix}, A = \begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix}, B = \begin{bmatrix} B_{11} & B_{12} \\ B_{21} & B_{22} \end{bmatrix}, D = \begin{bmatrix} D_{11} & D_{12} \\ D_{21} & D_{22} \end{bmatrix}$$

Note that D is a square matrix which models asymmetric effects in variances and covariances through η_{t-1} . Thus, the D matrix captures the asymmetric characteristics of the time-varying variance-covariance relationship, representing covariance asymmetry. While the diagonal coefficients of the D matrix measure the reaction of an asset to its own shock, the off-diagonal coefficients quantify the reaction of one asset to the shock of other assets. Accordingly, a positive and significant coefficient of D is indicative of asymmetric effect, implying that bad news events induce larger volatility in financial assets than good news.

The parsimonious variance-covariance equations estimated for the NSE ASI, 3-Month Bond Yield, 10-Year Bond Yield and 20-Year Bond Yield returns under the symmetric and asymmetric BEKK-MGARCH models in this paper are specified as follows: Equations (5) to (8) specify the individual conditional variance equations for the return.

$$\sigma^2_{r_{NSE,t}} = \omega + \alpha_1 \varepsilon^2_{r_{NSE,t-1}} + \beta_1 h^2_{r_{NSE,t-1}} \dots\dots\dots (5)$$

$$\sigma^2 r_{3my,t} = \omega + \alpha_1 \varepsilon^2 r_{3my,t-1} + \beta_1 h^2 r_{3my,t-1} \dots\dots\dots (6)$$

$$\sigma^2 r_{10yy,t} = \omega + \alpha_1 \varepsilon^2 r_{10yy,t-1} + \beta_1 h^2 r_{10yy,t-1} \dots\dots\dots (7)$$

$$\sigma^2 r_{20yy,t} = \omega + \alpha_1 \varepsilon^2 r_{20yy,t-1} + \beta_1 h^2 r_{20yy,t-1} \dots\dots\dots (8)$$

Where $\sigma^2 r_{NSE,t}$, $\sigma^2 r_{3my,t}$, $\sigma^2 r_{10yy,t}$ and $\sigma^2 r_{20yy,t}$ are the conditional variances of the NSE, 3-Month Bond Yield, 10-Year Bond Yield and 20-Year Bond Yield returns respectively at time t. ω is the constant for the variance equation, while $\alpha_1 \varepsilon^2 r_{NSE,t-1}$, $\alpha_1 \varepsilon^2 r_{3my,t-1}$, $\alpha_1 \varepsilon^2 r_{10yy,t-1}$, and $\alpha_1 \varepsilon^2 r_{20yy,t-1}$ are the innovation terms for the NSE, 3-Month Bond Yield, 10-Year Bond Yield and 20-Year Bond Yield returns respectively. The $\beta_1 h^2 r_{NSE,t-1}$, $\beta_1 h^2 r_{3my,t-1}$, $\beta_1 h^2 r_{10yy,t-1}$ and $\beta_1 h^2 r_{20yy,t-1}$ are the respective GARCH terms for the four return series. On the other hand, the parsimonious conditional covariance equations for the NSE ASI, 3-Month Bond Yield, 10-Year Bond Yield and 20-Year Bond Yield returns are specified in equations (9) to (14) respectively.

$$Cov(r_{NSE,t}, r_{3my,t}) = \psi + \phi_1 \varepsilon r_{NSE,t-1} \varepsilon r_{3my,t-1} + \phi_1 cov(r_{NSE}, r_{3my})_{t-1} \dots\dots\dots (9)$$

$$Cov(r_{NSE,t}, r_{10yy,t}) = \psi + \phi_1 \varepsilon r_{NSE,t-1} \varepsilon r_{10yy,t-1} + \phi_1 cov(r_{NSE}, r_{10yy})_{t-1} \dots\dots\dots (10)$$

$$Cov(r_{NSE,t}, r_{20yy,t}) = \psi + \phi_1 \varepsilon r_{NSE,t-1} \varepsilon r_{20yy,t-1} + \phi_1 cov(r_{NSE}, r_{20yy})_{t-1} \dots\dots\dots (11)$$

$$Cov(r_{3my,t}, r_{10yy,t}) = \psi + \phi_1 \varepsilon r_{3my,t-1} \varepsilon r_{10yy,t-1} + \phi_1 cov(r_{3my}, r_{10yy})_{t-1} \dots\dots\dots (12)$$

$$Cov(r_{3my,t}, r_{20yy,t}) = \psi + \phi_1 \varepsilon r_{3my,t-1} \varepsilon r_{20yy,t-1} + \phi_1 cov(r_{3my}, r_{20yy})_{t-1} \dots\dots\dots (13)$$

$$Cov(r_{10yy,t}, r_{20yy,t}) = \psi + \phi_1 \varepsilon r_{10yy,t-1} \varepsilon r_{20yy,t-1} + \phi_1 cov(r_{10yy}, r_{20yy})_{t-1} \dots\dots\dots (14)$$

Where $Cov(r_{NSE,t}, r_{3my,t})$, $Cov(r_{NSE,t}, r_{10yy,t})$, $Cov(r_{NSE,t}, r_{20yy,t})$, $Cov(r_{3my,t}, r_{10yy,t})$, $Cov(r_{3my,t}, r_{20yy,t})$ and $Cov(r_{10yy,t}, r_{20yy,t})$ are the covariances between the NSE, 3-Month Bond Yield, 10-Year Bond Yield and 20-Year Bond Yield returns respectively at time t.

In this paper, the log likelihood of the symmetric and asymmetric MGARCH models was maximized using the Marquardt optimization algorithm. In view of the preponderance of empirical evidence that financial asset returns are hardly normally distributed and thus tend to exhibit excess kurtosis and fat tails, the models were estimated under the assumption that the conditional errors follow a student's t rather than a normal distribution pattern.

In order to establish whether the symmetric or asymmetric model performed better, the study utilized the Akaike Information Criteria (AIC) and the Schwarz Bayesian Information Criteria (SBIC) as model selection criteria. The lower the values of the model selection criteria, the better fitted is a model relative to its counterpart. The AIC is computed based on the following model:

$$AIC = -2l/T + 2k/T \dots\dots\dots (15)$$

The SBIC, which is often employed as alternative to the AIC, imposes larger penalty for additional coefficients in the model. The SBIC is computed based on the following specification:

$$SBIC = -2l/T + (k \log T)/T \dots\dots\dots (16)$$

Where l is the log likelihood, T is the number of observations and k is the number of right-hand side regressors.

4. RESULTS AND DISCUSSIONS

The series NSE and bond yield returns were examined for stationarity as specified under the methodology of the paper. Summary of the results is presented in Table 1.

Table 1. Stationarity Test Results

<i>Panel A: Pre-Recession Return Series Stationarity Test Results</i>				
	<i>ADF Test</i>	<i>PP Test</i>	<i>KPSS Test</i>	<i>Order of Integration</i>
NSE Return	-20.12***	-19.59***	0.64	I(0)
3-Month Bond Yield Return	-8.57***	-32.76***	0.53	I(0)
10-Year Bond Yield Return	-14.00***	-27.04***	0.12	I(0)
20-Year Bond Yield Return	-31.16***	-31.15***	0.18	I(0)
<i>Panel B: Post-Recession` Series Stationarity Test Results</i>				
	<i>ADF Test</i>	<i>PP Test</i>	<i>KPSS Test</i>	<i>Order of Integration</i>
NSE Return	-24.43***	-24.79***	0.36	I(0)
3-Month Bond Yield Return	-30.19***	-30.22***	0.27	I(0)
10-Year Bond Yield Return	-29.26***	-29.29***	0.93	I(0)
20-Year Bond Yield Return	-19.36***	-35.10**	0.87	I(0)

Source: Author's Compilations from E-Views 10 Output, 2021

*, ** and *** imply significance at the 10%, 5% and 1% levels respectively.

It can be seen that results in Panel A of the table, which presents pre-recession return series, strongly rejected the null hypothesis of existence of unit root in the series using the ADF and PP tests. Similarly, the KPSS test failed to reject the null hypothesis of stationarity of for all the series. This in effect implies that the series of NSE and bond yield returns were found to be stationary at levels and integrated of the order I(0). In the same vein, the results for post-recession stationarity test presented under Panel B of the same table show evidence of rejection of the null hypothesis of presence of unit root in the series based on the ADF and PP tests. Results based on the KPSS in the same panel showed evidence of failure to reject the null hypothesis of stationarity. This implies that, like their pre-recession counterparts, the NSE and bond yield return series were stationary at levels and also integrated of the order I(0). This behavior is not surprising considering the existing evidence that financial asset returns tend to be stationary while their prices are non-stationary (Agung, 2009; Brooks, 2008).

To be sure that the return series under investigation display significant ARCH innovations in their time-varying behavior, the residuals from an ARMA model for each of the series were subjected to Engle (1982) ARCH-LM test. The results are presented in Table 2.

Table 2. ARCH-LM Test Results

Panel A: Pre-Recession` ARCH-LM Test Results			
	<i>No. of lags</i>	<i>F-Statistics</i>	<i>Chi-Statistics</i>
NSE Return	12	5.42***	61.49***
3-Month Bond Yield Return	12	4.73***	54.18***
10-Year Bond Yield Return	12	10.72***	114.07***
20-Year Bond Yield Return	12	1.94*	11.33*
Panel B: Post-Recession` ARCH-LM Test Results			
	<i>No. of lags</i>	<i>F-Statistics</i>	<i>Chi-Statistics</i>
NSE Return	12	9.39***	101.36***
3-Month Bond Yield Return	12	4.77***	96.28***
10-Year Bond Yield Return	12	10.41***	111.81***
20-Year Bond Yield Return	12	13.15***	136.97***

Source: Author's Compilations from E-Views 10 Output, 2021

*,**and*** imply significance at the 10%, 5% and 1% levels respectively.

It can be seen from Panel A of Table 2 that the ARCH-LM test conducted at a lag length of 12 revealed strong evidence of ARCH innovations in the pre-recession NSE return, 3-month yield and 10-year yield respectively. However, the series of return on the 20-year bond yield was marginally significant. This evidence was supported by both the Chi and F-statistics. For the post-recession series, the results presented in Panel B revealed that all the series exhibited strong evidence of significant ARCH innovations.

Two things can be inferred from these results. Firstly, the fact that the series exhibited significant volatility confirms the appropriateness of GARCH family models as the tool of analysis. Secondly, the evidence stronger volatility in the post-recession sample is *prima facie* indication of increase in volatility in the period post-recession.

To further understand behavior of the return series, descriptive statistics have been computed. Table 3 presents the key summary statistics for the NSE and bond yield returns.

Table 3. Pre-Recession and Post-Recession Return Descriptives

Panel A: Pre-Recession Return Descriptives							
	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min.</i>	<i>Max.</i>	<i>Skewness</i>	<i>Kurtosis</i>	<i>Normality</i>
NSE Return	0.01	1.07	-4.19	8.31	0.41	9.73	1750.36***
3-Month Yield	0.51	12.74	-59.14	202.76	8.25	116.03	497495.3***
10-Year Yield	-0.02	1.52	-13.22	8.94	-0.98	23.19	15679.66***
20-Year Yield	-0.01	1.36	-10.72	14.32	-0.14	31.88	31805.62***
Panel B: Post-Recession Return Descriptives							
	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min.</i>	<i>Max.</i>	<i>Skewness</i>	<i>Kurtosis</i>	<i>Normality</i>
NSE Return	0.01	0.96	-4.26	3.88	0.47	6.18	443.55***
3-Month Yield	0.97	33.87	-73.66	1037.9	29.70	910.10	3329510***
10-Year Yield	-0.02	0.86	-5.64	4.87	-0.77	10.91	2617.12***
20-Year Yield	-0.01	0.90	-7.86	7.82	-0.12	20.41	12207.90***

Source: Author's Compilations from E-Views 10 Output, 2021

*,**and*** imply significance at the 10%, 5% and 1% levels respectively.

Table 3 shows in Panel 1 that the mean or average return for the NSE and the 3-month yield in the pre-recession period is positive while that of 10-year and 20-year yields are negative. The 3-month yield bond had the highest mean return in the pre-recession period. The standard deviation also showed relatively moderate dispersion, suggesting that market risk was not too extreme. However, the same 3-month yield bond recorded the highest relative rate of dispersion around the mean return. However, the relatively wide gap between the minimum and maximum values of return in the pre-recession period suggest high variability during the period. The panel further shows that the NSE and 3-month bond yield returns are positively skewed and thus their distributions have longer right tails, while the 10-year and 20-year yield returns are negatively skewed. All the series of returns in the pre-recession period exhibited excess kurtosis or leptokurtic distribution and non-normality.

On the other hand, descriptives in Panel B for the post –recession period revealed that the mean values for the NSE and 3-month yield are positive, while those of the 10-year and 20-year yields are negative, with the positive return for the 3-month yield being the highest. The panel shows a lower level of dispersion around the mean as well as variability between the minimum and maximum values of return for the post-recession period when compared with that of the pre-recession period. Like in the previous panel however, return on the 3-month bond yield exhibited higher dispersion and variability in the in the post-recession sub-sample in relative terms. The panel further depicts positive skewness for the NSE and 3-month yield returns while the 10-year and 20-year yields returns were negatively skewed. It can be seen from the panel that all the series in the post-recession period are leptokurtic in their distribution and therefore were not normally distributed. Particularly, 3-month yield return displayed extreme leptokurtic as well as non-normal behavior over the period.

It is thus obvious from Table 3 that the NSE and bond yield-return series in the pre-recession and post-recession displayed approximately similar characteristics in terms of dispersion, variability, skewness, kurtosis and normality. There was evidence of relatively high dispersion and variability, negative skewness, excess kurtosis as well as non-normality, with the results being extreme for the 3-month yield return in both the pre-recession and post-recession periods. The extreme distributional characteristics of the 3-month yield point to its profitable and concomitant risky nature over the entire period under consideration. In effect, the characteristics displayed in Table 3 closely approximate to those of financial asset returns established by theory that they are hardly normally distributed and therefore exhibit excess kurtosis and fat tails (Greene, 2003; Gujarati, 2003).

In line with the specified methodology, the paper estimated asymmetric MGARCH model based on BEKK parameterization. The results are presented in Table 4

Table 4. Symmetric BEKK-MGARCH Variance and Covariance Equations Results

Panel A: Pre-Recession Variance and Covariance Equations Coefficients				
	NSE Return	3-Month Yield Return	10-Year Yield Return	20-Year Yield Return
$\omega_{i,t}$	0.2147**	3.0397***	0.1978**	0.2869***
$\alpha r_{i,t}$	0.4611***	0.6386***	0.4117***	0.8877***
$h_{i,t}$	0.9356***	0.8600***	0.9350***	0.7508***
$Cov(r_{NSE,t}, r_{3my,t})$	-	0.1989***	-	-
$Cov(r_{NSE,t}, r_{10yy,t})$	-	-	-0.1821***	-

$Cov(r_{NSE,t}, r_{20yy,t})$	-	-	-	0.0687***
$Cov(r_{3my,t}, r_{10yy,t})$	-	-	3.4520***	-
$Cov(r_{3my,t}, r_{20yy,t})$	-	-	-	3.4758***
$Cov(r_{10yy,t}, r_{20yy,t})$	-	-	-	0.9639***
t-Distribution	2.3466***			
Panel B: Post-Recession Variance and Covariance Equations Coefficients				
	NSE Return	3-Month Yield Return	10-Year Yield Return	20-Year Yield Return
$\omega_{i,t}$	18.0371	0.0000	0.8603	1.4712
$ar_{i,t}$	3.4456	10.2259	1.6445	1.6098
$h_{i,t}$	0.7454***	0.5673***	0.9658***	0.9451***
$Cov(r_{NSE,t}, r_{3my,t})$	-	-1.8359***	-	-
$Cov(r_{NSE,t}, r_{10yy,t})$	-	-	-0.0353***	-
$Cov(r_{NSE,t}, r_{20yy,t})$	-	-	-	0.0319***
$Cov(r_{3my,t}, r_{10yy,t})$	-	-	0.7981***	-
$Cov(r_{3my,t}, r_{20yy,t})$	-	-	-	-0.0634***
$Cov(r_{10yy,t}, r_{20yy,t})$	-	-	-	0.3220***
t-Distribution	2.011***			

Source: Author's Compilations from E-Views 10 Output, 2021

*, ** and *** imply significance at the 10%, 5% and 1% levels respectively.

From Panel A of Table 4, it can be seen that in terms of univariate analysis, the coefficients of ARCH innovations for the NSE, 3-month yield, 10-year yield and 20-year yield returns in the pre-recession period were strongly significant, indicating the presence of significant volatility in all the return series. These ARCH innovations appear to be highest in the 20-year and 3-month yields respectively, suggesting that they were more volatile in behavior than the other series. Similarly, the panel shows evidence of strongly significant volatility persistence in all the returns, with the evidence more pronounced for the 3-month yield and the 20-year yield respectively. In terms of multivariate results, the panel shows that there is strong positive and significant volatility co-movement between the NSE and 3-month yield bond returns, between the NSE and 20-year yield, between the 3-month and 10-year yield, between the 3-month yield and 20-year yield, and between the 10-year yield and the 20-year yield returns in the pre-recession period. However, only the co-movement between the NSE and 10-year bond yield returns was negative and strongly significant within the same period. In view of the fact that the return series were found to be non-normally distributed, the strongly significant student's t coefficient supports suitability of the distribution in estimating the relationship in the pre-recession sub-sample.

On the other hand, results from Panel B on post-recession depict evidence of insignificant ARCH innovations, suggesting that volatility became less pervasive and pronounced after the 2016 recession. However, volatility was persistence was very high and as significant as was the case in the pre-recession period. In terms of co-movement, the volatility co-movement between the NSE and 3-month bond yield returns, the NSE and 10-year yield returns, and the 3-month yield and 20-year yield returns was negative and strongly significant.

However, co-movement between the NSE return and 20-year yield, the 3-month yield and 10-year yield returns, and the 10-year yield and 20-year yield returns was positive and strongly significant in the post-recession period. The coefficient of t-distribution was also strongly significant at the one percent level.

In a nutshell, results based on symmetric models suggest that spillovers of volatility among the NSE return, 3-month yield return, 10-year yield return and 20-year yield return in the period preceding the economic recession is significant and pervasive. However, such degree of interconnectedness and spillover between the various returns, though significant, declined in the period after the recession.

In order to account for the effect of asymmetries, the MGARCH model was re-estimated with its BEKK form to account for asymmetric effects. Results of the model are presented in Table 5.

Table 5. Asymmetric BEKK-MGARCH Variance and Covariance Equations Results

<i>Panel A: Pre-Recession Variance and Covariance Equations Coefficients</i>				
	NSE Return	3-Month Yield Return	10-Year Yield Return	20-Year Yield Return
$\omega_{i,t}$	0.1850***	1.4487***	0.1493***	0.1804***
$ar_{i,t}$	0.2912***	0.3636***	0.4097***	0.9009***
$h_{i,t}$	0.9216***	0.8734***	0.9214***	0.7344***
$\gamma_{i,t}$	0.5707***	0.7968***	-0.2571***	-0.1928
$Cov(r_{NSE,t}, r_{3my,t})$	-	0.1992***	-	-
$Cov(r_{NSE,t}, r_{10yy,t})$	-	-	-0.1822***	-
$Cov(r_{NSE,t}, r_{20yy,t})$	-	-	-	0.0687***
$Cov(r_{3my,t}, r_{10yy,t})$	-	-	3.4527***	-
$Cov(r_{3my,t}, r_{20yy,t})$	-	-	-	3.4744***
$Cov(r_{10yy,t}, r_{20yy,t})$	-	-	-	0.9639***
t-Distribution				2.4637***
<i>Panel B: Post-Recession Variance and Covariance Equations Coefficients</i>				
	NSE Return	3-Month Yield Return	10-Year Yield Return	20-Year Yield Return
$\omega_{i,t}$	18.3209	0.0000	1.1270	2.2018
$ar_{i,t}$	4.8330	8.7107	1.6058	0.7129
$h_{i,t}$	0.6430***	0.5391***	0.9499***	0.9158***
$\gamma_{i,t}$	2.7475	-9.1758	1.7284	2.7459
$Cov(r_{NSE,t}, r_{3my,t})$	-	-1.7832***	-	-
$Cov(r_{NSE,t}, r_{10yy,t})$	-	-	-0.0384***	-
$Cov(r_{NSE,t}, r_{20yy,t})$	-	-	-	0.0307***
$Cov(r_{3my,t}, r_{10yy,t})$	-	-	0.7907***	-
$Cov(r_{3my,t}, r_{20yy,t})$	-	-	-	-0.0623***
$Cov(r_{10yy,t}, r_{20yy,t})$	-	-	-	0.3222***

t-Distribution	2.0136***
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Source: Author's Compilations from E-Views 10 Output, 2020

*, **and*** imply significance at the 10%, 5% and 1% levels respectively.

Panel A of Table 5 indicates that ARCH innovations for all the return series in the pre-recession period are strongly significant, suggesting the presence of volatility in these markets. Similarly, the level of persistence of volatility in all these return series was also found to be strongly significant, implying the sustainability of volatility and the non-quick decay of its effect in such financial markets. There was also strong evidence in favour of asymmetry in the observed volatility for the NSE return, 3-month yield return, and 10-year yield return. The evidence of asymmetric effects implies that negative information generates higher volatility than positive information of the same magnitude or value. In terms of multivariate results, co-movement between the NSE and 3-month yield returns, the NSE and 20-year yield returns, 3-month yield and 10-year yield returns, 3-month yield and 20-year yield returns, and 10-year yield and 20-year yield returns was found to be positive and strongly significant in the pre-recession period. However, only the co-movement between NSE and 10-year yield returns was found to be negative and significant during the period. The t-distribution employed to estimate the pre-recession period relationship strongly fitted the asymmetric BEKK model estimated as shown by the strongly significant value.

On the other hand, results for the post-recession results presented in Panel B show insignificant ARCH innovations but strongly significant volatility persistence over time. Similarly, the observed symmetric effect across all the asset classes was not significant at any of the conventional levels. are not statistically significant at any of the conventional levels. In terms of co-movement, the NSE and 20-year yield returns, 3-month and 10-year yield returns, and 10-year and 20-year yield returns were found to positively and strongly co-move over time. The panel also shows strongly significant coefficient of t-distribution, suggesting fitness of the distribution in estimating the asymmetric model.

On the overall, results of both the symmetric and asymmetric models support the evidence of stronger volatility in form of ARCH innovations in pre-recession period compared to the post-recession period. Furthermore, the results also show persistence of volatility in the NSE return, 3-month yield return, 10-year yield return, and 20-year yield return within the pre-recession and post-recession periods. However, the persistence was also more pronounced in the pre-recession period rather than the post-recession period. In terms of volatility spillovers and co-movement, the results showed on the overall that the NSE return and 10-year yield return consistently co-varied negatively in the pre-recession period while the remaining return series consistently co-moved positively over the same period. The positive co-movement between the NSE return and 3-month yield return, NSE return and 20-year yield return, and 10-year yield and 20-year yield returns shows that assets move in the same direction. In the post-recession period, overall results show that the NSE return and 3-month yield return, NSE return and 10-year yield return, and the 3-month yield and 20-year yield returns consistently co-moved negatively while the remaining asset return co-varied positively over the period. The findings suggest that the advent of the 2016 economic recession in Nigeria has altered the nature of volatility co-movement and transmission among these various classes of assets. Specifically, the NSE return and 3-month yield return, and the 3-month yield and 10-year yield returns, which positively co-moved in the pre-recession period realigned and negatively co-moved in the post-recession period.

While no previous known study in Nigeria has concentrated on examining the behavior of volatility spillovers and co-movements during periods of economic turmoil, the finding of this study is consistent with those of other financial markets such as Slimane et al. (2013),

Dewandaru et al. (2014), Gencer and Hurata (2017) and Sari et al. (2017) who variously found that financial crises have altered the nature of volatility co-movement and transmission among financial markets. However, the findings of this study appear to be inconsistent with those of Valls and Chulia (2014) who found mixed evidence on effect financial crises on volatility spillovers and transmission.

5. CONCLUSION

This paper examined the effect of volatility transmission and co-movement among the stock and bond market returns in Nigeria around the 2016 economic recession. The study found evidence of higher volatility in the asset returns in the period before the recession. This evidence is consistent with the notion that economic activities were at their best before the recession set in. High rate of market activities in the period just before economic recessions set in is a notorious feature that has long been established by economist.

For the multivariate results on co-movement, the study found that economic recession altered the nature of co-movement among the various financial assets. This finding has far-reaching implications for portfolio diversification and wealth planning by investors. In the post-recession period where assets with hitherto positive co-movement reversed to negative, the sudden realignment is capable of inducing unexpected losses to investors as a result of the need to re-balance investors' portfolios and other holdings of these financial assets. Most importantly however, it can be concluded that the sudden reversal of co-variance and co-movement among some of the financial asset returns means that the opportunities for investors to diversify the recession risk between the stock and bond markets across different classes of such assets increased in the post-recession period.

This paper therefore recommends the need for financial market policy makers in Nigeria such as the NSE and the Securities and Exchange Commission (SEC) to provide adequate liquidity support and enhance information dissemination in financial markets during period of economic recessions. This will go a long way in reducing the risk associated with the attendant portfolio realignment and further sustain the tempo of market activities.

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NEW DATA ON THE HELMINTH FAUNA OF *CHONDROSTOMA VARDARENSE* FROM LOWER STREAM OF RIVER TUNDZHA, BULGARIA

Mariya Chunchukova*

Department of Agroecology and Environmental Protection, Agricultural University-Plovdiv, Bulgaria

Abstract: River Tundzha, with its length of 349.5 km on Bulgarian territory, is the third-longest among the rivers of Bulgaria and the biggest tributary of Maritsa River (Aegean Basin). Almost the entire Lower Tundzha River from the city of Yambol till before leaving Bulgarian boundaries is about to be pronounced as Protected Zone (NATURA 2000 zones: Reka Tundzha 2 BG0000195). During the ecological study of 12 specimens of an endemic Vardar nase (*Chondrostoma vardarense* Karaman, 1928) by applying standard techniques for parasites, an infestation with nematode species, larva was found. Helminth parasites were recorded in seven specimens of *Chondrostoma vardarense* (58.33). The basic ecological characteristics and biotic indices of the parasite populations and communities are determined. Bioindicator significance of established parasite species was discussed for ecological evaluation of the state of the studied freshwater ecosystem. As a result of this study, new data for helminths of *Chondrostoma vardarense* is presented.

Keywords: *Chondrostoma vardarense*, fish parasites, River Tundzha, biomonitoring

1. INTRODUCTION

River Tundzha with its length of 349.5 km (on Bulgarian territory), is third among the rivers of Bulgaria and the biggest tributary of Maritsa River. The ichthyofauna of the Lower stream of River Tundzha is presented by 19 fish species (Kolev, 2014). The dynamics of upstream fish migration in the lower course of Tundzha River was recently studied by Angelov et al. (2020). Fish parasite communities and biodiversity from the Tundzha River were studied from Kakacheva-Avramova (1972), Kirin et al. (2013), Chunchukova & Kirin (2020), and Chunchukova & Kirin (2021). Helminths and helminth communities are extremely important as elements of biodiversity and reflect the state of the freshwater ecosystem and the food web structure because of their complex life cycle. This study aims to present the diversity of helminth fauna of the endemic *Chondrostoma vardarense* from Tundzha River, Bulgaria. As a result of this survey, new data for the helminth fauna of Vardar nase is presented.

* Corresponding author: m.chunchukova@abv.bg

2. MATERIALS AND METHODS

A total of 12 specimens of Vardar nase (*Chondrostoma vardarense*) are collected and examined from the Lower stream of River Tundzha in Bulgaria (village Konevets). Konevets (42.2667° N 26.5667° E) is a village in southeastern Bulgaria, Tundzha municipality, Yambol District. Fish were caught by angling. According to the FishBase database, the scientific and common names of fish hosts are used (Froese & Pauly, 2021).

The fish samples were examined for gastrointestinal parasites (incomplete parasitological study) using standard techniques and immediately after their capture. Helminthological examinations are carried out following recommendations and procedures described by Petrochenko, 1956; Bauer et al., 1981; Bykhovskaya-Pavlovskaya, 1985; Moravec, 1994; etc. Nematodes are examined as temporary microscopic preparations in glycerin and identified (Moravec, 1994; 2013).

The dominant structure of the component helminth communities was determined according to the criteria proposed by Kennedy (1993) based on the prevalence (P%): accidental (P% < 10), component (10 < P% < 20), and core (P% > 20) species. The ecological terms prevalence (P%), mean intensity (MI), and mean abundance (MA) are used based on the terminology of Bush et al. (1997).

3. RESULTS

3.1. MODEL FISH SPECIES

A total of 12 specimens of Vardar nase (*Chondrostoma vardarense* Karaman, 1928) are collected and examined from the Tundzha River. The studied fish species is estimated as near threatened (NT=Near Threatened; IUCN Red List Status).

Vardar nase is freshwater, benthopelagic, gregarious fish species. This fish species belongs to the family Cyprinidae and is endemic for the Balkan peninsula and Aegian Sea basin (Stefanov, 2007). *C. vardarense* occurs in lowland watercourses. Adults of this fish species feed on benthic diatoms (Karapetkova & Zivkov, 2010; Froese & Pauly, 2021). For the migration activity of *C. vardarense* in the Tundzha River, the role of water temperature is more significant than that of water flow (Angelov et al., 2020).

3.2. HELMINTH COMMUNITY STRUCTURE

Helminth parasites are recorded in 7 Vardar nase specimens (58.33%) from the Tundzha River. One parasite species is identified: the nematode *Contracaecum* sp., presented by 13 specimens (Table 1).

Table 1. Species diversity of helminth parasites of *Chondrostoma vardarense* from Tundzha River (N – number of examined hosts, n – number of infected hosts, p – number of parasites, P – prevalence, MA – mean abundance, MI – mean intensity)

Helminth species	N=12					
	n	p	P%	MA±SD	MI±SD	Range
<i>Contracaecum</i> sp., larvae	7	13	58.33	1.08±1.19	1.86±0.99	1-3

Contracaecum sp. (P%=58.33) is core parasite species for the helminth communities of *Chondrostoma vardarense*. The largest number of helminth specimens established in a single host specimen is 3.

4. DISCUSSION

Contracaecum sp. belongs to family Aniskidae Railliet et Henry 1912 (Nematoda). The first intermediate hosts of *Contracaecum* sp. are different copepods. Larvae of this genus develop in the viscera of fishes that may serve as second intermediate hosts or paratenic hosts, while adult nematodes parasitize in the digestive tract of fish-eating birds and marine animals (Moravec, 2013). There is no reliable identification for larvae of this genus (see Moravec, 2013), but it has 25 fish hosts recorded in Bulgaria (Table 2).

Table 3. Overview of fish species reported as hosts of *Contracaecum* sp. larvae in Bulgaria

Fish species	Locality	Authors
<i>Alburnus alburnus</i>	Danube	Chunchukova et al. (2019) Zaharieva & Kirin (2020a)
<i>Abramis brama</i>	Danube	Chunchukova et al. (2016) * Chunchukova et al. (2017) *
<i>Abramis sapa</i>	Danube	Kakacheva-Avramova (1977) ***
<i>Chondrostoma nasus</i>	Danube	Zaharieva & Zaharieva (2020) Zaharieva & Kirin (2020b)
<i>Chondrostoma vardarense</i>	Tundzha	This study
<i>Carassius gibelio</i>	Srebarna Lake	Shukerova (2005) *
<i>Cyprinus carpio</i>	Srebarna Lake Mesta	Shukerova (2006) * Kirin (2001) **
<i>Rutilus rutilus</i>	Srebarna Lake	Shukerova & Kirin (2019) *
<i>Leuciscus cephalus</i>	Chepelarska River	Kirin (2002) **
<i>Perca fluviatilis</i>	Danube Srebarna Lake	Kakacheva-Avramova (1977) Shukerova et al. (2010)
<i>Knipowitschia caucasica</i>	Lake Atanasovsko	Stoyanov et al. (2018a)
<i>Lepomis gibbosus</i>	Lake Atanasovsko	Stoyanov et al. (2018b)
<i>Silurus glanis</i>	Danube Ivaylovgrad Reservoir	Kakacheva-Avramova (1977) *** Kirin & Kuzmanova (2014) ***
<i>Gymnocephalus cernua</i>	Timok River	Margaritov (1966) ***
<i>Gymnocephalus schraetser</i>	Danube	Kakacheva-Avramova (1977) ***
<i>Zingel zingel</i>	Danube	Margaritov (1966) ***
<i>Zingel streber</i>	Timok River Danube	Margaritov (1966) *** Kakacheva-Avramova (1977) ***
<i>Neogobius fluviatilis</i>	Timok River Danube	Margaritov (1966) *** Kakacheva-Avramova (1977)
<i>Gobio kessleri</i>	Danube	Kakacheva-Avramova (1977)
<i>Gobius cephalarges</i>	Danube	Margaritov (1960) ***
<i>Proterorhinus marmoratus</i>	Danube	Kakacheva-Avramova (1977) ***

<i>Acipenser ruthenus</i>	Danube	Rusev (1963) *** Kakacheva-Avramova (1977) ***
<i>Exos lucius</i>	Danube Maritsa River	Kakacheva-Avramova (1977) *** Kirin (2006) ***
<i>Lota lota</i>	Danube	Kakacheva-Avramova (1977)
<i>Alosa ponica</i>	Danube	Kakacheva-Avramova (1977) ****

* reported as *Contracaecum microcephalum*

** reported as *Contracaecum squalii*

*** reported as *Contracaecum bidentatum*

**** reported as *Contracaecum aduncum*

Chunchukova & Kirin (2020) reported for the helminth fauna of Vardar nase from Tundzha River the acanthocephalan species *Acanthocephalus anguillae*. This is the first report for *Contracaecum* sp. larvae for the helminth fauna of *Chondrostoma vardarense* for Bulgaria and the first report for *Contracaecum* sp. larvae from the freshwater ecosystem of the Tundzha River. For River Tundzha, up till now are reported six nematode species from 7 fish hosts, mainly cyprinids (Table 3).

Table 3. Nematode species reported for fish from Tundzha River in Bulgaria

Fish species Nematode species	<i>Alburnus alburnus</i>	<i>Squalius cephalus</i>	<i>Salmo trutta</i>	<i>Barbus cyclolepis</i>	<i>Vimba melanops</i>	<i>Scardinius erythrophthalmus</i>	<i>Chondrostoma vardarense</i>
<i>Rhabdochona denudata</i>	● ¹	● ^{1,2}					
<i>Salmonema ephemeridarum</i> *			● ¹				
<i>Schulmanella</i> sp.				● ¹			
<i>Philometra rischta</i>					● ¹		
<i>Philometra cyprinirutili</i>						● ³	
<i>Contracaecum</i> sp.							● ⁴

¹ Kakacheva-Avramova (1972)

² Kirin et al. (2013)

³ Chunchukova & Kirin (2020)

⁴ present study

* *Salmonema ephemeridarum* was reported with the synonym *Cystidicoloides tenuissima*

According to Shamsi (2019), the populations of *Contracaecum* parasites may be increasing due to anthropogenic factors. Mina et al. (2014) reported decreased genetic diversity for *Chondrostoma vardarense* from the Polyphytos artificial lake of the river Aliakmonas (Kozani, Greece) can seriously affect the survival and reproduction of the species.

4. CONCLUSION

As a result of the investigation of 12 specimens of *Chondrostoma vardarense* from the Tundzha River, one gastrointestinal parasite species was established – the nematode

Contracaecum sp. *Contracaecum* sp. (P%=58.33) is core parasite species for the helminth communities of Vardar nase. This is the first report for *Contracaecum* sp. larvae for the helminth fauna of *Chondrostoma vardarense* for Bulgaria and for *Contracaecum* sp. larvae from the freshwater ecosystem of Tundzha River. The obtained results for only one parasite species – *Contracaecum* sp., indicate the dominant presence of its first intermediate hosts in the studied freshwater ecosystem of Tundzha River, Bulgaria.

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NEW H2H MARKETING PARADIGM IN RESPONSE TO THE GREAT CRISIS OF TRUST

Adrijana Jevtić^{1*}, Dejan Riznić¹, Goran Milovanović²

¹ *University of Belgrade, Technical Faculty in Bor, Bor, Serbia;*

² *University of Niš, Faculty of Economics, Niš, Serbia*

Abstract: The modern market is characterized by the presence of fierce competition, as well as a high level of consumer involvement on the creation of values that are delivered to the market. In such conditions, companies compete for survival and stay on the market. In the desire for as much profit as possible, they take unethical measures, overload consumers with information about their products, leading them to buy, which in the end turns out that the buying is unprofitable for them. The result of such activities of individual companies, which are evidently increasing, is the emergence of a major crisis of trust. The crisis of trust has escalated so that many brands are in danger. It also raised great doubts about marketing and its role by imposing the question of whether marketing is really a support to people when buying or whether it still works against them. The credibility of marketing was further impaired the moment consumers became aware that marketing campaigns conducted by numerous companies lead them to buy overpriced products and services. For the sake of survival, marketing had to undergo a major transformation, which involved having a key role in relation to consumers - an innovative approach involving employees, consumers and partners. In response to the great challenge, at the end of the 10s of the 21st century, a new H2H (human to human) marketing model was created, as an integration of hitherto individually used tools, techniques, methods, etc. into one whole, placing human need at the center. This paper presents the basis of the new H2H marketing model and its structure, with special reference to the strategic aspect, which puts the management of H2H trust and H2H brand at the center of the analysis.

Keywords: modern market, marketing transformation, trust crises, H2H trust management, H2H brand management

1. MODERN MARKET CHARACTERISTICS AND CHALLENGES

Over the years, marketing has evolved, going through various concepts and phases. As the marketing discipline evolves, so does more and more analysis, and tools, processes, and research techniques that managers can use to assess business phenomena and implement new marketing strategies are evolving.

Effective implementation of marketing strategy is of great importance for the success of the company. Academic studies provide evidence of strong links between marketing actions

* Corresponding author: ajevtic@tfbor.bg.ac.rs

(brand and sales costs) and marketing metrics (customer satisfaction, loyalty, market share) with a company's financial performance. For example, improving customer satisfaction is not just a "feeling good" tactic, but is associated with positive financial outcomes, including improved and stable (predictable) cash flows, sales growth, improved gross margin, and total shareholder returns. Research also shows that not every strategy pays off every time. Thus, some of the strategies that could increase market share could actually seriously damage profitability. (Palmatier & Sridhar, 2017)

Modern market is determined by specific business environment. The business environment changes dynamically in many forms. Although the number of factors is large, the modern market is characterized by the dominant influence of a number of factors. The most influential factors that externally create the market situation are: globalization, fierce competition, specific consumer requirements, social responsibility, digitalization and high usage of IT.

Globalization is one of the most influential factors which is constantly changing the market. Some authors understand globalization as a process. Globalization has reduced the world to a smaller place, resulting in a situation where the effects of international laws and legislations as well as impacts of international organizations reduce the influence of domestic governments (Osamor et al., 2013). Since globalization became a trend across the world, numerous studies have attempted to determine whether it is beneficial to economic and financial performances (Olasehinde-Williams & Balcilar, 2020). The impact of globalization is felt across all sectors of an economy, the marketing sector included. According to Potrafke (2015), globalization is a multifaceted concept that extends beyond its traditional indicators such as trade and financial openness, and includes economic, social and political dimensions. Economic globalization's emphasis on competition and profit maximization has been commended for increasing global economic efficiency, but also blamed for causing unemployment in disadvantaged sectors (Pierce & Schott, 2016).

Fierce competition between companies on the market is most common today. The dynamics of the global economy drag most of the world's countries to engage in free trade and to develop national economic cooperation. High performance achieved through competitive advantage is the goal of all companies who want to thrive in a dynamic, unpredictable modern business environment. In an effort to achieve this goal, medium enterprises are faced with the challenge of increasingly critical consumers who expect personalized service and fulfillment of products needed (Sil, 2018). According to Song & Wang (2018) market competition affects production innovation, and such an effect would indirectly affect trade comparative advantages. However, many authors have different views on the measurement of intensity of market competition. Current market competition is no longer limited to the competition on products. Market competition is also impacted by carbon emission, resource utilization, and environmental protection (Song & Wang, 2018).

Specific consumer requirements. The modern marketer shows a growing interest in the research of consumer decision-making styles to understand how an individual makes his/her buying decisions on the competitive environment (Bandara, 2014). A consumer considers a large number of brands to meet their needs.

Social responsibility as a belief that corporations have a responsibility towards society is not new (Agudelo et al., 2019). During the period from 1930s to 2010s SR were developing, but its influence on business has been increased, so today's impact is very strong, so companies have responsibilities towards society, particularly in the context of their business location and activities (Tamdava, 2020).

Digitalization has been identified as one of the major trends changing society and business in the near and long term future (Tihinen & Kääriäinen, 2016). According to

Parviainen et al. (2017) digitalization is as significant as industrial revolutions. It changes the way of doing business by applying the digital technology in all aspects of human society. There is no doubt that its influence is more positive than negative.

Digital technologies have changed the way companies around the world do business, so that the different pace and scale digitalization opens up new business opportunities, expanding market boundaries for many companies. At the same time, they pose new business challenges, which are faced by managers in the field of marketing. Digitalization has enabled the realization of economic growth, as well as increasing the competitiveness of goods and services. Given the significant scale and pace of digital transformations that are taking place today, the speed of responding to emerging changes is necessary to maintain a competitive advantage. The modern challenges of globalization contribute to the rapid application of the latest innovative possibilities of the digital world. Digitization is a necessary process in the development of modern organizations. Its main task is to simplify and speed up work with large data sets, automate company activities and establish communication with the external environment (Shpak et al., 2020).

Digitization blurs the boundaries between technology and management, facilitating new business models, upgraded to the concepts, methods, and tools of the digital environment. The digital revolution is reshaping the way individuals live and work fundamentally, and the public remains optimistic about the opportunities that Industry 4.0 can offer for sustainability (Javad et al., 2020).

Industry 4.0 was conceived as the fourth revolution to emerge in the manufacturing industry, but this conceptualization has evolved over the last few years (Xu et al., 2018). It is well known that Industry 4.0 has a significant strategic impact on the development of global industry, in the long run. The digital transformation of Industry 4.0 involves the digitization and integration of the entire product life cycle value chain (Ghobakhloo, 2020).

IT can be considered as a significant part of digitalization, and also as a necessary condition to establish digitalization.

For many companies fulfilling the specific market demands is not easy at all. That requires from them to improve their business, which is not always possible.

2. MARKETING CRISIS AND TRANSFORMATION

In the conditions of fierce competition present in the market, many companies were looking for a way to survive and stay in the market. Today, only those who have managed to respond to strict requirements are successful. Socially responsible business is just one of them. It means that the company operates in such a way that as a result of its work it achieves good both for itself and for the wider community and the environment.

Yet many companies have neglected this dimension of business, resulting in great doubt on the credibility of marketing. This led to doubts about marketing and its role and raised the question of whether marketing is really supportive of the people or still works against them (Kotler et al., 2021). The crisis in which marketing fell in the late 10s of the 21st century culminated in the moment when consumers became aware that marketing activities, which some companies conduct, lead them to buy overpriced products and services. Thus, the credibility of marketing was significantly impaired. In order to survive, marketing had to undergo a serious transformation. Transformation has meant having a key role in relation to consumers - an innovative approach involving employees, consumers and partners.

H2H marketing (human to human marketing) is a new and comprehensive framework proposed to combine current development and future challenges, and is based on two basic levels. The first is the H2H marketing model, which provides a conceptual basis and consists

of the following factors: creative thinking, digitalization and service-dominant logic. The second level refers to the implementation of conceptual thinking in marketing, and consists of: H2H way of thinking, H2H management and H2H processes.

3. NEW H2H MARKETING MODEL

H2H marketing model, ie. its theoretical framework includes the integration of the following influencing factors:

- Creative thinking,
- Service-dominant logic and
- Digitization.

Although all three factors already exist and are applied to some extent individually, and the novelty brought by this concept, H2H marketing, is that it connects all three factors, which were previously considered separately. There are already companies on the market that have digitalized and adapted their business so that consumers are always at the center of their activities, and that operate in the field of banking, trade and the automotive industry.

The new H2H marketing model is supported by conceptual thinking, and consists of: H2H way of thinking, as a basis for a successful application of H2H marketing; H2H management, which enables strategic planning, adjustment and control; and H2H processes, whose primary task is to ensure the application of the above (Kotler et al., 2021).

H2H or human to humane way of thinking indicates the necessity to put man and his needs in the center. It has risen somewhat in response to the suspicion that marketing was an unethical tool. This concept should be deeply ingrained in organizations in order to be said to exist. This means that it is not enough just to have employees trained according to H2H principles, but the whole organization needs to be adjusted. More precisely, the H2H concept implies the existence of empathy, adaptability, the ability to recognize problems and opportunities, readiness to be kind to others and undertake all activities so that people (clients) are in the foreground, ie. their interests.

H2H management elevates the strategic importance of traditional positioning based on segmentation and targeting by involving consumers in brand management and thus enabling companies to retain power over their brand. In this way, the weakened power of influence on their own brand, which companies face, turns into strong brand management and the creation of stronger and more stable relationships with consumers.

The H2H process complements the H2H mindset and strategic H2H management tools with an extremely flexible, experience, and iterative approach, which can be variably used for the operational implementation of human-centered marketing. Its peculiarity compared to the 4P marketing mix is its iterative character, as well as the fact that the starting point is always a human problem that must be solved. In addition, it explicitly integrates the marketing process with H2H management and links marketing to engineering and business development (Kotler et al., 2021, p. 34).

4. H2H MANAGEMENT

It is already mentioned that the new marketing paradigm implies a two-layer concept, which combines elements important for the application and functioning of marketing. H2H marketing management is one of the key elements of the second layer of the new concept, which relates to its implementation.

Strategic H2H marketing is based on two basic pillars:

I. Trust Management, and

II. Brand management.

As the essence of the concept shows, these two pillars are interconnected, because based on various market research, it has been shown that the trust that customers have in a certain brand affects its strength. These two pillars give companies certain tools for building trust through various levers such as social responsibility management, customer experience management, reputation management.

4.1. H2H TRUST MANAGEMENT

During the 10s of the 21st century, the crisis of trust increased. This is evidenced by the growing number of ethical issues facing marketing. Thus, the authors Jobber & Fahy, (2006) point out only some of them, and they refer to product safety, planned obsolescence and fraudulent packaging, which mislead consumers through various effects. The placement of genetically modified products is leading consumers to raise concerns about their safety. Also, the toys of some companies that are not adapted to children, are just another indicator that the companies have somewhat forgotten about consumers and their safety, due to the excessive desire for profit. We are witnesses that nowadays you can find products on the market with a lifespan not significantly longer than the warranty that came with their purchase. This fact, which indicates a significant reduction in the lifespan of the product, undoubtedly makes consumers wonder if they get real value for their money. The last of the three issues mentioned, fraudulent packaging directly affects the level of trust that consumers have in a particular brand. This mistrust is the result of false representation of the quantity of the product in the packaging, unclear indication of the country of origin of the product, non-emphasis on the composition of the product - especially allergens, etc.

When customers sign up for a service or buy a product, they often have to accept a bunch of conditions, which seem to have no end. Most customers never read the details and even if they are, if they don't agree with them, what can they do if they really want or need that product or service?

Another problem that customers encounter is compromised privacy. Thus, Hodgkinson et al. (2021) in their work asked one of the key questions: to what level can customers expect privacy given the level of data required that currently supports online shopping and search? They point out that it was only in 2018 that the world got its first insight into digital background services, when Cambridge Analytica was accused of selling the psychological profiles of American voters through political campaigns. In order to get this data at all, it was necessary to access the data of Facebook on tens of millions of users, after which algorithms were launched to determine which user would vote for which party. This manipulation of behavior, which was carried out without the knowledge of social network users, or indeed without their consent, may have changed the outcome of the 2016 presidential elections.

The latest data show that trust in a company to do the right thing is ranked among the top five criteria for buying, with 81% of consumers surveyed expressing its importance. Companies need to recognize this need for commitment. Thus, those who accept this development by actively engaging in brand activism and social responsibility, can reap strategic and economic benefits from it, while others in silence can bear the consequences. (Kotler et al., 2021).

The concept of H2H marketing puts the person and his needs at the center. One of the key obstacles in the application of this concept is based on overcoming the crisis of confidence.

To some extent, the Corona crisis also contributed to overcoming this crisis, which led to the fact that consumers today are significantly more informed than they were before.

Over the years, there have been a growing number of examples of organizations using rebranding as a way to ensure they stay in the relevant market. Managers today are facing rapid changes in the market, which have resulted in high competitive pressures, but also the expansion of the brand portfolio and the expansion of brand ownership. According to Marques et al. (2020), such changes are caused by consumer demand, which is characterized by large fluctuations, the influence of external stakeholders and inequalities in the distribution of resources within the firm and its brand portfolio. When trust is compromised, rebranding is sometimes necessary for companies to survive, but that doesn't necessarily mean it will always be successful. The rebranding process can be successful when stakeholders support the renamed identity, vision, and values of the corporate brand, which is considered a principle of success in corporate rebranding theory (Joseph et al., 2020).

A cause-and-effect model of integrated trust management was developed by Pfoertsch and Sponholz and it integrates several existing models and empirically proven influencing factors that affect the reputation and experiential trust. Empirically proven factors for reputational trust are: brand image, company size and industry to which the company belongs, and when it comes to experiential trust, the following factors are involved: communication behavior, conflict resolution, cooperation and orientation of people who establish direct relationships with customers, solving their problems. In addition, there are activities of supply companies such as investment in relationships, customer integration and the use of value-based pricing that affects experiential trust. Ultimately, consumer satisfaction plays a key role in experiential trust. All of these factors represent an action framework, which helps companies build trust in their brand. Brand activism is added to all of the above, as an updated version of the initiative for corporate social responsibility. Among the above factors and concepts, brand activism, consumer experience management and reputation management have a special role.

H2H trust management is based on the concept of trust, which consists of four parts: propensity to trust, affective trust, reputational trust, and experiential trust.

4.1.1 Social responsibility as a part of the new Model

Social responsibility consists of business efforts aimed at promoting, hindering or directing social, political, economic and / or environmental reform with a desire to improve society. It is very important in a customer-driven society, as it optimizes the favorable impact on the market, the company and various stakeholders (Misha & Devakumar, 2020). In the marketing context, and especially in branding, socially responsible business has a number of positive effects, which is an important argument in favor of the need to include it as a mandatory element in the marketing strategies of modern companies positioned as good corporate citizens (Georgieva, 2020).

In business ethics, marketing, and management literature, companies are judged based on their engagement in several aspects of social activities, such as corporate governance, product quality, community engagement, diversity, employee relations, and the environment. Although company managers are often in a dilemma whether to commit to socially responsible business, having in mind the necessary trade-offs between financial costs and benefits to society, as well as stable business. Research conducted by Sun & Govind (2020) indicates that marketing in companies has a great impact on the establishment of socially responsible business, the effects of which have a positive impact on all stakeholders.

H2H management follows the idea of strengthening the reputation of activism for the benefit of society. Brand activism fits into the H2H marketing model because of its correlation

with H2H brand management. This kind of new thinking is urgently needed, because consumers today demand that the brand take positions on important social and political issues. This is especially true of Generation Z, a group of early adopters of the digital age. Once understood, the new dynamics of brand activism will enable new ways to connect consumers within their communities.

4.1.2. Customer Experience Management as a part of the new Model

Customer experience is a key marketing concept. Over the past decade, the customer experience has enjoyed tremendous attention both in marketing research and in practice. Marketers call it the basis for marketing management (Lemon & Verhoef, 2016). Although there is confusion in the literature on how to define the consumer experience, Becker and Jaakkola, (2020) suggest that the consumer experience be defined as an unintentional, spontaneous response and reaction to certain stimuli. Many researchers agree with the statement that the consumer experience is a subjective category, so it is very difficult to analyse it.

With new channels online and offline, connected customers are constantly switching between channels, so the customer experience has become increasingly complex and increasingly influenced by a number of factors. Therefore, effective management of consumer experiences is crucial to nurturing experiential trust, one of the components of trust that can be managed.

Customer experience is the cumulative perception and reflection of all experiences from single or multiple customer interactions in contact with supplier outlets during a period of one or more exchange processes. Mapping the entire customer's journey along all points of contact and channels can help marketers understand the complexity of the consumer experience. For a company that wants to provide its customers with a flawless experience on all channels and points of contact, identifying the purchase route is a great challenge, given the fact that customers are constantly switching from one channel to another, and are not always in touch with those points that the company can control.

4.1.3. Reputation management as a part of the new Model

The importance of reputation has escalated in recent years, due to the escalation of the crisis of trust. Trust and reputation cannot be viewed in isolation. Reputation is of crucial strategic importance and is a task for top management, where it should be part of a comprehensive business strategy. Reputation is the aggregation of images of stakeholders, which arise from the coincidence and the discrepancy between the expectations and the offer of the company. Moreover, images are more unstable because they are easily affected by external factors, while reputation management requires an estimated sum of all images in the long run. Depending on the stakeholders, the image of the same company can vary considerably.

Reputation management includes the essential mission of the organization, reflecting its historical path, major resources and competencies, and its results. Success in reputation management can facilitate success in performance. Reputation management involves a dynamic relationship between the identity and profile that the branding organization wants to project and how it is perceived within the organization, especially by external stakeholders (Christensen & Gornitzka, 2017).

Reputation management can be said to be based on the communication and expectations that management has from internal and external stakeholders in the form of a certain form of reputation over a long period of time. Reputation needs values, norms, morals and ethics as the

basis for which the H2H way of thinking provides guidelines, helps to translate these values and norms into words and deeds that focus on the deed rather than mere words. Although reputation is difficult to measure and quantify in money, it definitely has an impact on increasing a firm's value based on reputation and therefore on its actual market value. A good reputation is said to act as a magnet.

Personality background research can help to understand how stakeholder groups work together to create value with a firm. Effective personalities are based on the type of information that cannot be obtained on the basis of demographic data, survey data or assumptions, but only by observing and interviewing individual people in their environment. Obtaining this key context information can help in the active management of expectations and can be translated into an integrated reputation management model.

For H2H marketing, the central task of systematic reputation management is to build, maintain and protect the good reputation of the company in synergy with identity, brand and image in the desired form, to achieve a positive attitude towards the company and its services, among all stakeholders, and integrated and evaluated with the strategic, operational, and financial goals of the organization.

4.2. H2H BRAND MANAGEMENT

Branding has long been present as a means of separating the goods of one manufacturer from the goods of another. Today, brands have a number of important roles that affect the quality of life of consumers, on the one hand, but also the financial value of companies, on the other hand. According to Paul, (2018), a brand is the basis of an organization's intangible assets.

For marketers, the word brand has a specific meaning. The American Marketing Association defines a brand as "a name, term, design, symbol, or any other characteristic that identifies the goods or services of one vendor as opposed to those of other vendors," and Kotler does the same. Keller calls these characteristics brand identity by one name. There are other authors (e.g. Duncan) who define a brand as "a perception that arises from experiences with and information about a company or product line" (Lee et al., 2015). According to Burman et al. (2017), a brand can be viewed from different angles, from the point of view of: markets, resources and competencies.

According to Iglesias et al. (2020), a brand can be viewed from different points of view: traditionally and dynamically with or without consumer participation in its creation. According to the traditional understanding, a brand is seen as a set of unique associations, attributes or values, chosen by the managers. It is viewed as a managerial creation defined by organizational behavior (Kapferer, 2012). In contrast to the traditional approach, there is an increasingly influential perspective, which considers a corporate brand identity that is subject to a co-creation process involving multiple internal and external stakeholders. The brand can be seen as a means of product differentiation, which involves the creation of mental structures on the basis of which consumers recognize a particular product with its characteristics and distinguish it from others, similar. Branding can be applied in all areas where consumers have a choice. So you can brand a product, service, organization, person, place, etc.

The way consumers think about a brand, the feelings that a given brand evokes in them and the way they behave towards it, can reflect the value of the brand, as an added value given to products or services (Kotler & Keller, 2006). From a strategic point of view, it is very important for companies to understand what leads consumers to be willing to pay a premium price when buying, as this has a direct impact on revenue growth (Nyffenegger et al., 2015).

H2H Marketing follows a highly integrated and collaborative approach. The future of marketing and brand management is human-oriented. Marketing 3.0 introduces human-centered marketing. Today, this is still considered the next evolutionary step after customer-centric marketing. As consumers communicate with hundreds of brands on a daily basis, it is not possible to develop meaningful and strong connections with each of them. Therefore, brand managers have always tried to focus on important elements that can foster consumer-brand relationships (Kumar & Kaushik, 2020).

The new proposed H2H brand management combines three components: holistic brand management, which is the starting point for two pillars: Brand Shaping Design and Collaborative Branding, which are added to the starting point. Brand-shaping design is a new multidimensional communication tool that integrates and creates feelings, emotions, associations or a desire to be integrated consumers into the collaborative branding process, helping the company mobilize consumer resources, including them in creative and innovative processes. Holistic brand management has had and still has the task of creating a consistent and authentic brand at the regional, national, international and global levels and to dynamically adapt to new environmental requirements in order to remain relevant as a brand. At this level, the company must strategically determine the brand identity, and its value propositions should be different from the competition in the eyes of the customer, thus creating a brand image.

A strong brand identity is paramount when it comes to effective branding, which is increasingly difficult to achieve in today's environment. It is also known that a powerful brand and a strong brand protect a company from potential risks that a product or service will not fulfill its function.

A concept based on brand identity is viewed from the outside. Instead of just finding customer needs and directing the firm accordingly, the inward perspective, which analyzes the brand image from the point of view of all internal target groups, is also integrated. Brand identity can be actively developed and formed, while brand image, on the other hand, appears delayed and only indirectly as a consequence of brand identity management. The first step in creating a strong brand is to make promises about the brand, summarizing the brand identity into tangible and understandable statements about its usefulness. It should fulfill two functions: customer needs (brand needs) and differentiation from the competition.

To overcome a major crisis of trust, a brand must be associated with an authentic emotional promise from the company and / or product that it will solve the identified human problem effectively. It is desirable to do this in cooperation with partners, because only in that way will all stakeholders have full confidence in the brand. Companies can use a variety of management approaches, but they must, whichever management approach they use, maintain their reputation by managing effectively and creating a success story with continuous reference flows, which acts as a magnet for all stakeholders.

The new management of the H2H brand, which includes design thinking, service-dominant logic and digitalization, gives today's retailers a powerful tool that will be more significant and relevant to stakeholders. The future of H2H brand management is human-based and built on a brand-specific design that works from a customer perspective. Together with the "humanized personality of the brand", it is becoming more and more human.

5. CONCLUSION

Both in the market and in marketing (practice and theory), changes are constantly happening, most often with the aim of giving them answers to some new questions or offering a solution to new, hitherto unforeseen situations. Fierce competition has led some companies

to look at the use of unethical means to increase their profits, without taking into account consumers. This created a major crisis based on a lack of trust in brands that are available to consumers around the world. A lack of trust indicates that consumers are delaying or giving up shopping because they are not sure that a particular brand will really solve their problem or need the way they need it.

The new H2H marketing paradigm was created to point out these problems. As a solution, it offers the integration of individual tools, factors, resources, etc., which were previously used individually, in the new H2H marketing based on the H2H model and the implementation of the H2H model, as the basic layers.

This paper presents the essence of H2H marketing, with special reference to the part of the implementation - H2H management, which is of strategic importance. The new model presented indicates complexity in its application, a long list of requirements for implementation, but also promises to achieve superior performance of companies and strengthen their shaky brands, in order to maintain or improve relationships with their customers. To achieve this, the authors of the model propose a focus on building and managing the H2H trust and the H2H brand, which they consider an imperative for success.

Based on everything presented, bearing in mind that this is a completely new concept, it can be concluded that there is great potential for application, but also that the complexity of the concept can make it much more difficult. How the application of this concept will prove in practice, and whether it will take root among the marketing community, remains to be seen in the future.

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ANALYSIS OF IMPACT OF COVID- 19 PANDEMIC ON SUSTAINABLE DEVELOPMENT GOALS

Danijela Voza^{*}, Milovan Vuković, Milica Veličković

University of Belgrade, Technical faculty in Bor, Vojske Jugoslavije 12, Bor, Serbia

Abstract: For more than a year, the world has been making efforts to overcome the extraordinary circumstances caused by the COVID-19 virus pandemic. Measures taken by international and national institutions to establish control over the spread of the virus have caused unfavorable economic conditions. It is now clear that the pandemic is not only a health crisis, but also a socio-economic, humanitarian, security crisis and a human rights crisis. Therefore, the main obstacle to the establishment of sustainable development at the global level. The implementation of the United Nations plan adopted in 2015 on achieving 17 sustainable development goals by 2030 is under great uncertainty. Developing countries are particularly vulnerable, in part due to a lack of international support. In this paper, the SDG index analysis was performed to determine the impact of the COVID-19 pandemic on the level of achieving the specific goals of sustainable development (SDG) and their overall rank. The research was conducted on the example of the countries of the Western Balkans.

Keywords: Sustainable Development Goals, COVID-19, pandemic, Western Balkan countries

1. INTRODUCTION

The new coronavirus pandemic (COVID-19) has proven to be a significant challenge in establishing sustainable development globally. National and local societies worldwide are fighting the most dramatic global public health emergency of our time. However, the pandemic is not only a health crisis but also a socio-economic, humanitarian, security and human rights crisis. That means that all key dimensions of people's lives are endangered. One way to overcome the new problems caused by the COVID-19 pandemic is a holistic approach to improving the relationship between man and his environment and restoring the focus on sustainable development.

The United Nations (UN) envisions recovery and creating a better post-COVID world by planning activities aimed at addressing climate change, inequality, exclusion, deficiencies in social protection systems and many other weaknesses and injustices that have arisen (UN, 2020). The 2030 Sustainable Development Agenda, adopted by the UN in 2015, defines 17 Sustainable Development Goals (SDGs). These goals represent solutions to the problem of sustainability in terms of the economy, society and environment. Achieving all these goals would enable a timely response to potential threats in the future. However, this is not easy to achieve, especially when it comes to developing countries that, during the COVID-19 pandemic, were faced with a lack of international support in making progress on the 17 Sustainable Development Goals (SDGs) (Barbier & Burges, 2020). In this way, the crisis has

^{*} Corresponding author: dvoza@tfbor.bg.ac.rs

revealed unstable relations within and between countries and their unwillingness to establish a coordinated system as a global response to common threats. As a result, despite numerous attempts worldwide to reach SDGs, the progress in this regard is still lower than expected (Asadikia et al., 2021). The pandemic has significantly contributed to that, and the question is increasingly being asked whether the SDGs will be fulfilled at the global level by the planned 2030.

By analyzing the consequences of the pandemic, the SDGs whose realization is endangered have been recognized (UN, 2020):

- Goal 1. No poverty - lack of income that contributes to increasing poverty,
- Goal 2. Zero hunger - delay in food production and delivery,
- Goal 3. Good health and well-being - devastating health outcomes,
- Goal 4. Quality education - closing schools and applying distance learning,
- Goal 5. Gender quality - endangerment of women's economic gain,
- Goal 6. Clean water and sanitation - water supply delays and inadequate access,
- Goal 7. Affordable and clean energy - disruptions in electricity supply,
- Goal 8. Decent work and economic growth,
- Goal 11. Sustainable cities and communities - exposure to high population density,
- Goal 13. Climate action - less commitment to solving climate problems,
- Goal 16. Peace, justice and strong institutions - intensified conflicts, arrest of the population,
- Goal 17. Partnerships for the goals - growing opposition to globalization and increasing nationalism.

The positive impact of the pandemic is recognized in the goals:

- Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation,
- Goal 12. Ensure sustainable consumption and production patterns,
- Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development,
- Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

On the other hand, some studies have proven positive changes during the COVID-19 pandemic only in terms of the so-called environmental goals, more precisely, the quality of natural resources (Arora & Mishra, 2020; Adams, 2020; Yunus et al., 2020; Bherwani et al., 2021). Thus, the negative impact of anthropogenic activities on the environment is much more significant than the impact of the pandemic on nature.

Developing countries have felt and will feel the consequences of the coronavirus pandemic to the greatest extent (Barbier & Burges, 2020). These include the Western Balkans countries, which characterize an unsatisfactory economic situation and an unstable environment that could jeopardize their sustainable development. Although a relatively low number of coronavirus cases in these countries were reported and the pandemic has weakened already weak health and social care systems and social threats such as increasing poverty, exclusion, insecurity, and social vulnerability. All the weaknesses of the system that are reflected in lousy policy, limited monitoring of service provision, and slow policy and practice responses become ever more problematic (Matković & Stubbs, 2020). For the Western Balkans region to respond

to these challenges as quickly as possible and create a mechanism for dealing with this and future crises, all countries need proactive solutions and joint action.

This paper aims to define and analyze trends in sustainable development and success in achieving sustainable development goals during the COVID-19 pandemic in the Western Balkans (Serbia, Montenegro, Northern Macedonia, Albania and Bosnia and Herzegovina). Also, a comparative analysis of the observed countries was performed to identify the strengths and weaknesses of each of them and determine the directions for further action to repair all the adverse effects of the pandemic and establish sustainable development.

2. EXPERIMENTAL

2.1. METHODOLOGY

For this research, comparing the annual values of total country scores and ranks of the SDG index for each observed country was performed. The considered period is 2016-2020. years. Also, a comparative analysis was conducted based on the achievement of sustainable development goals shown through the success of the observed countries in establishing sustainable development and achieving SDG. The database is based on the SDG Index and Dashboards Report produced annually since 2016 by the Bertelsmann Stiftung and the Sustainable Development Solutions Network (SDSN). In this study, data referring only to the countries of the Western Balkans were selected.

The global SDG Index score and scores by goal can be interpreted as the percentage of achievement. The difference between 100 and countries' scores is the distance in a rate that needs to complete to achieve the SDGs and goals. The SDG Index score signifies a country's position between the worst (0) and the best or target (100) outcomes (Lafortune et al., 2018).

Using historical data, we estimate how fast a country has been progressing towards an SDG. For each indicator, SDG achievement is defined by the green threshold set for the SDG Dashboards. The difference in percentage points between the green threshold and the normalized country score denotes the gap that must be closed to meet that goal. To estimate the SDG trend, the linear annual growth rates needed to achieve the goal by 2030 were calculated and compared to the average annual growth rate over the most recent period (Lafortune et al., 2018). Progress towards goal achievement on a particular indicator is presented through 5 categories whose explanations are given in Table 1.

Table 1. Trends of performance in achieving SDG's

Decreasing	Stagnating	Moderately increasing	On track	Maintaining SDG achievement
Decreasing score, i.e. country is moving in the wrong direction	Score remains stagnant or is increasing at a rate below 50% of a growth rate needed to achieve the SDG by 2030	The score is rising at a rate above 50% of a required growth rate but below the rate required to achieve the SDG by 2030	The score is increasing at the rate needed to achieve the SDG by 2030	The score is level, and the trend remains at or above SDG achievement

To estimate the overall SDG trend, each indicator for that SDG was re-normalized on a linear scale from 0-1. The trend for an SDG was calculated as the arithmetic average of all trend indicators for that goal. An average between 0-1 corresponds to a "decreasing" goal trend,

between 1-2 to a "stagnating" goal trend, 2-3 "moderately improving goal trend", 3-4 "on track or maintaining achievement". For this research, each category is numerically denoted by values from 1 to 4, starting from Decreasing to the category of On track or maintaining SDG achievement, respectively.

2.2. RESEARCH AREA

The area covered by this research is the region of the Western Balkans. The Western Balkans is a part on the Balkan Peninsula, defined by the European Union (EU) institutions as a set of countries that are not its members. These include Serbia, Bosnia and Herzegovina, North Macedonia, Montenegro and Albania (Figure 1).



Figure 1. Western Balkan countries (Source: www.slobodnaevropa.org)

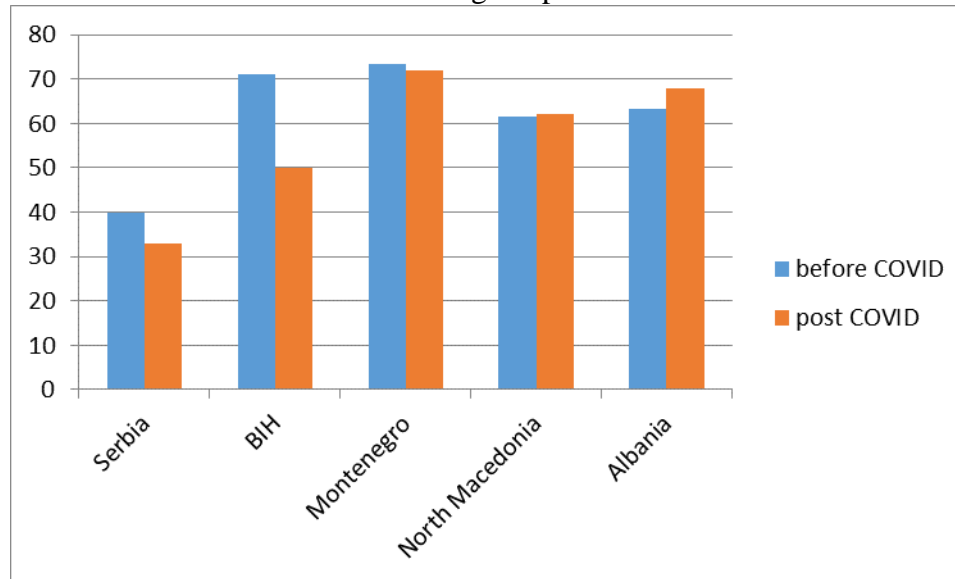
The accession process involves adjusting the legislative framework and working intensively to meet EU requirements. Given that each of these countries aspires to become a member of the EU, the whole area characterizes transitional processes and turbulent economic, political and social changes. The EU emphasizes the establishment of sustainable development as one of the fundamental principles based on gaining the goals defined by the UN. In this regard, the analyzed countries are subject to regular monitoring and reporting on progress.

3. RESULTS AND DISCUSSION

3.1. THE IMPACT OF A PANDEMIC ON SUSTAINABLE DEVELOPMENT

The first step was to examine and compare the changes in SDG rank in the observed countries in the period before the pandemic (2016-2019) and during the pandemic (2020) (Table 2).

Table 2. SDG rank before and during the pandemic



Based on the obtained results, it can be noticed that the best-ranked country in both observed periods is Serbia, while Montenegro is the worst-ranked. A comparative analysis of the rank of countries depending on whether it is the COVID or post-COVID period emphasizes that Albania is the only one of the analyzed countries whose SDG rank decreased in the post-COVID period. Northern Macedonia kept almost the same rank regardless of the impact of the pandemic, while Serbia and BiH progressed in 2020.

Further, the impact of the pandemic on the SDG index score, SDI index rank, and the degree of sustainable development goals achievement was examined using ANOVA analysis. The input variable Pandemic was created so that the measurements performed in the period from 2016 - 2019 were defined as the before-COVID period, while 2020 presented the post-COVID period. The results indicated that a statistically significant influence of the pandemic is present only in the SDG index and SDG 13, which relates to climate changes (Table 3).

Table 3. The impact of pandemic on SDG index and SDG 13

		Sum of Squares	df	Mean Square	F	Sig.
SDG_index_score	Between Groups	83.906	1	83.906	6.902	.015
	Within Groups	279.616	23	12.157		
	Total	363.522	24			
SDG13	Between Groups	6.075	1	6.075	13.018	.011
	Within Groups	2.800	6	.467		
	Total	8.875	7			

3.2. DIFFERENCES BETWEEN THE COUNTRIES

The influence of variable Country on the SDG index score, SDG rank and SD goals were also examined using the ANOVA analysis. The results indicated a statistically significant impact of the country only on SDG index rank and SDG 10, which refers to reducing inequality (Table 4).

Table 4. The impact of the country on SDG index and SDG 10

			Sum of Squares	df	Mean Square	F	Sig
SDG_index_rank	Between Groups	(Combined)	3455.360	4	863.840	14.236	.000
		Linear term	941.780	1	941.780	15.520	.001
		Contrast Deviation	2513.580	3	837.860	13.808	.000
SDG 10	Between Groups	(Combined)	6.375	4	1.594	9.563	.047
		Linear term	2.455	3	.818	4.910	.112
		Contrast Deviation	3.333	1	3.333	20.000	.017

3.3. PROGRESS TOWARDS GOAL ACHIEVEMENT

Given that the pandemic caused numerous negative consequences at all levels and in all segments of people's lives, the paper analyzes the trends in progress towards achieving sustainable development goals in the Western Balkans during 2020 (the year of the pandemic) (Table 5). When it comes to Serbia, it can be noted that it has met only SDG 1 (No poverty), while progress towards achieving other SDG's is stagnant or moderately increasing. The situation is similar in Bosnia and Herzegovina, except for the progress in SDG 17 (Partnerships for the goals). When it comes to Montenegro, there is progress only in SDG 1, while the negative effect prevails in terms of achieving most other goals (SDG 2, SDG 10, SDG 11, SDG 12 and SDG 14). Except for SDG 2 (Zero hunger), all other goals can be subsumed in the so-called Environmental goals. That means that the negative impact during the pandemic period was reflected in the quality of the environment. North Macedonia stagnated the most during 2020 in achieving sustainable development goals, and unsatisfactory results were recognized when it comes to SDG 10 (Reduced inequality) and SDG 16 (Peace, justice and strong institutions). Finally, in terms of the number of goals that the country is estimated to be moving in the wrong direction, Albania is equal to Montenegro, while only goal SDG 13 (Climate action) has been achieved.

Table 5. The trends of achieving sustainable development goals during 2020

2020	SD G1	SD G2	SD G3	SD G4	SD G5	SD G6	SD G7	SD G8	SD G9	SD G10	SD G11	SD G12	SD G13	SD G14	SD G15	SD G16	SD G17	Mean
Serbia	1	3	3	2	2	3	2	3	3	2	3	3	2		3	3	2	2,5
BIH	1	3	3		3	3	3	3	3	2	3	3	3		2	3	1	2,6
Montenegro	1	4	3	2	3	3	2	3	3	4	4	4	3	4	3	3		3,1
North M.	2	3	3	2	3	3	3	3	3	4	3	3	2		2	4	2	2,8
Albania	2	4	4	2	3	3	2	4	3	4	3	3	1	4	2	3	2	2,9

^{*}Bold numbers show that the related SDG is achieved

^{**}Italic numbers indicate the increasing trend

4. CONCLUSIONS

The new situation caused by the pandemic threatens to nullify the achieved and future progress in establishing sustainable development at the global level. It can lead to an increase in poverty, setbacks in education and health care, and deepening inequalities. However, in addition to the huge negative consequences that the pandemic has already caused and will cause, this crisis can also be seen as an opportunity to derive certain lessons from it and realize positive future changes. The pandemic reminded us that all countries are connected, and people of all cultures and experts from different fields should cooperate and make joint efforts to overcome similar crises as easily as possible.

Given that success in the fight against the coronavirus is often associated with the stability of a country's economic and health system, this paper aimed to define the progress of Western Balkans countries (candidate countries for joining the EU) in establishing sustainable development. The Sustainable Development Index and the country rank and trends in achieving all 17 sustainable development goals were used to assess success in these efforts. The results did not show statistically significant differences between the analyzed countries, except for SDG rank I achieving the SDG 10 goal (Reduced inequality). Analysis of the existence of a statistically significant impact of the COVID-19 pandemic on the observed parameters also showed an impact only on the SDG index score and SDG 13 - taking urgent actions to combat climate changes and their impacts.

It was further revealed that the increasing trend and the best rank in 2016-2020 were reached by Serbia, while the unsatisfied results were achieved in Montenegro and Albania. If we compare the SDG ranking of observed countries in the period before (2016 - 2019) and after COVID-19 pandemic (2020), it was noticed that Serbia and Bosnia and Herzegovina improved their position in 2020, while Montenegro and North Macedonia remained at approximately the same level in both periods. The exception is Albania, where a certain decline in the SDG rank in 2020 compared to the previous four years was defined.

Finally, it can be said that there are no significant changes in terms of reaching SDG's, while the changes are noticeable in the ranking of countries. It should be emphasized that, due to the still-unpublished report UN sustainable development goals for 2021 in the period of conducting research, as a post-COVID period was considered only in 2020. For this reason, the results should be taken with a grain of salt and assume that the crisis will produce longer-term consequences of the pandemic on sustainable development. Therefore, it is important to monitor and analyze trends in the coming years. That can also be defined as the recommendation for further research leading to more reliable information.

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ANALYSIS OF FACTORS INFLUENCING NEETs RATES

Andelka Stojanović*, Ivan Mihajlović, Ivica Nikolić

University of Belgrade, Technical Faculty in Bor, Serbia

Abstract: The analysis of the factors that affect the status of NEETs in European countries was presented in the paper. NEETs are young people between the ages of 15 and 29, who are no longer in the formal education system and are unemployed or otherwise out of the labour market, and who represent a group at high risk of social exclusion. NEET research is a field in the literature gaining importance given the problems young people face during the transition to adulthood and more severe conditions for adequate labour market inclusion. The hypotheses examined in the paper refer to three groups of influencing factors: economic indicators of countries, level of education, and institutional and labour market indicators. The data analysed in the survey referred to 31 European countries and were observed in the period 2015-2019. The results confirm that all examined groups of indicators impact NEET rates and indicate those indicators whose impact is the most significant.

Keywords: NEET rate, economic indicators, level of education, institutional and labour market indicators

1. INTRODUCTION

Young people represent the essential asset of one country or region, taking into account the evident ageing of the European population. On the other hand, the youth faces numerous challenges in the transition from adolescence to the adult world. A significant problem that young people face after completing the formal education process is finding adequate employment. As a result, the number of young people who fall into the category called NEET (neither in education nor in employment or training) is increasing day by day. In the literature, the population of young people in the 15 to 29 years who are no longer in the formal education system and are unemployed or are for some other reason outside the labour market is classified as NEET.

Youth unemployment differs from adult unemployment in that young people do not have work experience and therefore represent a burden to the company in the sense of additional training that should be conducted. Also, if financial problems occur, there is a high chance that the youngest and the less experienced workers will lose their job first (Verick, 2009). In the long term, if unemployment persists, much greater discouragement develops in young people than in adults (Liotti, 2020).

States recognize the existence of youth problems when entering the labour market and try to alleviate these problems with specific measures. In addition to purely economic reasons, the high unemployment of the NEET population brings with it other serious consequences such as loss of human capital due to migration, even higher unemployment in the future, lower incomes, increased crime rate and negative psychological effects on individuals

* Corresponding author: anstojanovic@tfbor.bg.ac.rs

(Choundry et al., 2012). Moreover, young people often lose hope due to the inability to find a suitable job and are recognized as a highly vulnerable group (The Council of the European Union, 2013).

The paper discusses the impact of financial parameters, levels of education, institutional factors on the size of the NEET population. The impact is considered at the international level, but certain specific issues concerning NEET status in Serbia are being thought of too.

2. ANALYSIS OF NEET IN SERBIA

Before researching influential factors, it is important to consider the position of Serbia in relation to the European Union to point out the importance and need for such research and reveal the specifics of the Serbian NEET youth.

The share of unemployed youth is often much higher than the total share of unemployed in countries. Considering unemployment data, Liotti (2020) listed Portugal, Ireland, Italy, Greece and Spain as particularly vulnerable to high unemployment rates. However, in addition to these countries, the high unemployment rate between the ages of 15-29 includes North Macedonia, which in 2020 recorded the highest youth unemployment rate of 44.4%, followed by Slovakia with 42.2% and Spain and Sweden, which recorded a drastic increase in youth unemployment compared to the year 2019. In Spain, youth unemployment increased 32.1% in 2019 to 37.4% in 2020, while Sweden recorded an increase of 31.0% in 2019 to 36.8% in 2020. In 2020, the lowest rate of unemployed youth had Switzerland 9.1% and Netherland, 11.0%. In 2020, with a youth unemployment rate of 30.2%, Serbia belonged to countries with a high rate but recorded an improvement compared to 2019, when it was 32.2% (Eurostat, 2021).

The NEET population in Serbia has been facing great challenges in the last ten years, which are a reflection of both the socio-economic occurrences that Serbia had been facing and the dramatic social changes that society and people are experiencing. Figure 1 shows that the ratio of young people from 15 to 29 years in the total population in Serbia is the same as in Europe, meaning that nation facing serious ageing.

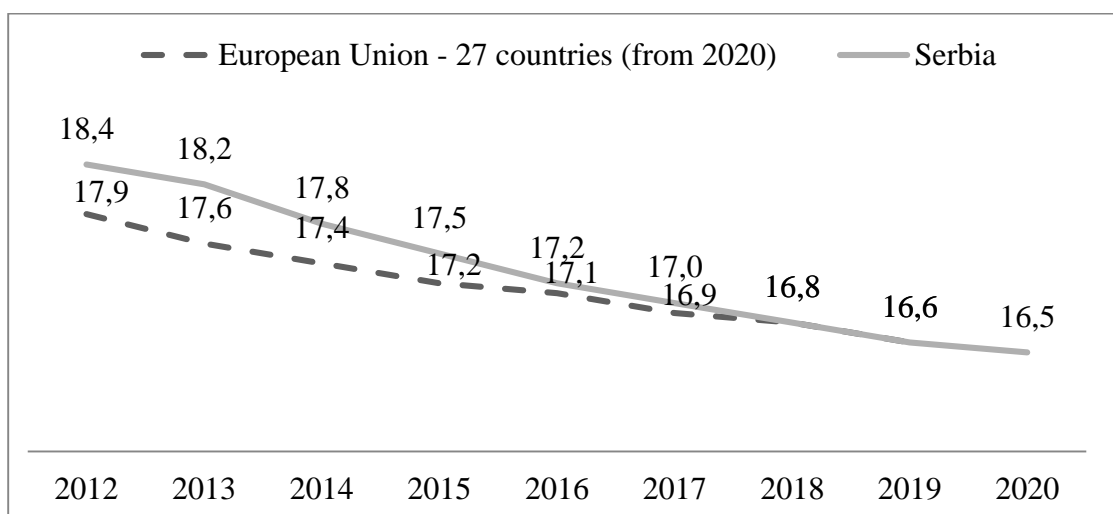


Figure 1. Ratio of young people from 15 to 29 years in the total population (Eurostat [yth_demo_020] retrieved 20.5.2021.)

However, the rate of youth unemployment in Serbia is still much higher than in the European Union, although there is a trend of unemployment declining, Figure 2. In its report, Nikolić et al. (2020) pointed to emigration and the issue of "brain drain" as the most dangerous consequences of poor youth employment in Serbia.

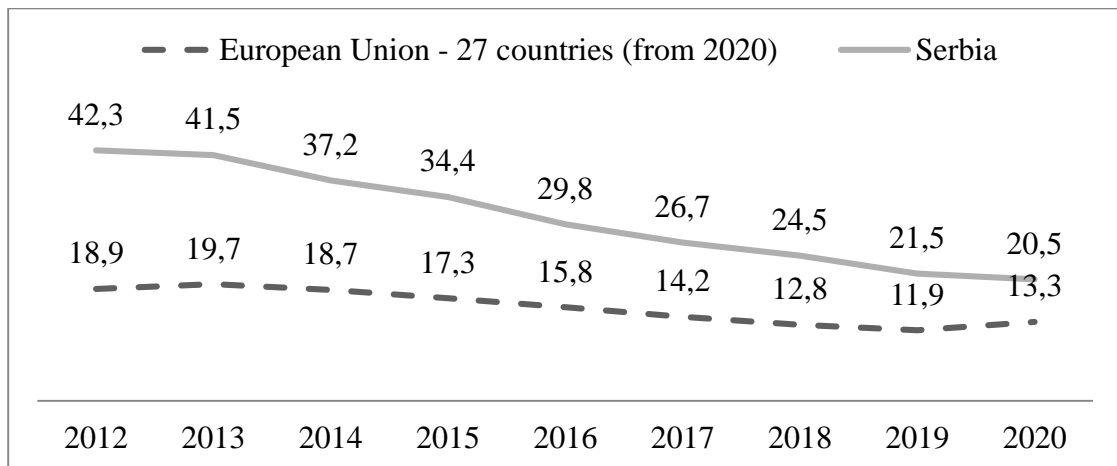


Figure 2. Youth unemployment rate (from 15 to 29 years) (Eurostat [yth_empl_090] retrieved 20.5.2021.)

Another consequence of low youth employment is the large share of those belonging to the NEET group. The percentage of young people aged 15 to 29 who have NEET status in Serbia in 2020 was 20%, which is an increase compared to previous years, Figure 3.

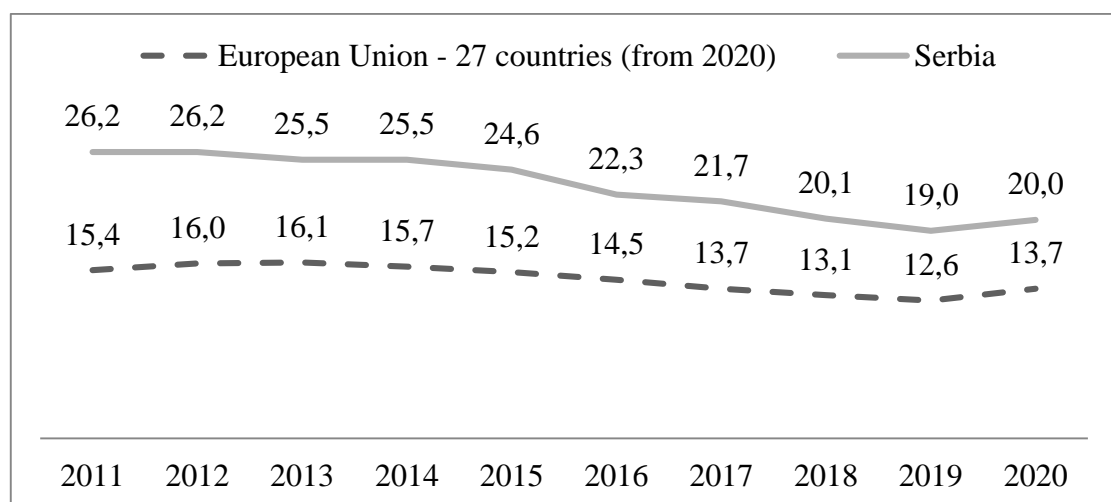


Figure 3. Young people neither in employment nor in education and training from 15 to 29 years (NEET rates) (Eurostat [yth_empl_150] retrieved 20.5.2021.)

Bearing in mind previous statistics, extensive desk research was conducted and has revealed a shortage of relevant strategic framework directly related to the position of vulnerable and socially excluded youth in the Republic of Serbia. After leaving the formal education system, the process of monitoring young people, especially in rural areas, is not given enough attention. The data that exist are generalized, and there is no standardized methodology for their collection and monitoring.

To define the NEET population, it is very important to know the definitions of urban and rural settlements used in the statistical classification of the population. In the last census conducted in the Republic of Serbia in 2011, the division of settlements into urban and other settlements was applied. The size of settlements and the ratio of agricultural and total population served as a criterion for classification. According to census results, 40.5% of the population lives outside urban areas, making Serbia one of the most rural countries in Europe. Research further shows that demographic trends are not favourable, especially in rural areas. Migration from rural areas is particularly pronounced in population groups aged 15–24 and 25–34, which affects the further negative shift in the age structure of the rural population. This results in that as many as 1 200 villages in Serbia are in the phase of disappearance (Gulan, 2015).

The position of NEET is covered by parts of other laws and action plans, which create certain preconditions for monitoring and proposing measures for their social inclusion. According to Statistical Office of the Republic of Serbia data, for the first quarter of 2020, the unemployment of young people aged 15-24 in the Republic has a rate of 25.5%. In the reports for 2019, this rate was 27.5% and is lower compared to previous years. In general, the contingent of young people aged 15-24 continues to decrease by 1.5% compared to 2018. In the Labor Force Survey in the Republic of Serbia, 2019, the NEET category stands out, amounting to 15.3%.

Regarding gender, the rate of vulnerable and socially excluded rural youth is higher in the female part of this population (RZS, 2020).

As stated in the Nikolić et al. (2020) report, one of the challenges for Serbian youth is education, which is slowly adapting to the needs of the labour market. It is stated that: "education system has an emphasis on learning and memory to the detriment of critical thinking", which reduces the possibility of adapting young people to the new requirements of the labour market. The early school leaving rate, i.e. the percentage of young people aged 18–24 with the highest completion of primary school, which are not included in further education or training, is 6.6% (RZS, 2020).

The Law on Youth was enacted in 2011. Young people are defined as persons from 15 years of age to 30 years of age. This document additionally defines adoption of the National Strategy for Youth; rules for the association of young people in order to improve the conditions for personal and social development, their informing and inclusion in the social life of the community; the establishment of the Youth Council as an advisory body that encourages and coordinates activities related to the development, implementation and enforcement of youth policy and proposes measures for its improvement, etc. (The Law of Youth, 2011).

This analysis provides only a general insight into the state of NEET in Serbia and indicates the need for a more detailed analysis of factors influencing the level of NEET.

3. LITERATURE REVIEW

In recent years, youth unemployment has gained an important place in the literature (Kelly et al., 2013; Vasile& Anghel, 2015; Carcillo et al., 2015; Erdoğan et al., 2017; Bingöl, 2020; Liotti 2020).

Risk factors faced by young people may stem from their family values. However, the personal context related to the level of education and competencies, then the expectations that they have about themselves and the social environment, are circumstances that significantly affect the emergence of social exclusion. Exclusion from the labour market substantially

increases other factors of social exclusion. The level of education is considered the best predictor of youth involvement in the employees' world (Keep, 2012; Kelly et al., 2013). A higher level of education reduces the risk of unemployment as well as increases income. However, in recent years, there has been a declining trend in the number of faculty students. According to the National Bureau of Statistics, the number of students enrolled at state faculties in the 2017/2018 school year was 223 728, 2018/2019 was 215 877, and 2019/2020 was 208 719 (RZS, 2021). It can be said that the share of students is decreasing due to negative demographic trends and emigration. Still, a certain percentage decreased is undoubtedly a consequence of economic reasons and lower employability after graduation.

In their work, Vasile and Anghel (2015) point to education as a significant factor for the exclusion of young people from the labour market. Exploring the difficulties that young people face when entering the labour market, the authors identified the economic crisis as significant for intensifying the exclusion of even more young people from the labour market, both in Romania and Europe. Some research shows that a low level of education is an important prerequisite for NEET status, independently of other factors (Carcillo et al., 2015; Erdoğan et al., 2017). The results of Vasile and Anghel (2015) indicated, contrary to expectations, that in the crisis, more educated young persons were the hardest hit in Romania.

In addition to the level of education that stands out in the literature as a condition of a high NEET rate, research indicates that the level of economic development of the country significantly affects the level of the NEET population. In his study, Bingöl (2020) dealt with the impact of economic aspects on the NEET population, assuming that macroeconomic variables related to individual countries significantly condition the employability of, particularly vulnerable groups. Bingöl (2020) used various economic indicators such as GDP per capita, Inflation Rate, Adjusted Savings for Education Expenditure, Foreign Direct Investments and Human Development Index, and found a significant impact of almost all parameters on NEET level in the considered sample.

The post-industrial global economy can explain youth unemployment. There is a drastic change in the demand for certain new occupations and the inability of more rigid education systems to adapt to the situation. This leads to the next group of significant factors that represent institutional factors. The global economic crisis has additionally caused an increase in unemployment among all population categories, including the NEET. In order to reduce the negative effects of high unemployment, various measures are adopted that increase the flexibility of the labour market. The authors Vasile and Anghel (2015) mentioned several institutional factors related to the poor functioning of the labour market: over-regulation, insufficient investment in young graduates, tolerance of discriminatory behaviour towards people with certain disadvantages and vulnerable social groups etc. Tamesberger et al. (2014) recognized the institutional framework as an important cause of weak NEET integration and through their research highlighted three important subsystems: the employment system, the education system and the training system.

Considering the mentioned elements that have been highlighted in the literature as influential on the NEET population, the initial hypotheses are defined:

H1: Economic level affects NEET rates.

H2: Education level affects NEET rates.

H3: Institutional level affects NEET rates.

4. RESEARCH METHODOLOGY

4.1. DATA

In order to empirically confirm the mentioned connections, a sample consisting of data collected for 31 European countries is used. Data from the Eurostat database, World Bank Development Indicators and UNDP Database were used to provide a uniform methodology for data collection from all countries. The definition of the selected variables and the data source are presented in Table 1. The research was conducted considering data from 2015 to 2019, which gave a sample of 155 valid cases.

Table 1. Variables and the data sources

Variable	Abbreviation	Data source
Human development index	HDI	United Nations Development Programme (UNDP)
Adjusted savings: education expenditure (% of GNI)	EE	The World Bank
GDP per capita (current US\$)	GDP	The World Bank
Less than primary, primary and lower secondary education (levels 0-2)	EdL 0-2	Eurostat [yth_empl_090]
Upper secondary and post-secondary non-tertiary education (levels 3 and 4)	EdL 3-4	Eurostat [yth_empl_090]
Tertiary education (levels 5-8)	EdL 5-8	Eurostat [yth_empl_090]
Job vacancy rate by NACE Rev. 2 activity	JV	Eurostat [jvs_a_rate_r2]
Annual net earnings	ANE	Eurostat [earn_nt_net]
Employment and activity	E&A	Eurostat [lfsi_emp_a]
Young people neither in employment nor in education and training rate	NEET	Eurostat [yth_empl_150]

The relationships examined in this study can be presented as follows:

$NEET = f(HDI, EE, GDP);$

$NEET = f(EdL\ 0-2, EdL\ 3-4, EdL\ 5-8);$

$NEET = f(JV, ANE, E\&A)$

The Human Development Index (HDI) is a dimension of living standards. It emphasizes that people and their abilities should be the ultimate measure of a country's development in addition to economic growth. HDI is a collective measure based on achievements in critical dimensions of human development: "a long and healthy life, being knowledgeable and having a decent standard of living. The HDI is the geometric mean of normalized indices for each of the three dimensions" (UNDP, 2021).

Education expenditure is the amount of funds allocated in one country from the total budget (GNI) for various educational activities. According to the definition of The World Bank, it "refers to the current operating expenditures in education, including wages and salaries and excluding capital investments in buildings and equipment" (The World Bank, 2021). The value was obtained based on the weighted average of the collected data, given the sizeable disproportionate cost of public education and its effectiveness.

Gross domestic product GDP is an important statistic that measures a country's wealth. According to The World Bank, GDP per capita is: "gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products". Data are expressed in current US dollars.

Youth unemployment by educational attainment level is approached following The International Standard Classification of Education (ISCED), which assumes eight levels of education. The levels of education are grouped into three categories: Less than primary, primary and lower secondary education (levels 0-2); Upper secondary and post-secondary non-tertiary education (levels 3 and 4); Tertiary education (levels 5-8). The data were based on the results of the European Union Labor Force Survey (EU-LFS).

Job vacancy statistics (JVS) provide information on the level and structure of labour demand. The data cover all economic activities defined by NACE Rev. 2 (Statistical classification of economic activities in the European Community), the usual classification system for economic activities, except for the activities of households as employers and the activities of extraterritorial organizations and bodies. "The job vacancy rate (JVR) is the number of job vacancies expresses as a percentage of the sum of the number of occupied posts and the number of job vacancies: $JVR = \text{number of job vacancies} / (\text{number of occupied posts} + \text{number of job vacancies}) \times 100$ (Eurostat, 2021).

Information on annual net earnings (ANE) represents net pay taken home, in absolute numbers at the annual level. The transition from gross to net earnings requires subtracting income taxes and employee's social security contributions from the gross amounts and the addition of family allowances, if appropriate (Eurostat, 2021).

The indicator Employment and activity (E & E&A) is based on the European Labour Force Survey (EU-LFS). The definitions of employment and unemployment follow the definitions and recommendations of the International Labour Organisation (ILO). The precise definition of unemployment is given in Commission Regulation (EC) No 1897/2000:

- "Employed persons are all persons who worked at least one hour for pay or profit during the reference week or were temporarily absent from such work. The employment rate is the percentage of employed persons in relation to the total population".
- "Unemployed persons are all persons 15 to 74 years of age (16 to 74 years in ES, IT and the UK) who were not employed during the reference week, had actively sought work during the past four weeks and were available to begin working immediately or within two weeks." (Eurostat, 2021)

4.2. METHODOLOGY

Multiple linear regression is used to analyse the relationships, where the NEET share is taken as the dependent variable, and the independent variables are grouped into three predictor groups. Multiple linear regression allows predicting a dependent variable using various independent variables where the correlation index (R) value represents the correlation between the dependent and independent variables. The determination index (R^2) is analysed to determine the total variation for the dependent variable that the independent variables could explain. A value greater than 0.5 shows that the model is effective enough to determine the relationship. In addition to examining the influence of individual predictor groups on the dependent variable, all predictor groups' influence is examined to determine whether there is a

certain order of influences by predictor sets. In addition to testing each set of predictor variables, this analysis also checks the validity of all groups together.

5. RESULTS

Three multivariate regression analyses were performed to predict the total NEET rate. Each analysis included all three groups of predictor variables. The first model determines how well the NEET population is predicted first by an economical set of predictor variables and then through a set of predictor variables related to education and institutional predictors. In the second model, the order of groups was modified, examining the prediction of the NEET population by a set of predictor variables that describe the level of education and then through the influence of economic and institutional predictors. Finally, in the third model, the analysis is conducted by estimating how well the dependent NEET variable is predicted by the institutional and labour market set of predictors plus the other two sets. The results of all three models are shown in Table 2.

Table 2. Summary statistics for three models

Predictors	R	R ²	F	Sig.	R ² _{change}	F _{change}	Sig. F _{change}
Model 1							
HDI, EE, GDP	.806	.650	76.253	.000	.650	76.253	.000
HDI, EE, GDP, EdL0-2, EdL 3-4, EdL 5-8	.914	.835	101.160	.000	.185	44.732	.000
HDI, EE, GDP, EdL0-2, EdL 3-4, EdL 5-8, JV, ANE, E&A	.954	.910	130.926	.000	.075	32.274	.000
Model 2							
EdL0-2, EdL 3-4, EdL 5-8	.808	.654	77.382	.000	.654	77.382	.000
EdL0-2, EdL 3-4, EdL 5-8, HDI, EE, GDP	.914	.835	101.160	.000	.181	43.925	.000
EdL0-2, EdL 3-4, EdL 5-8, HDI, EE, GDP, JV, ANE, E&A	.954	.910	130.926	.000	.075	32.274	.000
Model 3							
JV, ANE, E&A	.860	.740	116.600	.000	.740	116.600	.000
JV, ANE, E&A, HDI, EE, GDP	.941	.885	153.661	.000	.145	50.357	.000
JV, ANE, E&A, HDI, EE, GDP, EdL0-2, EdL 3-4, EdL5-8	.954	.910	130.926	.000	.025	10.727	.000

Regression equations for all three groups of predictor variables are statistically significant. The first model results show that the correlation between the dependent and independent variables concerning the economic group is $R = 0.806$ while $R^2 = 0.650$. Since the R^2 value is greater than 0.5, the model is effective enough to determine the relationship. Also, high F-value ($F=76.253$) and p-value less than 0.05 ($p<0.001$) indicate that the model is statistically significant. The impact of the set of education variables has an additional statistically significant effect on predicting the NEET rate since $R^2_{change} = 0.185$; $F_{change} = 44.732$ and $p < 0.001$. Also, the influence of the set of institutional variables in model 1 has a

statistically significant influence on the change of NEET rate through the influence of the other two sets with $R^2_{change} = 0.075$; $F_{change} = 32.274$ and $p < 0.001$.

Regarding the level of education, the correlation between NEET rate and education level has a value of $R=0.808$. Total variation for the dependent variable that the independent variables could explain has a value $R^2=0.654$, which is acceptable for further analysis. Value of F test is $F = 94.354$ and $p < 0.001$.

For the variables accessing the institutional conditions and labor market, $R= 0.860$ and $R^2 = 0.74$ with statistical significance of the model ($F = 116.600$ and $p < 0.001$). As in model 1, in models 2 and 3, all added predictor groups contribute to the prediction of the NEET rate in relation to the first examined group in each model, which can be seen based on R^2 increase and achieved statistical significance ($p < 0.001$) for F changes (Table 2).

Also, multiple regression analysis of all nine predictor variables was performed to determine the power of individual predictors. The linear relationship of all predictors is statistically significant with respect to the NEET rate, $R^2 = 0.910$; $F = 130.926$; $p < 0.001$. Based on the analysis of strength and statistical significance of Beta coefficients of individual predictor variables, a significant influence of variable HDI from the economic set of predictors, the significance of EdL5-8 from education set and significance of predictors JV, ANE and E&A can be determined (Table 3).

Table 3. Regression coefficients for individual predictors

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Model 1					
Constant	97.675	9.378		10.415	.000
HDI	-92.075	11.897	-.711	-7.739	.000
EE	-.377	.420	-.066	-.899	.370
GDP	-1.634E-5	.000	-.063	-.743	.459
Model 2					
Constant	6.896	.814		8.475	.000
EdL 0-2	.034	.048	.059	.713	.477
EdL 3-4	.068	.134	.099	.506	.614
EdL 5-8	.464	.117	.675	3.980	.000
Model 3					
Constant	71.961	4.224		17.036	.000
JV	-1.252	.337	-.181	-3.715	.000
ANE	-6.467E-5	.000	-.152	-2.719	.007
E&A	-.745	.063	-.687	-11.779	.000

6. DISCUSSION

In order to adequately design and implement policies to reduce the share of NEET youth, it is clear that various aspects affecting NEET status need to be studied. Analysing obtained result, it can be noticed the significant influence of economic indices on the NEET

rate, which confirms hypothesis H1. However by further analysis of B coefficients indicate that variable HDI (Human Development Index) have statistical significance, therefore the countable influence. This index brings together measures of poverty, general literacy and competences and decent living standards whose low values are recognized as the causes of high NEET rates in some countries.

The second hypothesis, H2, which examined the relations between NEET rate and education, is also confirmed with a high value of correlation and determination coefficients as well as the value of the F test. B coefficients and its significance reveal that only influence of Tertiary education (levels 5-8) is significant while Less than primary, primary and lower secondary education (levels 0-2) and Upper secondary and post-secondary non-tertiary education (levels 3 and 4) do not significantly influence the NEET rate. The result obtained in this research is also interesting, as in the work of Vasile and Anghel (2015), where the higher level of education is shown to be influential for the share of NEET, despite the expectation that lower educational levels would be.

Hypothesis H3 is confirmed, which means that institutional and labour market conditions influence the NEET rate. In this case, examined independent variables, all predictor variables Job vacancy rate, Annual net earnings and Employment and activity, significantly influence the NEET rate. Tamesberger et al. (2014), in their research conducted in Austria, proved the strong influence of per capita expenditure on active labour market policy and the number of available jobs, which also confirmed the importance of institutional factors.

7. CONCLUSION

In addition to the overall economic and social consequences, the NEET status can have serious consequences for young individuals. The results of this research indicate the need for influence, both, state institutions and individual actions to further reduce NEET populations and their adequate inclusion in the labour market. After analysing statistical indicators and existing policies and activities of institutions in Serbia, it can be concluded that it is necessary to first establish mechanisms for targeting the NEET youth. In addition, the specific needs of this population need to be addressed through special programs that meet the conditional and necessary needs of the Serbian labour market. The narrowing of the gap between education and the labour market, the high share of the rural population, and the nation's ageing should be the main targets of all further activities related to NEET youth.

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PRODUCTION AND DISPOSAL OF INFECTIOUS MEDICAL WASTE IN THE HEALTH CENTER IN PARACIN

Jasmina Jovanović Mirković^{1*}, Violeta Ilić Todorović¹, Maja Mrkić², Christos Alexopoulos¹, Zorana Jurinjak¹

¹The Academy of Applied Preschool Teaching and Health Studies, Cuprija, Serbia

²Vana d.o.o., Stevana Brakusa 6, 11000 Belgrade

correspondent author: ninajovanovic.vms@gmail.com

Abstract: Medical waste is the waste, hazardous or non-hazardous, in solid or liquid state, generated during the provision of health services in hospitals, clinics, health centers, dispensaries, laboratories, research centers and all health care institutions operating within the health system. Infectious medical waste, as hazardous solid waste, poses a risk of infection. The aim of the paper was to present, monitor, process and compare data on the amount of generated medical waste for the five-year time interval 2016-2020. yr. in primary health care institutions in the city of Paracin.

The paper presents the amount of infectious waste generated in the health center in Paracin for the period from 2016-2020. years. The results of the amount of generated infectious medical waste on the territory of the city of Paracin in this research work show a declining trend from 2016 to 2019. After that, there is a significant growth trend related to 2020, which can be explained by the epidemiological situation caused by COVID 19. The comparison of the obtained data is extremely important and useful for creating and making the most complete plan and correct decisions related to infectious medical waste disposal.

Keywords: medical waste, infectious waste, primary health care, waste management, environment

1. INTRODUCTION

Waste is defined as any substance or object listed in the European Waste Catalog that the owner discards, intends or must discard, in accordance with the law (European waste catalogue, 2000). Medical waste means all waste generated in medical institutions (both public and private), medical research centers or laboratories (Ratkovic et al., 2012). Medical waste means all waste, non-hazardous or hazardous, generated during the provision of health services (diagnostics, prevention, treatment and research in the field of human and veterinary medicine). Medical waste can also be defined as waste generated during the provision of human and animal health services or related research (Ugrinov, D. & Stojanov, A., 2011). The largest producers of medical waste are health institutions, namely health centers, hospitals, diagnostic and research laboratories, dental offices, institutions for the care of the infirm and the elderly, and

* Corresponding author: ninajovanovic.vms@gmail.com

institutions that provide medical care in any form (Bansal et al., 2013; Birpinar et al., 2009). There are several divisions of medical waste, and on the basis of one of them medical waste can be classified as follows: A- Risk-free medical waste, A1- recyclable waste, A2- biodegradable waste, A3- other non-hazardous waste ; B-medical waste requiring special attention, B1- human anatomical waste, B2-blades, B3- pharmaceutical waste (B31-non-hazardous pharmaceutical waste, B32- potentially hazardous pharmaceutical waste, B33-hazardous pharmaceutical waste), B4- cytotoxic pharmaceutical waste, B5- blood and body fluids, C- infectious and highly infectious waste, C1- infectious waste and C2-highly infectious waste, D- other hazardous waste and E-radioactive waste. Municipal waste is a very common category of waste that also comes from health care and social care institutions, as well as from the household of patients generated during home treatment. Other medical waste also includes waste generated during the maintenance of green areas within health care institutions and waste generated during the construction or demolition of buildings belonging to health care institutions (Slack et al., 2004; Miyazaki et al., 2007). Infectious waste is defined as all biomedical waste and waste from health facilities that is known or clinically assessed by a physician or veterinarian to have the potential for transmission of pathogenic microorganisms to humans or animals. Infectious medical waste contains a large number of pathogenic microorganisms which, in contact with humans or animals and other living beings, can cause an infectious disease. Such material is produced during the diagnosis, treatment or prevention of disease, health assessment or from procedures aimed at identifying the cause of the disease, from patients (blood, body fluids, tissues or excreta) or waste related to nosocomial infections in wards (Wenzel, 2003). It consists of: bandages, swabs contaminated with blood or other body fluids and originate from patients suffering from infectious diseases, syringe needles, scalpels and more (Cardo et al., 1997), then cultures and media for seeding as well as cultures and media containing infectious agents from research laboratories, waste generated during the production of vaccines and serum etc. In this way, infectious medical waste, as hazardous waste in solid form, poses a risk of infection. So defining a strategy and ways to collect, transport and store waste is a crucial issue when managing infectious waste.

After the identification of a certain category of waste, the risk assessment procedure that carries medical waste and prevention measures that should be defined and applied during control and protection are important. Taking the initiative for defining procedures, guidelines, professional instructions and recommendations when handling and disposing of medical waste, as well as respecting the plan of protective measures against harmful effects of medical waste is one of the important solutions, all in the direction of proper management and disposal of medical waste. It is considered that the process of recycling medical waste, preparation of disposable syringes and needles, without prior sterilization, e.g. in developing countries one of the most serious problems. Therefore, it is important to introduce procedures for the selection and selection of non-hazardous medical waste (paper, glass, plastic, wood, food) that is subject to the recycling process and can be reused if it can withstand the sterilization process. Proper handling, labeling, disposal, recycling together with sterilization and decontamination of infectious waste from health care institutions as well as complete destruction of biomedical waste in order to protect against environmental pollution and protect the health of the entire population are very important (Van Veen, 1998). There are numerous pathological conditions described and a large number of pathophysiological disorders in humans and animals and other living beings that may be caused by the harmful effects of medical waste. Medical waste is one of the leading risks of environmental pollution through increased pollution of soil, groundwater and air, especially during the incineration process caused by heavy metals and other toxic substances that can be directly and indirectly included in the food chain (Benotti et al., 2009; Lee et al., 2004). It is crucial to apply and monitor legislation, regulations and guidelines during

activities related to adequate classification and disposal of infectious and all medical waste, given that most health and non-medical workers often consider medical waste management not so important even as a secondary activity. To that end, it is very important for good waste management practice that health workers and associates be motivated, well educated for activities related to sorting, collection, storage, transport, processing or temporary and final disposal, i.e. to possess the management skills of proper handling and disposal of medical waste. Also, adequate cooperation with the management of the health institution is necessary, as well as the local self-government, the environmental sector and all other entities related to these activities

2. OBJECTIVE OF THE RESEARCH

The aim of the paper was to display, monitor, process and compare data on the amount of generated infectious medical waste for the five-year time interval 2016-2020. yr. in primary health care institutions on the territory of the town of Paracin.

3. RESEARCH METHODOLOGY

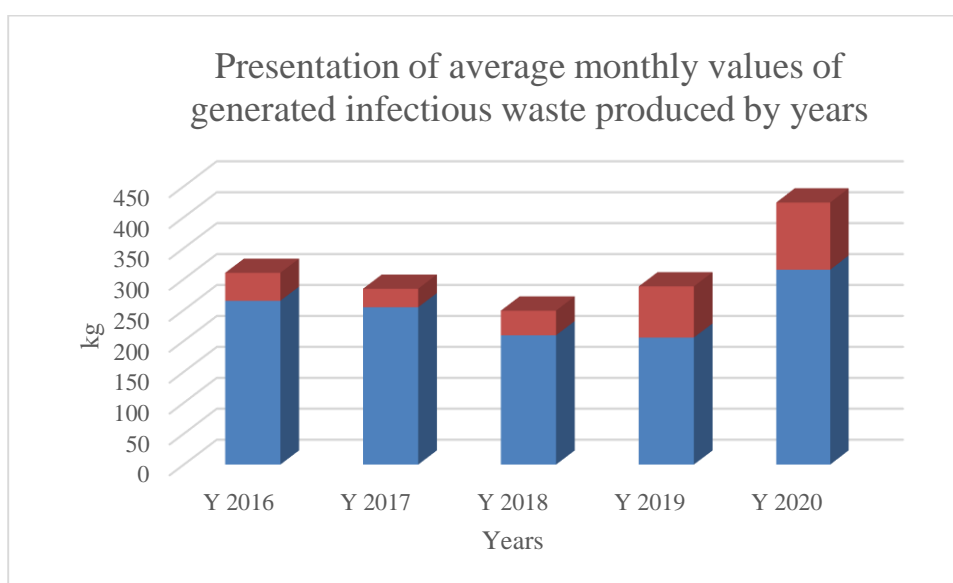
In this research work, the dynamics of infectious medical waste generation in the period from 2016-2020 was monitored in the Paracin Health Center. The obtained data were collected through the Infectious Waste Generation Report and interviews with key persons in charge of medical waste management. The obtained data were statistically processed in the program SPSS 20.0, then subjected to a descriptive and correlation study of analysis and after summarizing the results are presented in tabular and graphical terms in the section Results and discussion. The statistical significance $p < 0.05$ that exists in the production of infectious medical waste in the Paracin Health Center during the comparison of individual years in a given time interval is also presented.

4. RESULTS AND DISCUSSION OF THE RESEARCH

The World Health Organization (WHO) has been actively working for many years to find an adequate solution to the problems related to the proper and safe management of medical waste. It has been noticed that in developing countries there is a trend of growth in the total amount of waste generated as a result of the increased volume of health care in health systems. Taking into account the emerging epidemiological situation COVID 19, the fact is that during 2020 and 2021. there has been an increased use of masks, gloves, napkins and other disposable items in the medical field, all with the aim of protecting health and applying all measures to prevent and prevent the spread of this highly contagious disease.

Paracin is a municipal town in the Pomoravski district in Serbia. According to the latest census, about 58,300 people live in Paracin. The number of health care users on the territory of this municipality is 47,687. Inspecting the data on the amount of waste generated for the period 2016-2020, it was noted that the largest amount of medical infectious waste generated during 2020, with an average calculated monthly value in kg of infectious waste of 315.08 ± 108.63 , for difference from 2019, which records the amount of generated medical infectious waste at

the level of primary health care of 205.42 ± 82.72 as the average monthly value in the specified year (Graph 1). The year 2018 in relation to 2020. shows that there is a certain statistical significance $p < 0.05$, which also exists between 2019 and 2020. A rational explanation for the observed difference is related, presumably, to the new epidemiological situation COVID 19, which resulted in far higher production and amount of medical infectious waste from the COVID department, as well as greater use of protective masks, gloves, boots, protective suits and tests and others. accessories for the identification and confirmation of the disease. The collection and disposal of medical infectious waste from the health center in Paracin is subject to special requirements for storage, transportation and disposal in the hospital in Paracin according to a well-institutionalized waste management plan for the prevention of infections. It was noticed that there are slight variations in the generation of infectious waste during certain months in all observed years. Based on operationally processed statistical data, an exponential increase trend was observed in the last six months in 2020. compared to 2019, where the production of infectious waste has decreased in the last 6 months of the year.

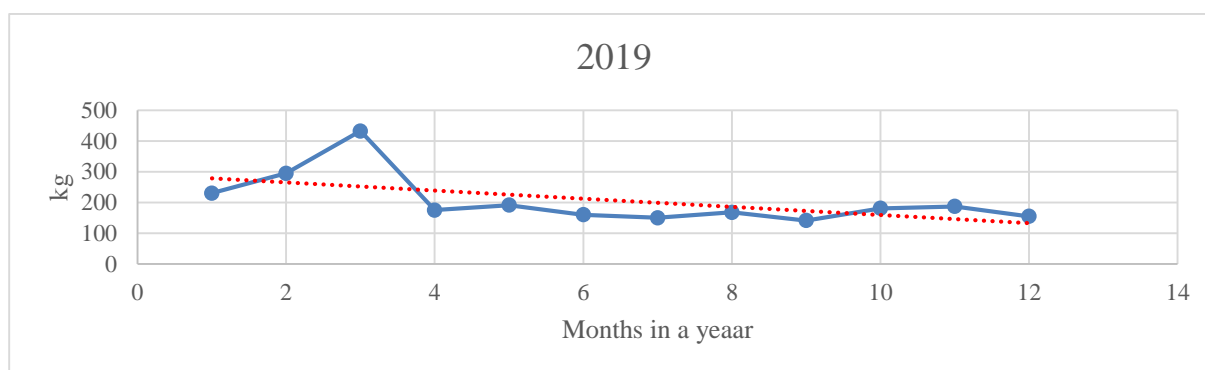


Graph 1. Presentation of the amount of average monthly value of generated infectious waste during 2016-2020.

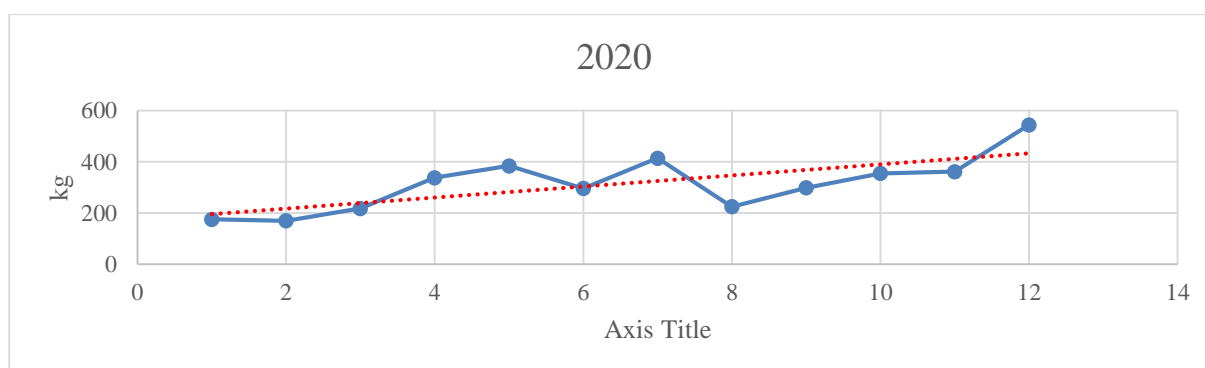
Table 1. Amount of generated infectious waste (expressed in kg) for a six-month period and a period of one year in the Health Center Paracin

Year	Amount of infectuous waste produced (kg)
2016.	1571+1607 3178
2017.	1535+1518 3053
2018.	1170+1359 2529
2019.	1483+982 2465
2020.	1582+2199 3781

The results of the research (Table 1) showed that there was a significant difference between 2019 and 2020 in the amount of generated infectious waste, so that 2019 showed the production of infectious waste in the amount of 1483 kg for the first six months of the year and the number of outpatient visits of 208 and 982 kg for the other six months of the year and the number of outpatient visits of 202, while the total production of infectious waste for that year was 2465 kg with a total number of outpatient visits of 410 per year. For the sake of comparison, we noticed that the production of infectious waste grew drastically and that in that year the total amount was 3781 kg with the number of outpatient visits of 292. Observing and monitoring in 2020 in the first half of the year the amount of generated waste was 1582 kg, while from July-December 2020. the amount was 2199 kg of generated infectious waste. Since the generated medical waste can endanger the environment and be dangerous to human health and life, it requires mandatory compliance with the law when managing it. Responsible management should respect the principle of prevention and waste management hierarchy. That is why the gold standard in medical waste management is knowledge and skills in the correct and safe way of dealing with medical waste. A prerequisite for quality handling and disposal of medical waste contributes to the preservation and improvement of public health and the environment (Stanković et al., 2008).



Graph 2. Presentation of the amount of infectious waste produced (kg) by months during 2019. at the Paracin Health Center



Graph 3. Overview of the quantities of produced infectious waste (kg) by months during 2020. at the Paracin Health Center

Priority is also given to the amount of generated infectious medical waste, which should be reduced to a minimum because great attention is paid to in recent years focused on the protection of ecosystems and public health of the entire population. The main task of all challenges related to the Koronom virus pandemic that await us in the future is the protection of health workers and non-medical staff employed in health care institutions, then the protection of health care users in health care systems and the wider community with increased production of infectious medical waste. It is estimated that about 48 tons of waste are produced annually in Serbia from all health care institutions, both state and private. About 9600 tons of this total amount of waste is hazardous waste. In this regard, the importance of generating this hazardous waste, which can be a significant factor or link in the spread and transmission of infectious diseases, should be emphasized and emphasized (Pruss et al., 1999).

The initiative to achieve the desired results in the direction of reduction, ie. minimizing the amount of potentially hazardous waste, improving waste handling and management requires the engagement of several ministries such as the Ministry of Health and the Ministry of Environmental Protection. This team approach, joint efforts and involvement of the whole country to solve the problem of efficient waste management is a step in the right direction to achieve the desired results for responsible and proper packaging, labeling of waste materials in health systems and reducing health risks among health professionals and non-medical staff handling medical waste. The overall waste management policy in the country should be regulated by clearly defined guidelines, regulations, procedures, provisions and legal regulations. Further training, education, responsibility of health and non-medical workers in the fight against infectious diseases would reduce health risk and serious environmental challenges with a proper medical waste management strategy (Almuneef & Memish, 2003). It should also be borne in mind that the costs of safe treatment and disposal of infectious waste are far higher than the costs of disposal of other medical waste (Muhlich et al., 2003).

The main problem that occurred in our country was the lack of adequate systems for the treatment of various types and categories of biomedical waste, starting with defining clear guidelines, guidelines and procedures for medical waste related to separation and selection at the place of creation in health care facilities, both public and private, marking with certain colors and adequate transport. It is very important to assess and conclude on the amount of infectious medical waste produced both during the six-month period and on an annual basis, all with the aim of identifying infectious waste, separating, storing and safely disposing of it. The introduction of the correct way of managing medical waste in health care institutions is one of the key topics that can affect the reduction of the amount of generated medical waste. One of the biggest challenges in modern society is the safe, safe and efficient disposal and final disposal of waste without polluting ecosystems and endangering human health (WHO, 2007). Both regional and national support and government support are very important in terms of finances for the construction of dedicated facilities for medical waste disposal and the formation of technical teams that would organize and stage activities related to easier and safer management of medical waste, all in order to protect public health and environmental protection.

5. CONCLUSION

Infectious waste is defined as all biomedical waste and waste from health facilities that is known or clinically assessed by a physician or veterinarian to have the potential to transmit pathogenic microorganisms to humans or animals. Infectious medical waste that was produced in the Health Center Paracin in the time interval from 2016-2020. year, shows a downward

trend in the amount of generated medical waste from 2016 to 2019. In contrast, 2020 showed deviations from the previous one in the amount of medical infectious waste produced at the level of primary health care. It is considered and assumed that the observed difference clearly shows the connection with the new epidemiological situation COVID 19, which is a consequence of greater use of protective masks, gloves, boots, protective suits, all in order to better and more fully protect the health of medical and non-medical workers in the fight against Coronavirus

It is also important to report regularly on an annual basis, as well as to propose measures by combining health and environmental guidelines, regulations, regulations and legal acts regarding the treatment and disposal of medical waste. Also, it is important to constantly improve and educate health workers and people who use health services on the prevention of infectious diseases.

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GENERATING AND MANAGING PHARMACEUTICAL WASTE IN COMMUNITY HEALTH CENTRES IN SERBIA

Sladana Pirić¹, Violeta Ilić Todorović¹, Jasmina Jovanović Mirković^{1*}, Aleksandra Ikonov² Christos Alexopoulos¹

¹The Academy of Applied Preschool Teaching and Health Studies, Cuprija; ² Faculty of Biology, University of Belgrade, Belgrade, Serbia

Abstract: Medical waste is the waste generated in health care institutions which is related to the performance of health care activities, regardless of whether it is primary, secondary or tertiary health care or veterinary service. Pharmaceutical waste includes pharmaceutical products, vaccines, expired serums, unused or contaminated, as well as equipment used in handling (bottles, boxes, gloves, masks, test tubes, etc.). The paper presents the amount of waste generated in health centers in Paraćin and Kragujevac for the period from 2015-2019. The results obtained in this research work clearly show that the amount of pharmaceutical waste from year to year from 2015 to 2017 as a reference is declining, with a slight increase from 2017 to 2019. All generated pharmaceutical waste has been collected, rehabilitated and disposed of in an appropriate manner and in accordance with established regulations. The assumption is that the same trend will continue in the coming period, with an indication that the treatment capacity of pharmaceutical waste should be increased in order to minimize the amount of waste that reaches the environment.

Keywords: waste, pharmaceutical waste, primary health care, generated waste

1. INTRODUCTION

Lifestyle and excessive consumption of various materials lead to an increase in the amount of waste. Every item / material becomes waste after prolonged use. Waste collection and thus waste accumulation is a major environmental and health problem. The goal of every country is to dispose of the generated waste in the simplest and safest way possible in order to ensure a healthy environment and protect people's lives (Working Group on the Environment, 2011). Waste originating from health care institutions is partly medical waste that can be divided into several different categories (Ugrinov & Stojanov, 2011) and groups: infectious, pathological, radioactive, pharmaceutical, chemical waste and waste containing heavy metals. Medical waste is a particularly dangerous type of waste for human health due to the large amounts of toxic, infectious and other substances (Bera, 2007). In fact, medical waste means all waste generated in medical institutions, medical research centers or laboratories. It is a heterogeneous mixture, which 10-25% is hazardous waste risky for human health and the environment (Mick, 2014).

* Corresponding author: ninajovanovic.vms@gmail.com

Wastes that include pharmaceutical products, drugs and chemicals are pharmaceutical wastes. Also, all bottles containing drugs and vaccines, unused serums, bottles, boxes and packaging (Pruss et al., 1999). In fact, pharmaceutical waste is all medicines, primary packaging, as well as accessories for the use of such products, which have become unusable due to expiration date or defects in terms of their quality, contaminated packaging or cannot be used for other reasons. Such waste may be: non-hazardous pharmaceutical waste, hazardous pharmaceutical waste, hazardous pharmaceutical waste - cytostatics, hazardous pharmaceutical waste - drugs for which the Medicines and Medical Devices Agency of Serbia has issued a license for the drug, and which contain psychoactive controlled substances and hazardous pharmaceutical waste - medicines for which the Agency for Medicines and Medical Devices of Serbia has issued a license for a medicine, and which contain precursors of the first category.

Any waste that by its origin, composition or concentration can cause danger to the environment and human health and has at least one of the hazardous characteristics from the "H" list, which are determined by special regulations, including the packaging in which it was located is hazardous waste. Pharmaceutical waste is usually labeled: H1 - "explosive", H2 - "oxidizing", H3-A - "highly flammable", H3-B - "flammable", H6 - "toxic", H7 - "carcinogenic", H14 - "ecotoxic" and H15 - waste that produces any substance from H1-H14 (Rulebook on conditions and manner of classification, packaging and storage of secondary raw materials, Official Gazette of the Republic of Serbia, No. 55/2001). Waste classification is one of the most important procedures in waste classification, since the further process depends on the type of waste. In order to accurately determine the origin, method of disposal, components that are in the waste, it is necessary to observe several lists: Q list - determines the category of waste, H list - characteristics that make waste hazardous, D list - method of waste disposal, R - waste recovery, Y list - determines the category or types of hazardous waste according to their nature or activity by which they are generated, C list - components that make waste hazardous (Barnes et al., 2008).

Pharmaceutical waste management is a set of measures that include the collection, sorting, labeling, storage, transport and ultimately treatment of waste for the purpose of its final disposal in a safe manner for human, animal and environmental health ("Official Gazette of RS", No. 49 / 2019). Depending on the type, pharmaceutical waste must be packed in special boxes, containers and destroyed at high temperatures (1200°C) in furnaces with special filters. Pharmaceutical waste management is performed in accordance with the principles of waste management prescribed by the law governing waste management (Jakšić et al., 2001). Pharmacies and veterinary organizations are obliged to conclude a contract with a person who performs the collection and transport, treatment, reuse, disposal or export of pharmaceutical waste. The treatment of pharmaceutical waste depends on the type and the substance that can be found in the waste. Pharmaceutical waste containing live microorganisms is performed by steam sterilization under pressure in an autoclave, to a safe level of sterility.

Hazardous pharmaceutical waste is treated by the method of incineration or co-incineration, as well as appropriate physico-chemical procedures (neutralization, solidification, adsorption, distillation, etc.), which reduce the hazardous characteristics of waste, in accordance with the best available technologies (Klangsin & Harding, 1998). Non-hazardous pharmaceutical waste is treated by composting, anaerobic digestion, fermentation and other approved methods in accordance with the best available technologies. Cytostatic and cytotoxic waste is treated by the incineration process in a plant that has a permit for the treatment of hazardous waste in accordance with the law governing waste management. Waste from drugs containing psychoactive controlled substances and precursors is treated by the method of incineration, in accordance with the regulations governing psychoactive controlled substances and precursors, regulations governing the field of drugs, as well as regulations

governing waste management (Mihajlov, 2003). Treatment of pharmaceutical waste by incineration and co-incineration is performed in plants provided for that purpose, provided that the emission of pollutants in the air, water and soil does not exceed the prescribed limit values, in accordance with special laws.

2. OBJECTIVE OF THE RESEARCH

The aim of the research was to monitor the dynamics of pharmaceutical waste generation in the period from 2015 to 2019 in the primary health care systems in the territories of the cities of Paraćin and Kragujevac.

3. RESEARCH METHODOLOGY

The four-year research work included empirical verification of the amount of pharmaceutical waste, in order to follow the trend of this type of waste in a broader context and thus record the impact on the environment, both directly and indirectly, on human health. The research data were obtained by analyzing the available data from the monitored health centers, then by monitoring from the field, but also by surveying the employees, and by interpreting and extrapolating the obtained results.

The paper analyzes the amount of generated pharmaceutical waste in the period from 2015 to 2019 in the health center in Paraćin and in the health centers in Kragujevac. All pharmaceutical waste generated during this period is marked according to the Q-list, Q3 (expired products); according to Y-list, Y2 (waste pharmaceuticals, drugs, etc.); according to the C-list, C33 (compounds used in pharmacy or veterinary medicine), and the hazardous characteristics are described by the designation H15 (waste that has the property of producing another substance in any way after disposal).

4. RESEARCH RESULTS AND DISCUSSION

A key step in pharmaceutical waste management is compliance with applicable laws and regulations, which impose an obligation on health centers to manage waste, in order to minimize negative impacts and achieve a sustainable relationship that harmonizes field practices with European Union standards. The first step on this path is to record the amount of waste generated, followed by comparing quantities from different regions, in order to establish “bases for planning, cost forecasting and optimization of the entire waste management system” (Xin, 2015).

Paracin is a municipal town in the Pomoravski district in Serbia. According to the latest census, about 58,300 people live in Paracin. The number of health care users on the territory of this municipality is 47,687. Kragujevac is a city with about 179,500, according to the latest census. The number of health care users is 169,397. Considering that it is the fourth largest city in Serbia, the health institution of primary health care is organized through several services in order to perform its activities more efficiently and rationally.

In both analyzed territories, in addition to medical waste, health centers also generated pharmaceutical waste, primarily from pharmaceutical products, vaccines, expired serums, unused or contaminated preparations, as well as equipment used in handling (bottles, boxes, gloves, masks, test tubes, etc.). The results of this research contribute to the formation of a

qualitative and quantitative review of the situation in the municipalities of Paracin and Kragujevac, thus enabling the most efficient solution for treatment, disposal and management of pharmaceutical waste with possible accurate projections for the long term, based on years of research. period. Also, comparing the results from the field with the goals of the Waste Management Strategy for the period from 2010 to 2019 ("Official Gazette of RS", No. 36/09). According to the same document, the projected waste from the field of medical waste by 2019 amounts to 56 thousand tons per year, while the professional literature points out that the total amount of pharmaceutical waste generated in all public health institutions and state pharmacies in Serbia is estimated at 7 tons per year (Šerović et al., 2016). In the private health care sector, it is 1 to 3 tons per year.

If the pharmaceutical waste generated in the household is taken into account, basic data are missing in order to estimate the amount of this waste, so only an expert assumption can be made based on the existing test data. It is assumed that the total amount of pharmaceutical waste production in this way is 50 tons per year, which indicates that the total amount can be estimated at 60 tons per year. Bearing in mind that Serbia does not have precise statistical data on the quantities of existing and generated pharmaceutical waste, these data can only be obtained with the help of an estimate. Depending on which method is used, it is estimated that between 1,000 tons (conservative estimate) and 1,500-2,000 tons of pharmaceutical waste are generated annually in Serbia (realistic estimate). Based on the official data of the Republic Bureau of Statistics, the amount of medical waste in the period from 2015 to 2018 is continuously growing. The data show that the amount of waste in 2016 is higher by 15.5% compared to the situation in 2015. During 2017, the amount of waste increased by 11.8% compared to the situation in 2016, while during 2018 the amount of waste increased by 13.5% compared to 2017 (Table 1). The exponential growth of the amount of waste is noticeable in the category of hazardous and non-hazardous waste.

Table 1. Quantity of medical waste from 2015 to 2018 in Serbia (Republic Bureau of Statistics)

Year / tonne per year	Hazardous waste	Non-hazardous waste	In total
2015.	24.132	5.792	29.924
2016.	25.904	8.651	34.556
2017.	29.652	8.980	38.631
2018.	32.010	11.832	43.842

Statistical data from the field research show that in 2015, 13.35 kilograms of pharmaceutical waste were generated in the health center in Paraćin. For the period of 2016, 5.7 kilograms were generated, while for 2017 and 2019, 7 kilograms of pharmaceutical waste were generated. During 2018, 7.87 kilograms of waste were generated in this health center (Table 2). Comparing the data by year in the homeland of health Paracin, the amount of pharmaceutical waste during 2016 was 57.3% lower than in 2015. The results during 2017 show a decrease of 47.6% compared to the situation in 2015, while in 2018 the decrease was in the value of 41%, and in 2019 of 47.6%. The highlighted data clearly show that the amount of pharmaceutical waste has been declining from year to year since 2015, with a slight increase since 2017. It is assumed that the same trend will continue in the coming period, with an indication that the capacity of pharmaceutical waste treatment should be increased in order to minimize the amount of waste that reaches the environment.

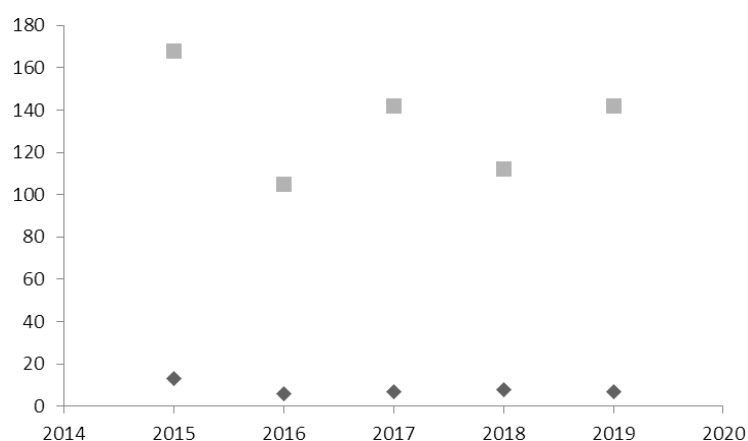
Table 2. The amount of generated pharmaceutical waste from 2015 to 2019 in the health center in Paraćin

Year	Amount of waste generated (kg per year)
2015.	13,35
2016.	5,7
2017.	7
2018.	7,87
2019.	7

Research data from health centers in Kragujevac show that in 2015, 168 kg of pharmaceutical waste was generated. In 2016, 105 kg, 142 kg in 2017, while in 2018 it was 112 kg, or 142 kg in 2019 (Table 3). Comparing the percentage changes in the amount of waste from 2015 to 2019, it is determined that during 2016 the amount of waste was 37.5% lower, during 2017 by 15.5%, and during 2018 by 33.3%, while the situation was recorded during 2019, the same as in 2017.

Table 3. The amount of generated pharmaceutical waste in the period from 2015 to 2019 in health centers in Kragujevac

Year	Amount of waste generated (kg per year)
2015.	168
2016.	105
2017.	142
2018.	112
2019.	142



Graph 1. Comparison of generated pharmaceutical waste in primary health care in Paraćin and Kragujevac for the period from 2015-2019. years

The results in the health centers in Kragujevac show the same trend as in Paracin, additionally confirming the efficiency of permanent laws and bylaws, as well as waste

management methods, but also the awareness of employees about the importance of proper processing of pharmaceutical waste. All waste that was stored in the analyzed period in the health center in Paracin, as well as in the health centers in Kragujevac, is commercial, and was in a solid and somewhat less in a liquid state. The envisaged procedure with this type of waste is according to the R-list, which determines the reuse operations, R12, so the waste is subject to changes in order to subject the waste to any operation from R1 to R11. Also, waste from the analyzed health centers is disposed of according to the D-list, which determines the disposal operation (Suruchi & Aditya, 2014). In this case, since it is a waste that can cause damage to human health and can be toxic to the environment (Daughton & Ternes, 1999), the procedure D10, incineration (incineration) on the ground is applied.

5. CONCLUSION

Pharmaceutical waste is waste generated during the production, distribution and application of pharmaceuticals. Includes transport packaging, as well as expired products. Since the generated waste can endanger the environment and be dangerous to human health and life, it requires mandatory compliance with the law, which eliminates the risk of pharmaceutical waste ending up in the environment. Responsible management should respect the principle of prevention and waste management hierarchy. The pharmaceutical waste generated in this period corresponds to the number of inhabitants of cities and the number of inhabitants who use health care in Paracin and Kragujevac.

All generated pharmaceutical waste in health centers in Paraćin and Kragujevac, in the period from 2015 to 2019, was collected, sorted, rehabilitated and removed in an appropriate manner and in accordance with established regulations. In order to completely eliminate the impact that this type of waste has on the environment, it is necessary to improve, expand and additionally train a larger number of workers employed in health care institutions throughout the Republic of Serbia.

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THE HIGH EDUCATION IN INTERGENERATIONAL FAMILY BUSINESS AS AN INSTRUMENT TO ENGAGE NEETs

Daniel Pavlov*

University of Ruse "Angel Kanchev", Bulgaria

Abstract: This material presents some results from a comparative study among two members of the international academic network INTERGEN – University of Ruse "Angel Kanchev", Bulgaria and the Technical Faculty in Bor, University of Belgrade, Serbia. The aim of this report is to show if the INTERGEN concept for intergenerational family businesses could integrate NEETs, too. In 2019 students from these two universities have answered different questions and one of them was related to their willingness to have joint business initiatives with their closest relatives. The main idea is that families should be considered as the most reliable unit to support entrepreneurs and the family members could integrate in their activities those relatives who have NEETs behavior. This could happen in case the educational system gives extra efforts to teach the family members how to deal with their NEETs and to promote the "new generation entrepreneurs" based on technological and business skills. The empirical findings confirm that many students are willing to integrate in their business intentions some of their closest relatives.

Keywords: relatives, NEETs, INTERGEN, family businesses

1. INTRODUCTION

In the period of 2018-2020 many researchers from six countries have conducted empirical studies on the student intentions to have family businesses, following the concept of the international academic network INTERGEN (Bakracheva et al., 2020). One of the studied issue was related to the willingness of the students to integrate in their businesses some of their closest relatives.

In increasing dehumanization of the economy leads to decrease of the job opportunities and creation of increasing unemployment. Especially in the COVID-19 lockdown in 2020 all governments have advised their population to stay home. This message could be recognized also as a sign that the companies are expected to increase the share of machines and Artificial Intellect and keep their levels of production (both stocks and services) with decreasing amount of employees. What to do with so many unemployed people?

Cities like Detroit (USA) have lost over 70% of their population in the last 60 years. Other industrial cities – Pittsburgh, in USA are also with constant declining trends, which increase the number of criminal activity and public dangers. It increases the pessimism in many people to find some opportunities to have good jobs.

The bank services also took advantages from the COVID-19 lockdown to foster the on-linen banking services and reduce the number of their employees. According to Ennis (2020)

* Corresponding author: dpavlov@uni-ruse.bg

the big banks had disclosed about 500,000 job cuts since the start of 2014 and are in a pace to cull thousands of positions in the coming years and slash annual costs of billions of USD.

The mechanization of the Agriculture sector has already replaced the workers with modern tractors and other farm equipment. It has provoked the decline of the villages and migration of their people to the cities (Pavlov et al., 2017).

The structural unemployment is constantly increasing and it requires digital transformation of the companies (Boneva, 2018) and elaboration of digital models for transformation of the CSR (Kostadinova, 2019). It also demotivates many people to search for a job, knowing that sooner or later they will be replaced by the machines or the Artificial intellect (Fig.1,2,3).



Figure 1. Replaced and useless. (Sources: GOOGLE)



Figure 2. Replaced and useless. (Sources: GOOGLE)



Figure 3. Replaced and useless. (Personal pictures of the author)

The dehumanization have a disastrous influence on many young people to search for any development. Many of them become NEETs - no longer in the education system, not working, nor being trained for work.

For many decades the elite universities have put their efforts to design some high qualified employees for the companies and institution. The career development has been prioritized in damage to the traditional family. The corporate culture has been a precondition for “development”, while the family members have been recognized as a burden, which distracts the career opportunities (business, sport, arts, policy, etc.). Thus the greed for individual career development has destroyed many families in the modern society. And the elite universities have well encourage this greed for individual career development.

The environment after COVID-19 and the limited natural sources would create a new concept for the meaning of “elite university”.

Here is the challenge for the high education system – could the professors encourage the family businesses in stead of produce replaceable employees?

2. METHODOLOGY DESIGN

The above mentioned challenge has been faced by scientists from 12 universities (six countries), who in 2018 established the international academic network INTERGEN to study the intergenerational family businesses as a stress management instrument for entrepreneurs. (INTERGEN, 2020).

In the period of 2018-2019 three questionnaires have been used and Table 1 shows the number of students per university.

Table 1. Number of students, participated the INTERGEN questionnaires in 2018-2019

Questionnaires	№1	№2	№3
AL, TIRANA UNIVERSITY	100	100	100
BG, "ANGEL KANCHEV" UNIVERSITY OF RUSE	141	120	116
BG,"KONSTANTIN PRES LAVSKY" UNIVERSITY OF SHUMEN	108	108	108
BG, SVISHTOV ACADEMY OF ECONOMICS "D.A.TSENOV"	100	100	100
BG, UNIVERSITY OF ECONOMICS – VARNA	102	100	100
PL, UNIVERSITY "JAN KOCHANOWSKI" IN KIELCE	100	100	100
RO, "EFTIMIE MURGU" UNIVERSITY OF RESITA	100	100	100
RO, TIMISHOARA POLITEHNICA UNIVERSITY	173	173	204
RO, WEST UNIVERSITY OF TIMISOARA	100	100	100
RU, LOMONOSOV MOSCOW STATE UNIVERSITY	184	107	107
RU, OREL STATE UNIVERSITY	100	100	100
SR, UNIVERSITY OF BELGRADE, TECHNICAL FACULTY IN BOR	116	103	103
Total:	1 424	1 311	1 338

For the purpose of this report we will focus only on Questionnaire №2, especially Question 2 “*I would like to have joint business initiatives with my closest relatives*”. That question was among 28 other questions.

The Questionnaire №2 study the general intentions of the students towards the family businesses. Each student had 10-20 minutes to answer all the questions, anonymously. The received answers are available in MS Excel tables by five quantity indicators – from “Totally agree” to “Totally disagree”. We will take into consideration the answers from Ruse and Bor.

In 2020 the INTERGEN network was enlarged and scientists from two continents, eight countries and over 20 universities are currently doing the research. We will take the preliminary data of Ruse university from 2021 to compare them with findings in 2019 of Ruse and Bor. The question in **2021** to the students is: *"In my business plans I would include my relatives, too"*.

Table 2 shows the number of students by gender from Bor (2019) and Ruse (2019 and 2021). In both universities the approached students have been mostly females, whose major study is: *04 Business, administration and law* for Ruse and *07 Engineering, manufacturing and construction* for Bor.

Table 2. Number of students from selected universities, by gender and years.

University	Females	Males	Total
SR, UNIVERSITY OF BELGRADE, TECHNICAL FACULTY IN BOR (2019)	70	33	103
BG, "ANGEL KANCHEV" UNIVERSITY OF RUSE (2019)	68	52	120
BG, "ANGEL KANCHEV" UNIVERSITY OF RUSE (2021)	116	46	162

3. FINDINGS

The answers of the students are given in Table 3. The first half of the table presents the number of the answer by each indicator, while the second half of the table presents the share (in percentage) of the same answers. The visualization in a graphical way is in Figure 4.

Table 3. Answers of the students from selected universities, by years.

University and period	Totally disagree	Disagree	N/A	Agree	Totally agree	Total
BOR – 2019	6	12	35	37	13	103
Ruse – 2019	16	19	29	30	26	120
Ruse – 2021	15	42	31	47	27	162
BOR – 2019	5,8 %	11,7 %	34,0 %	35,9 %	12,6 %	100 %
Ruse – 2019	13,3 %	15,8 %	24,2 %	25,9 %	21,7 %	100 %
Ruse – 2021	9,3 %	25,9 %	19,1 %	29,0 %	16,7 %	100 %

The two questions are quite similar:

2019 – *"I would like to have joint business initiatives with my closest relatives"*.

2021 – *"In my business plans I would include my relatives, too"*.

The data in Table 3 make possible to have a compartment between the two universities, but also to see the trend in Ruse University for the two periods.

The share of students, who answer with "Agree" and "Totally agree", remains almost constant with some small differences:

- BOR 2019 is 48,5 %.
- RUSE 2019 is 47,6%.
- RUSE 2021 is 45,7%.

There are bigger differences in the number of students, whose answers are "Disagree" and "Totally disagree":

- BOR 2019 is 17,5 %.

- RUSE 2019 is 29,1 %.
- RUSE 2021 is 35,2 %.

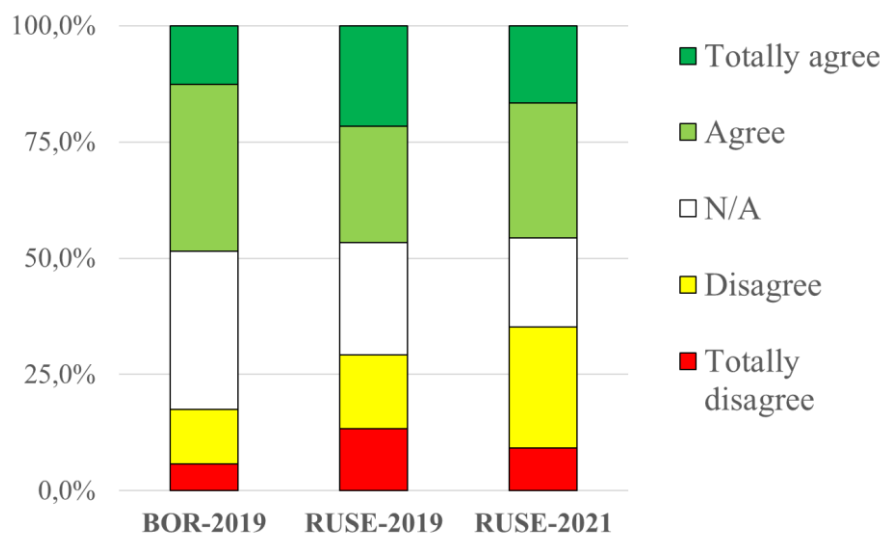


Figure 4. Answers of the students to the questions in 2019 and 2021

4. DISCUSSION

Almost half of the respondents have positive attitude to integrate in their business activities their closest relatives. COVID-19 has increased the role of the family, but also revealed some interfamily conflicts (Bakracheva & Zamfirov, 2020). Here is the role of the educational system to give them some models for family interactions, including their NEETs family members. The university could play important supporting role, as it is usually recognized as an important factor for the regional development (Kirova et al., 2018). On the base of the here presented findings we may confirm that many students are willing to work with their relatives. It is an opportunity for the academics to develop special teaching materials and interactive classes. As the number of NEETs increases, the role of such students (and their professors) will increase, too.

5. CONCLUSIONS

The findings under INTERGEN project confirm that families remain the most reliable unit to support entrepreneurs. The relatives have financial motivation to support each other on the base of common profit and well identifies interests, because this is one of the effects when having intergenerational family businesses.

Almost half of the respondents have answered that they are willing to integrate in their business intentions their relatives, too, which creates opportunities for some of the family entrepreneurs to integrate some of their NEET relatives, too.

The NEET issues increase the role of the educational system should, providing new academic opportunities to those professors who are willing to teach the family members how to deal with their NEETs. Especially the COVID-19 lockdown has encouraged different academic teams to introduce with more details the home business. This aspect of the family businesses has become more important in terms of NEETs attraction to activities to create earning.

The family businesses also require from the entrepreneur to have both technical and business skills in order to have a good organization of the activities. This is another opportunity for the universities to create “new generation entrepreneurs”, which requires good collaboration between the faculties with business and technological background. The findings in Table 4 show that these issues are already in every region, which gives a platform for further international academic collaboration.

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RESEARCH IN THE FIELD OF APPLICATION OF PROCESS APPROACH FOR IDENTIFICATION OF IMPROVEMENTS IN PERFORMING OF AFTERSALE PHASE OF CAR DEALERSHIPS

**Darko Stanojević^{1*}, Predrag Đorđević², Snežana Urošević³,
Ljubica Knežević⁴, Ivan Rašković⁵**

¹PDCA Project, Republic of Serbia; ²Technical Faculty in Bor, Republic of Serbia;
³Technical Faculty in Bor, Republic of Serbia; ⁴AIGO Business System, Republic of Serbia;
⁵Auto Čačak DOO, Republic of Serbia

Abstract: There is a frequent need for applying a process approach instead of a functional (traditional) one in the management of business organizations. No matter the core business of the organization, contemporary business management includes transparent measuring of the business performances and need for continuous improvement. With the process oriented approach faults and delays in performing of work activities in business systems can be determined. Elimination of faults and delays can provide continuous improvement and create values which will contribute to client's satisfaction and other interested parties. Regarding to the type of the organization, complexity of services and direct contact with consumers i.e. clients, the need for applying the process approach is also very relevant within car dealership organizations, especially within the field of aftersale – car repair and service (maintenance). This paper presents the results of the research which is based on the relevant data – general data about business organization (one car dealership), operational documentation of the business system, interviewing employees with the focus on top management. In the first part, the example of designing of a process model – identification of process, determination of key performance indicators (KPI) for one of the key working activities – car repair and service (maintenance) was presented. In the second part of the paper the example of measuring of KPI's for the mentioned process was given. Obtained results provide inputs for determining the specific improvements of the process performance – the process of car repair and service as a part or aftersale phase in a car dealership.

Keywords: Car dealership, Aftersale, KPI's, Process model, Measuring, Improvement

1. INTRODUCTION

Contemporary concept of business organization management tends to business systems which can provide a large scope of measuring of work performances which includes almost every part of the system. According to the authors' opinion, such reasoning within owners and top management employees has been occurring within the last years, where financial profit

* Corresponding author: stanojevic.darko.23@gmail.com.

as a measure of success is a result of series of particular work activities which measuring is also very important to provide before measuring of the final indicator - financial profit. Versus traditional approach where, for example, business targets were define including only monitoring of financial indicators, there is a frequent tendency for formulating also other targets for monitoring, where indicators for fulfilling of them includes other different indicators and where they are addressing other particular work activities. Thus, in business plans within contemporary business organizations could found defined targets which are outside the standard struture of business anatomy, such as targets in the field of client's satisfaction or customer care, environmental protection, healt and safety, IT systems etc. which can impact on final or financial success of the business organization. The possibility to measure business performance is conditioned by concise defining of measuring entity. In convetional business systems it is very hard to identify all entities which performances is necessary to be measure. Such business systems are based only on principles of functionality, not to specific real measuring of business performances. Thus approach, where focus is on functionality i.e. organizational structure is unsuitable from the point measuring of perfomances. Additionally, such an approach can derivative greater risk of separation of organizational parts i.e. organizational parts of one business system can perform working activities isolate (Radović et. all, 2012).

The intention to provide more effective work was always existing. Organizations are continuously looking for successful models for work optimization in aim to provide minimizing of costs and increasing of productivity. Top management of business organizations are oriented not only to quantity but also to work quality. The value of work quality is in directly relation with level of orderliness of the business through measuring not only of quantitiy indicators but also of measuring of quality indicators (Radović et. all, 2012). The base condition for concise determination of measuring entity and implementation of system for measuring, monitoring and reporting about success of determined entities is achieving of orderliness of the business system through: determination of precise hierarchy (roles and responsibilities of employees), the even distribution of working activities load, management or adequate control during the performing of work activities and etc.).

Today, one of the main tools for achieving the orderliness of the business and implementation of adequate system for measuring, monitoring and reporting about process perfomances of determined entities is international ISO standard – ISO 9001 – quality management system in business organizations. Beside other 6 principles of this standard, there is also such principles as: **process approach and improvement** (Erdeljan, 2016).

According to above mentioned there is a clauses or requirements within this international standard (ISO 9001:2015 - clause 4.4 – management system processes and clause 9.-Improvement) which fulfilling is directly in relation with application of process approach and systems for performance evalution in business organization (measuring, monitoring and reporting about process perfomances). Beside this generic international standard, organizations also can apply some other proved tools for achieving the orderliness of the business and implementation of adequate system for measuring, monitoring and reporting about process perfomances such as SIX SIGMA methodology or DMAIC, DMADV or 5S methodology, then Ishikawa diagram, DFD and QFD method or simillilar (Čelar et all. 2014, Sorak et all, 2015). In this paper authors decide to apply universal technology of process approach development by Radović et. all, 2012, which simillilar to applying of international ISO standard – ISO 9001.

In line with the nature of core business, tendecy to provide permanent development, frequent contact with the interested parties with the special focus on clients, searching for models for sustainable quality of products and services, car dealerhships organizations also

demonstrate the need for implementation of process approach which can provide simplest monitoring of quality of performing of business processes as well as overall quality (Dimitrijević, Vasić and Stanojević, 2014, Stevanović, Stanojević and Nedić, 2013).

Car dealership top management, as one of possible weaknesses, that it can be occurred, see in performing of process so called - car repair and service (maintenance). Process of car repair and service presents one particular “sensitive process”, based on close working with the clients, where clients expecting high level of comfort, transparency, affability, understanding and similar, during the providing of such services. Such services are those where they need to fulfill all expectations of the clients and where impression need to stay positive even after providing of services. Thus, clients expecting, after car repairing or service, for the vehicle to be fully functional, without noticeable deviations while overall process of car repairing and service need to fulfill different criterias, norms for such results. According to the author Kei, 2011, every first car is selling by sale sector, while every second car is selling by aftersale sector.

This paper present example of designing of process model – identification of process, determination of key performance indicators for the process (KPI) as well as example of measuring or evaluation of fulfilling of KPI's for one of the key work activities in aftersale phase within car dealership organizations – car repair and service (maintenance).

2. SHORT REVIEW OF PREVIOUS RESEARCH

According to the authors opinion, researches performed in the field of application of process approach or quality and monitoring of efficiency in car dealerships organizations, in scientific literature are in medium volume. In the last ten years there is a some of publications which topic is related to the such research field. Following, some of them are mentioned. Paper of the authors, Radojević et al. 2009, shows case study: application of process approach within the Toyota company. According to this research, Toyota is contemporary process oriented organization. Paper shows cycle of activities oriented to clients or so called Toyota process oriented to clients within after sale services. Toyota mentioned that for the evaluation of efficiency of their business and evaluation of targets achievements is using key performance indicators (KPI's). Dedication to quality of services within autocar dealer: results of the Australian pilot study, was shown in the paper by authors Fraser et al, 2013. Research in this paper was performed as following: Producers of cars are applying TQM tool for quality control of manufacturing but question arises: What about quality of business of car dealerships? Car dealerships represents the main bridge within clients of the vehicles and producers of the vehicles. The purpose of this research was to determine does car dealerships provide such organizational culture which fulfills key quality principles: supporting of top management, focus on clients, process management, employees management and etc. Result shows high level of dedication to quality of services in car dealerships. Publication by author Sliž, 2018, provides explanations, on the example of car dealership, for the strategy concept for organizational transformation from functional to process oriented organization. Paper shows empirical research about evaluation of maturity of the processes within car dealerships in Poland. Based on research results, the three strategies were formulated: adaptive, development and dynamic strategy. Paper by authors, Marcelo et al, 2018, provides information about benchmarking of several performed case studies addressing monitoring and evaluation of sale processes, for the first 10 brands of automobiles which are with the highest level of participation in the market from the point of view of applying of TQM principles. All

brands believe that their work practice of selling fulfill TQM principles, while results shows different.

3. RESEARCH METHODOLOGY

For the purpose of this research – research in the field of application of process approach for improvements identification in performing of aftersale phase of car dealerships – car repair and service, was necessary to choose which kind of modelling to use. Authors choose universal technology of process approach, or to be more precise, part of this technology (Radović et al, 2012) for the modelling of specialized anatomic part of business system (specialized subsystem) - car repair and services (Figure 1).

Authors decide to apply part of mentioned universal technology because some information and several assumptions that car dealership which is subject of the research, already have, in some form, defined other elements of universal technology of process approach like defined mission, vision, targets of business system, determination of programs and plans of work subject, existing of global structure of business system, identification of work activities (catalogue of work activities), while processes were not fully identified.

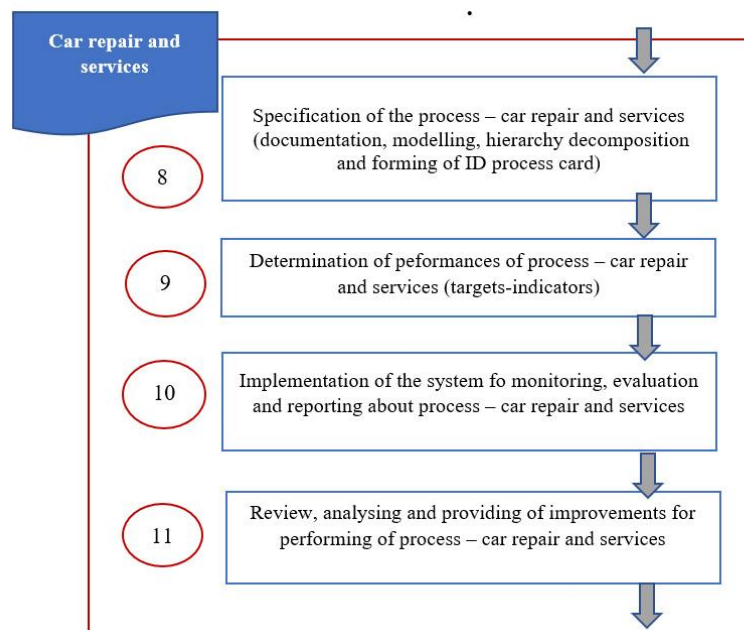


Figure 1: Illustration of part of universal process approach technology on car repair and services process of car dealership (source: authors)

To perform research, beside choosing of and applying of modeling principle, it was necessary also to collect other relevant information and data for analysing. Data and information was collect through interviews of employees in car dealership – active brainstorming, which included, as participants authors (researchers), employees responsible for performing of special subsystem – car repair and services (service advisors and others) as well as employees of top management of car dealership. The following information and data was collect:

- Data and information for specification and modelling of process – car repair and services, which includes:
 - Data and information for creating of data flow diagrams;

- Data and information for creating of ID process cards;
- Data and information for determination and formulation of key performance indicators for monitoring, evaluation and reporting about success/effects or outputs of the process;

Based on described research methodology, research was performed in aim to identify some possibility for improvements of performing of special subsystem – car repair and services.

4. PROCESS APPROACH

Using of process approach as basic tool for management of business organizations is frequently applied in the last two decades as response on variable market demands. Management techniques based on processes are improved from one simple tool for achievement of larger scale of work efficiency to comprehensive tool for advance planning, monitoring and control of the work or business (May, 2003). Adequate application of process approach can provide completely re-engineering of business processes or proposals for improvement of process. Regarding to its purpose, process approach developed and still develop different modeling technologies for the processes within different types of business organizations.

Thus, there is a different approaches for modeling that can be inputs for own approach in modeling. Radović et. al, 2012 provides own approach based on long-term practical experience from different types of industries so-called universal technology of process approach. In the previous years, authors, Melao и Pidd, 2000, provide conceptual frame for understanding and modeling of business processes, where they said that success of modeling depends on adequate understanding of business process nature. They present processes from the four different points of view: as deterministic machines, complex dynamic systems, as interactive loops and as a social structures. Authors, Brumec, 2018, states that for modeling of business processes is necessary to describe all relevant features of process in aim to exclude possibility of different fundamental interpretation of processes. Paper, Đorđević and Puškarić, 2015, provides information about new conceptual model of business processes for small and medium size enterprises, developed based on combination of Aleksić et. al, 2012 model, BSC method (Balanced Scorecard) by Kaplan and Norton, 2004 (strategic map) which simultaneously fulfill ISO 9001 requirements. This conceptual model is in line with clients perspectives and perspectives of one production business organization. Authors of this paper, have opinion that every of above mentioned approaches have some elements or views and interpretations similar to the approach of the authors Radović et. al, 2012.

5. ONE TYPE OF CAR DEALERSHIP ORGANIZATION AND FORMING OF PROCESS APPROACH

One car dealership organization have several the most significant organizational units or factors, which determine work phases of car dealership organization: pre-sale phase, sale phase and aftersale phase.

Term of aftersale in the automotive industry is define as all these activities which are performing after buying the car by client. Such activities are necessary to provide quality and reliability of the vehicle in exploitation in aim to achieve clients satisfaction (Velimirović, 2016).

After sale phase in focus have seven points which are identical as steps in providing of car repair and service (in below mentioned steps there is a direct interaction between clients and employee in workshop). Basic service process include following 7 steps:

- Arranging or arranging dates for vehicle service or repair;
- Systematic preparing for the meeting;
- Vehicle reception;
- Performing of service or car repair;
- Quality control of performed service or repair and preparing vehicle for delivering to the client;
- Delivering vehicle to the client;
- Follow up;

Figure 2, shows data flow diagram (DFD) for complete process of performing car repair and service within aftersale phase of car dealership organization.

5.1. FORMING THE PROCESS MODEL

In order to provide realization of monitoring and measuring/evaluation of success or performance of particular work activities within one business system, it is necessary to identify all parameters or indicators for measuring of performance. In this paper it is necessary to determine indicators for the process-car repair and service which is one part of the aftersale phase of car dealership organization. Indicators for performance evaluation were determined based on application of process approach i.e. based on application of formulated research methodology, given in chapter 3 of this paper. Furthermore, it was evaluated process quality for specific time period. Based on the previous mentioned 7 steps which are part of the main process – car repair and service, in aim to fully define all relevant key performance indicators for measuring, authors applied such approach where every step of main process – car repair and service is actually subprocess obtained by decomposition of main process. Thus, according to the defined research methodology, for every step i.e subprocess it is necessary to create data flow diagram (DFD) and ID card of process/subprocess which are inputs for defining of all relevant KPI's for measuring of performance of the main process.

Following it can be found for the first subprocess - Arranging or arranging dates for vehicle service or repair, designed process model which includes data flow diagram (DFD) and ID card of subprocess which includes determination of key performance indicators for performance measuring (Figure 3 and Table 1). Based on the same principle, it was create data flow diagram (DFD) and ID cards of all other subprocesses - systematic preparing for the meeting, vehicle reception, performing of service or car repair, quality control of performed service or repair and preparing vehicle for delivering to the client, delivering vehicle to the client and follow up.

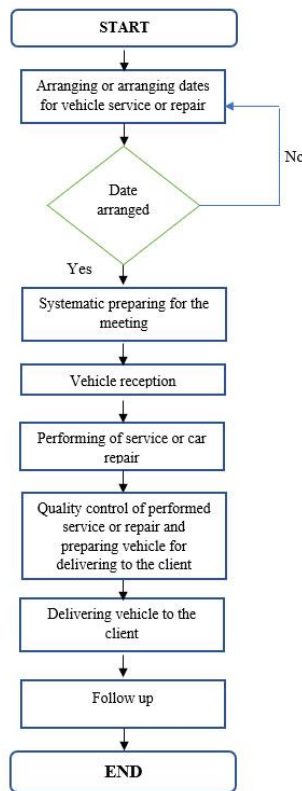


Figure 2: DFD for complete process of performing car repair and service (source: authors)

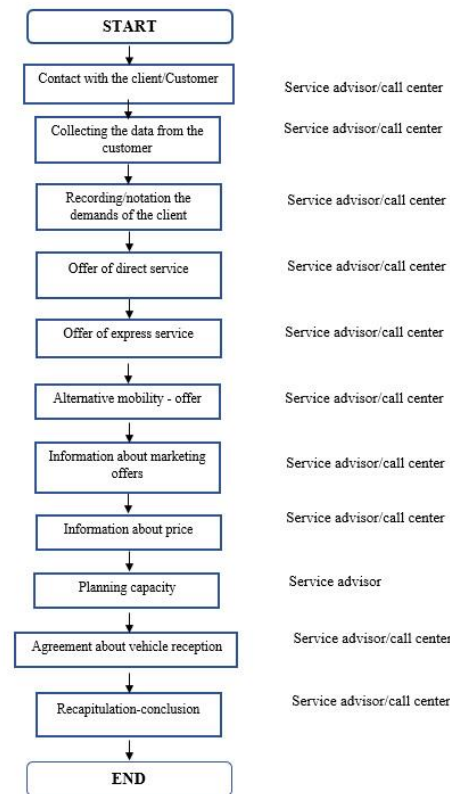


Figure 3: DFD for subprocess - Arranging or arranging dates for vehicle service or repair (source: authors)

Table 1. ID card of the subprocess - Arranging or arranging dates for vehicle service or repair (source: authors)

ID CARD OF SUBPROCESS		
Subprocess:	Arranging or arranging dates for vehicle service or repair	
Which is part of the key process:	Car repair and service	
Owner of the subprocess (responsible employee for the process)	Service advisor	
Structure of the process:	<ol style="list-style-type: none"> 1. Contact with the client/customer 2. Collecting data from the customer 3. Recording of the clients demands; 4. Offer of the direct service; 5. Offer of the express service; 6. Alternative mobility-offer 	<ol style="list-style-type: none"> 7. Information about marketing offers; 8. Information about price; 9. Planning of the workshop capacity; 10. Agreement about vehicle reception; 11. Recapitulation-conclusion
	START	END

Contact with the client/customer	Agreement about vehicle reception
Inputs (resources)	Suppliers
<ul style="list-style-type: none"> Data about clients as well as data about clients demands; Human resources: engagement of service advisor or employees in call centre; 	<ul style="list-style-type: none"> Training and development
Outputs (resources)	USERS OF THE PROCESS
<ul style="list-style-type: none"> Data about agreed meeting with the client and regarding to the vehicle reception for the service or repair 	<ul style="list-style-type: none"> Service reception unit
(KPI - key performance indicators)	
Agreed appointments for vehicle service or repair during the specific time period (I_{up-1})	

As it can be seen from above ID card for the subprocess - arranging or arranging dates for vehicle service or repair it was determined one key performance indicator (KPI) - Agreed appointments for vehicle service or repair during the specific time period (I_{up-1}). In sum, for all mentioned subprocesses, it was determined 8 KPI's as following:

- I_{up-1} - Agreed appointments for vehicle service or repair during the specific time period
- I_{up-2} - Successfully and precise prepared documentation for the meeting with the client in order to perform vehicle reception;
- I_{up-3} – Number of successfully accepted vehicles for the service i.e. number of work orders;
- I_{up-4-1} - Number of successfully performed vehicle services/repair – number of throughputs;
- I_{up-4-2} - Number of working hours in service;
- I_{up-5} - Number of successfully internal quality performed tests of the vehicle repair and service;
- I_{up-6} - Number of successfully delivered vehicles to the clients through invoicing of work orders;
- I_{up-7} – Result of feedback information analysis – clients satisfaction results;

6. MEASURING OF THE PROCESS PERFORMANCES – CAR SERVICE OR REPAIR – REVIEW OF THE MEASURING AND RESULTS

After the decomposition of the main process – vehicle service and repair and formulated key performance indicators (KPI) of every part of the main process (subprocesses) it was performed measuring of KPI's during the particular time period: from 01st March to 01st April, 2021. Measuring was performed within every seven days (once in a week). According to the authors Radović et. all, 2012, process performance involving indicators which address process capability, process rationality and time conformity of the process. There is a two approaches for measuring. First, when for measuring are using planned values and second one where are using extreme values. When for the measuring are using planned values, planned values are changing more than extreme values, so their accuracy is minor. The conclusion is that is more suitable to use extreme values (Radović et. All, 2012). Thus, when for the

measuring are using extreme values, indicators I_u are changing in range from 0-1 and it is more suitable to follow them. Below is given expression for the calculating of KPI's performances when for their measuring is using extreme values:

$$I_u = \frac{OI}{MaxI} * \frac{MinR}{OR} * \frac{MinT}{OT} \quad (1),$$

where:

- I_u – performance indicator;
- OI – the achieved level of the volume and quality of the output of the process;
- $MaxI$ – maximum level of the volume and quality of the output of the process;
- $MinR$ – minimum level of the resource consumption;
- OR – the achieved level of resource consumption;
- $MinT$ – minimum time of the process duration;
- OT – achieved time of the process duration.

Based of the process nature (characteristics), process performances can be also measure by exclude of the some of measuring elements (process capability, process rationality and time conformity of the process). It can be adopt such approach because of different causes (practical, in general). Nevertheless, the first indicator which address volume and quality of the output from the process is always consider (Radović et. All, 2012).

In this paper, it was performed measuring of the KPI's of the processes, considering the extreme valuse for the evaluation or measuring and considering all three performance parameters - process capability, process rationality and time conformity of the process, according to the expression (1). Data about formulated KPI's of the processes were collected by the following principle:

- **OI** – the achieved level of the volume and quality of the output of the process – data were collected based on observation – on-site recording of the process i.e. of all subprocesses – decomposition parts of the key process – vehicle service and repair by employees in workshop and by authors of the paper, for the defined time period;
- **MaxI** – maximum level of the volume and quality of the output of the process – based on experts (general manager, manager of the service etc.) experience and empirical approach, this data was defined for every subprocess;
- **MinR** – minimum level of the resource consumption - based on experts (general manager, manager of the service etc.) experience and empirical approach, this data was defined for every subprocess;
- **OR** – the achieved level of resource consumption - data were collected based on observation – on-site recording of the process i.e. of all subprocesses – decomposition parts of the key process – vehicle service and repair by employees in workshop and by authors of the paper, for the defined time period
- **MinT** – minimum time of the process duration - - based on experts (general manager, manager of the service etc.) experience and empirical approach, this data was defined for every subprocess;
- **OT** – achieved time of the process duration - data were collected based on observation – on-site recording of the process i.e. of all subprocesses – decomposition parts of the key process – vehicle service and repair by employees in workshop and by authors of the paper, for the defined time period;

Additionally, based on empiric approach and experts evaluation of top management of car dealership it was defined the universal limit value for I_u ($I_u=0.85$), which was adopted as acceptable value from the point of view of successful performances of the process (subprocess). All values for the I_u below **0.85** were consider as low values and demands identification and formulation of improvement proposals for the performing of the process or subprocess. Beside that, authors in cooperation with top management of car dealership organization, when the topic are resources which determines performance value of the I_u , as a resource consider only time for the performing of the particular process. In practice, of course there are other dimensions which determine other resources for the performing of the process (human resources, material resources and financial) but they also addressing time as a resource. Below are given results of the measuring of the KPI's for every subprocess i.e. for every performance indicator: I_{up-1} , I_{up-2} , I_{up-3} , I_{up-4-1} , I_{up-4-2} , I_{up-5} , I_{up-6} and I_{up-7} .

Table 2. Measuring results of subprocess - Arranging or arranging dates for vehicle service or repair for defined time period (source: authors)

Time period of KPI's measuring		Measuring of I_{up-1} - Agreed appointments for vehicle service or repair during the specific time period						
No.	Date of measuring time period	OI	MaxI	MinR	OR	MinT	OT	I_{up-1}
1.	01-06.03.2021.	180	190	1900 min	2200 min	1900 min	2200 min	0.69
2.	08-13.03.2021.	200	190	1900 min	2100 min	1900 min	2100 min	0.89
3.	15-20.03.2021.	193	190	1900 min	1950 min	1900 min	1950 min	0.95
4.	22-27.03.2021.	184	190	1900 min	1970 min	1900 min	1970 min	0.88

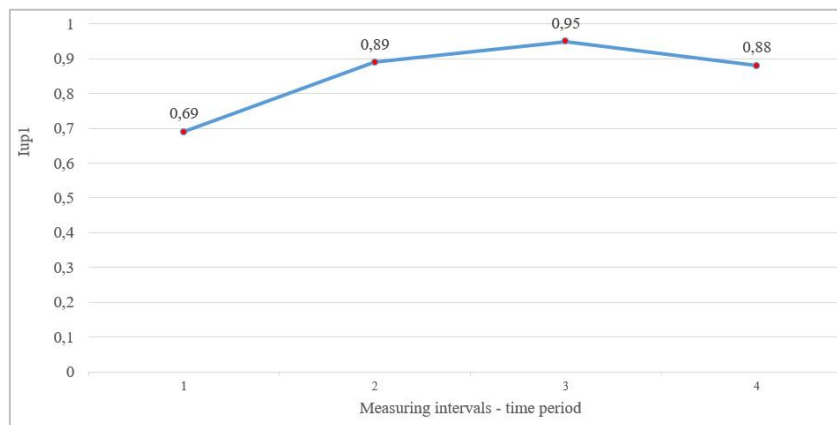


Figure 4. Diagram of measuring of KPI for subprocess - Arranging or arranging dates for vehicle service or repair, for defined time period (source: authors)

Based on performed measuring for defined time period, in the first working week of KPI measuring - I_{up-1} , it was identified deviation – value 0.69. (Table 2, Figure 4). In the second, third and forth week, obtained results shows that there is no deviations i.e. values of measured KPI's are acceptable (0.89, 0.95 and 0.88).

Table 3. Measuring results of subprocess - Systematic preparing for the meeting for defined time period (source: authors)

Time period of KPI's measuring		Measuring of I_{up-2} - Number of successfully receipted vehicles for the service i.e. number of work orders						
No.	Date of measuring time period	OI	MaxI	MinR	OR	MinT	OT	I_{up-2}
1.	01-06.03.2021.	173	190	3460 min	3378 min	3460 min	3378 min	0.94
2.	08-13.03.2021.	208	190	3460 min	3404 min	3460 min	3404 min	1.1
3.	15-20.03.2021.	189	190	3460 min	3360 min	3460 min	3360 min	1.02
4.	22-27.03.2021.	188	190	3460 min	3468 min	3460 min	3468 min	0.96

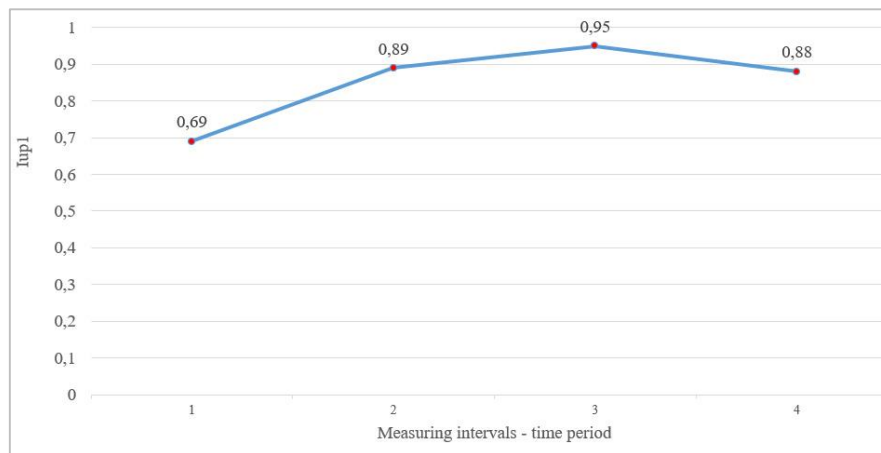


Figure 5: Diagram of measuring of KPI for subprocess - Systematic preparing for the meeting, for defined time period (source: authors)

Measuring of indicator I_{up-2} - Successfully and precise prepared documentation for the meeting with the client in order to perform vehicle reception, gives for the results, during all 4 working weeks, values above 0.85. Performing of this subprocess can be evaluated as effective. In the third and fourth, values are above range from 0 to 1, which is not typical when it's using approach of extreme values. This situation can be explained as possible unsuitable determination of parameters **MaxI**, **MinR** and **MinT** by expert team as well as possible transfer of working activities from one working week to another in aim to provide compensation for not fulfilling defined working activities in previous working weeks (Table 3, Figure 5).

Table 4. Measuring results of subprocess - Vehicle reception for defined time period (source: authors)

Time period of KPI's measuring		Measuring of I_{up-3} – Number of successfully receipted vehicles for the service i.e. number of work orders						
No.	Date of measuring time period	OI	MaxI	MinR	OR	MinT	OT	I_{up-3}
1.	01-06.03.2021.	150	190	3750 min	3850 min	3750 min	3850 min	0.73
2.	08-13.03.2021.	198	190	3750 min	3902 min	3750 min	3902 min	0.95
3.	15-20.03.2021.	187	190	3750 min	3650 min	3750 min	3650 min	1.02
4.	22-27.03.2021.	188	190	3750 min	3660 min	3750 min	3660 min	1.01

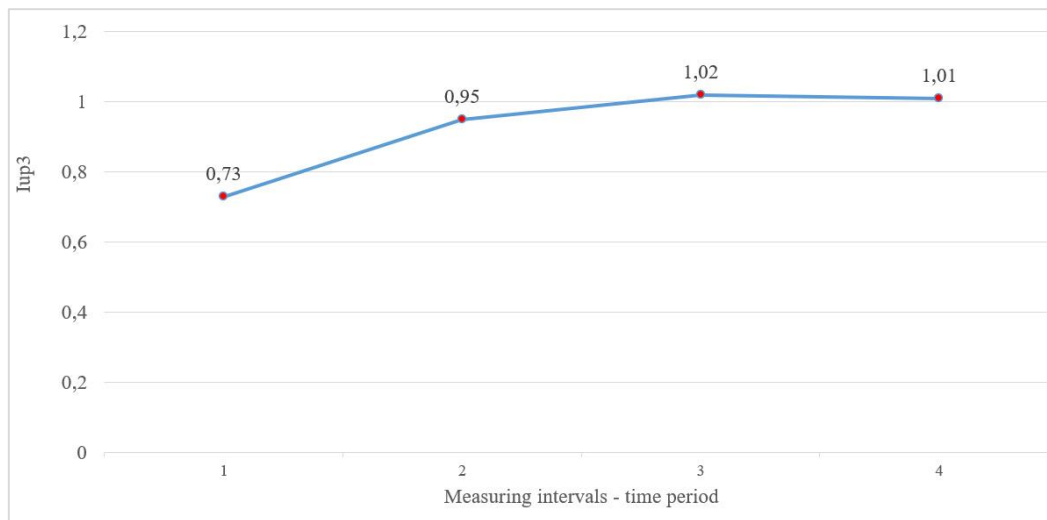


Figure 6: Diagram of measuring of KPI for subprocess - Vehicle reception, for defined time period (source: authors)

According to the performed measuring, there is a identified deviation in the first measuring week – identified value is 0.73, while results of measuring in the other working weeks was evaluated as successful.

Table 5. Measuring results of subprocess - Performing of service or car repair for defined time period (source: authors)

Time period of KPI's measuring		Measuring of I_{up-4-1} – Number of successfully performed vehicle services/repair – number of throughputs						
No.	Date of measuring time period	OI	MaxI	MinR	OR	MinT	OT	I_{up-4-1}
1.	01-06.03.2021.	150	190	12600 min	11900 min	12600 min	10800 min	0.85
2.	08-13.03.2021.	198	190	12600 min	13068 min	12600 min	13068 min	0.96
3.	15-20.03.2021.	187	190	12600 min	10098 min	12600 min	10098 min	1.21
4.	22-27.03.2021.	188	190	12600 min	11505 min	12600 min	11505 min	1.07

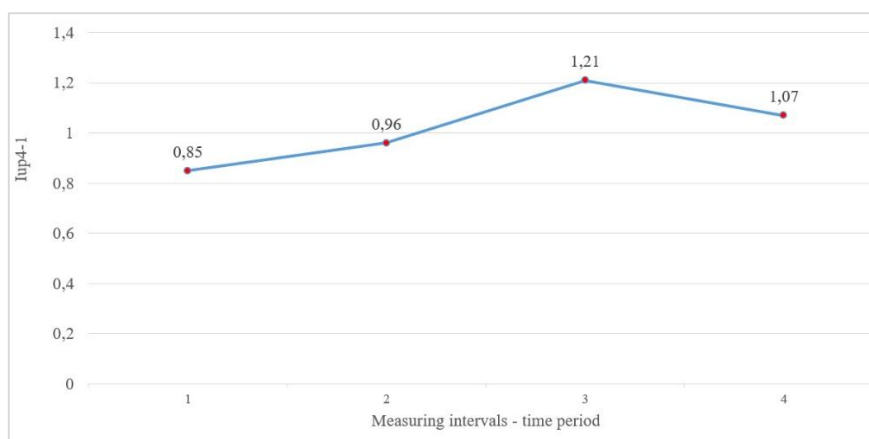


Figure 7: Diagram of measuring of KPI for subprocess - Performing of service or car repair, for defined time period (source: authors)

Values of indicator I_{up-4-1} through working weeks shows trend of stability of performing subprocess – car repair and service from the point of view of indicator I_{up-4-1} (Table 5, Figure 7).

Table 6. Measuring results of subprocess - Performing of service or car repair for defined time period (source: authors)

Time period of KPI's measuring		Measuring for I_{up-4-2} – Number of working hours in service						
No.	Date of measuring time period	OI	MaxI	MinR	OR	MinT	OT	I_{up-4-2}
1.	01-06.03.2021.	11900 min	12600 min	10800 min	11900 min	10800 min	11900 min	0.76
2.	08-13.03.2021.	13068 min	12600 min	10800 min	13068 min	10800 min	13068 min	0.85
3.	15-20.03.2021.	10098 min	12600 min	10800 min	10098 min	10800 min	10098 min	0.89
4.	22-27.03.2021.	11505 min	12600 min	10800 min	11505 min	10800 min	11505 min	0.78

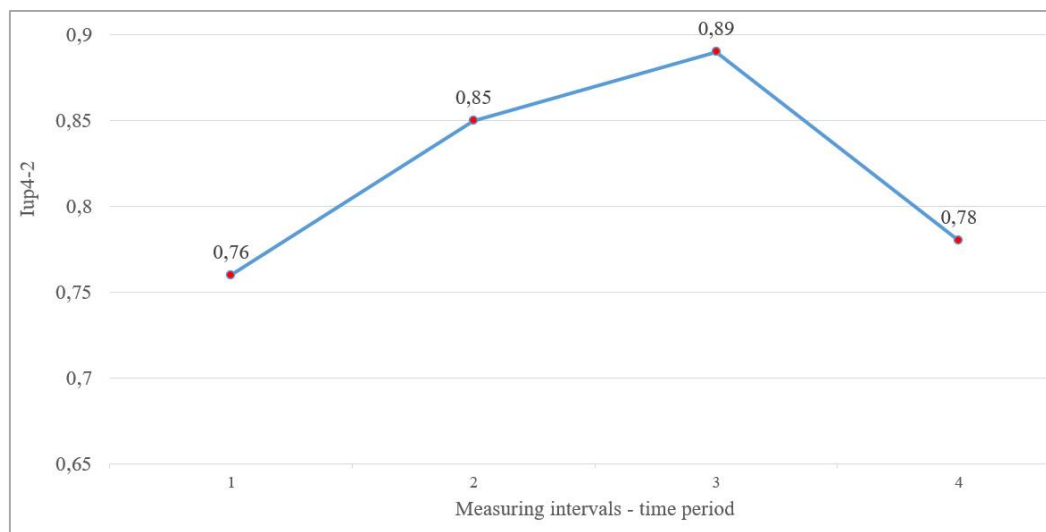


Figure 8: Diagram of measuring of KPI (number of working hours in service) for subprocess - Performing of service or car repair, for defined time period (source: authors)

For indicator I_{up-4-2} , after measuring, it was identified two deviations – in the first and fourth working week – values: 0.76 and 0.78, while other results are successful (Table 6, Figure 8).

Table 7. Measuring results of subprocess - Quality control of performed service or repair and preparing vehicle for delivering to the client for defined time period (source: authors)

Time period of KPI's measuring		Measuring of I_{up-5} – Number of successfully internal quality performed tests of the vehicle repair and service						
No.	Date of measuring time period	OI	MaxI	MinR	OR	MinT	OT	I_{up-5}
1.	01-06.03.2021.	13	14	400 min	390 min	400 min	390 min	0.95
2.	08-13.03.2021.	12	14	400 min	360 min	400 min	360 min	1.02
3.	15-20.03.2021.	14	14	400 min	420 min	400 min	420 min	0.90
4.	22-27.03.2021.	11	14	400 min	330 min	400 min	330 min	0.94

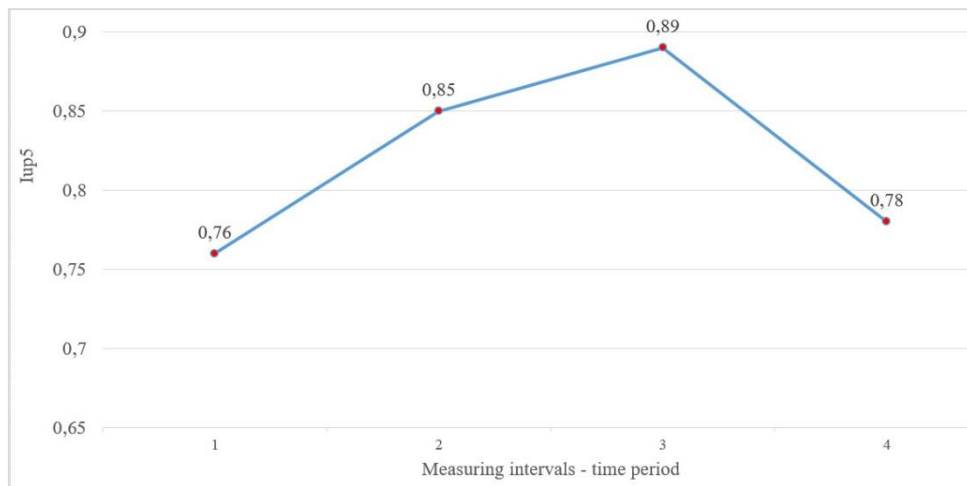


Figure 9: Diagram of measuring of KPI for subprocess - Quality control of performed service or repair and preparing vehicle for delivering to the client for defined time period (source: authors)

Subprocess - Quality control of performed service or repair and preparing vehicle for delivering to the client for defined time period was evaluated for all 4 working weeks as successful (Table 7, Figure 9).

Table 8. Measuring results of subprocess - Delivering vehicle to the client for defined time period (source: authors)

Time period of KPI's measuring		Measuring of I_{up-6} - Number of successfully delivered vehicles to the clients through invoicing of work orders						
No.	Date of measuring time period	OI	MaxI	MinR	OR	MinT	OT	I_{up-6}
1.	01-06.03.2021.	149	190	4750 min	3725 min	4750 min	3725 min	1.26
2.	08-13.03.2021.	198	190	4750 min	4356 min	4750 min	4356 min	1.13
3.	15-20.03.2021.	186	190	4750 min	4464 min	4750 min	4464 min	1.09
4.	22-27.03.2021.	188	190	4750 min	3572 min	4750 min	3572 min	1.7

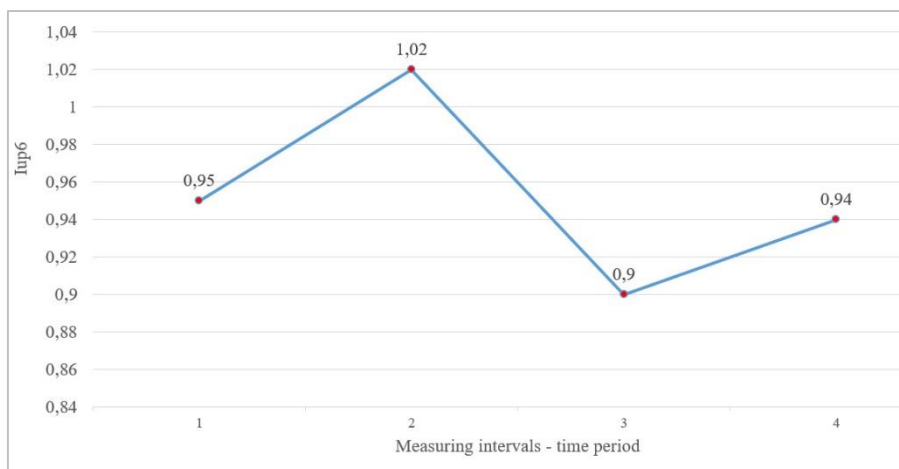


Figure 10: Diagram of measuring of KPI for subprocess - Delivering vehicle to the client for defined time period (source: authors)

When the topic is subprocess – delivering vehicle to the client, indicator **I_{up-6}** was evaluated within all working weeks as very successful.

Table 9. Measuring results of subprocess - Follow up, for defined time period (source: authors)

Time period of KPI's measuring		Measuring of I_{up-7} – Result of feedback information analysis – clients satisfaction results						
No.	Date of measuring time period	OI	MaxI	MinR	OR	MinT	OT	I_{up-7-1}
1.	01-06.03.2021.	4.68	5	10 min	10 min	10 min	10 min	0.93
2.	08-13.03.2021.	4.72	5	10 min	10 min	10 min	10 min	0.94
3.	15-20.03.2021.	5	5	10 min	10 min	10 min	10 min	1
4.	22-27.03.2021.	4.89	5	10 min	10 min	10 min	10 min	0.97

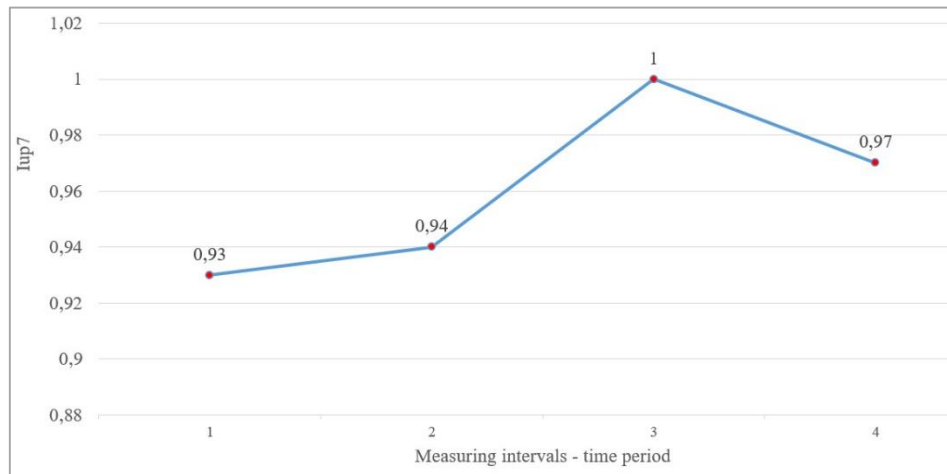


Figure 11: Diagram of measuring of KPI for subprocess - Follow up, for defined time period (source: authors)

At the end of the performed measuring of KPI's, it was performed measuring of KPI - Result of feedback information analysis. Beside all quantitative indicators, this indicator can be grouped as qualitative indicator of the main process – car repair and service. Thus, this indicator deserves special attention in possible future research. However, in this paper the main research is related to the analysing of effectiveness of mentioned subprocess – analysing of feedback information. From this point of view, performing of this process can be evaluated as very successful based on the results showed in Table 9 and Figure 11.

7. PROPOSALS FOR IMPROVEMENT OF PERFORMING OF PROCESS – REPAIR AND SERVICE OF VEHICLES BASED ON MEASURING RESULTS

Based on comprehensive analysing of process – repair and service of vehicles, it was identified several deviations in specific time period for particular decomposed parts or subprocesses. Deviations were identified based on performed measuring of previous defined indicators for performance measuring of subprocesses. Following are given subprocesses for which were identified deviations based on performed measuring as well as time periods when deviations were identified:

- Subprocess - Arranging or arranging dates for vehicle service or repair with intention to receive vehicles – Identified deviation (value 0.69), in the first working week – from 1st to 06th March, year 2021;
- Subprocess - Vehicle reception - Identified deviation (value 0.73), also in the first working week - – from 1st to 06th March, year 2021;
- Subprocess - Performing of service or car repair - Identified deviation for performance indicator - Number of successfully performed vehicle services/repair – number of throughputs also in the first working week - – from 1st to 06th March, year 2021 (value 0.76) as well as in fourth measuring week (value 0.78);

Based on above listed results of performed measuring i.e. identified deviations, description of subprocesses in which deviations were identified, estimation of researchers: authors and employees in car dealership organization (general manager, service manager and etc.), following are given proposals for improvement of functioning or performing of main process – service or car repair:

1. **First proposal for improvement – No. 1:** Participants or responsible employees for performing of subprocess - Arranging or arranging dates for vehicle service or repair are service advisors, employees in call centre or reception referents. Regarding to the deviation which was identified in just one time period of measuring, while in other time periods of measuring the results are acceptable and having in mind potential impact factors which can be related to the large number of calls in relative short time period, opinion of the authors is that is sufficiency to apply the following proposal for improvement in aim to provide further development of process performing: **Further training of mentioned employees in aim to improve communication and other skills in relation with clients;**
2. **Second proposal for improvement - No. 2:** When the topic is identified deviation in the subprocess – vehicle reception, the conclusion is that possible cause is insufficient development of competences of responsible employees for this subprocess – vehicle reception (service advisors and reception referents). Thus, the possible proposal for improvement is: **Additional education / training of employees - service advisors and reception referents, through so-called non-technical special trainings for vehicle reception as well as clients;**
3. **Third proposal for improvement – No. 3:** Employees which are participants in performing of subprocess - service or car repair are service manager, service technicians and mechanics. Deviation related to the number of successfully performed vehicle services/repair – number of throughputs, can be characterized as „expected“. Although within car reception department there is a documented information so-called „time planner“ for planning of vehicle service terms as well as time period of occupancy of work positions in workshops, which is input for performing of subprocess – car repair and service, opinion of authors is that is suitable to implement application of additional documented information in aim to improve performing of subprocess – car repair and service: **check list for monitoring of fulfilled working hours in workshop. Employee, responsible for using of this check list will be workshop manager.**

8. CONCLUSION

This paper shows example of application of universal technology of process approach on one of the main operational activities within car dealership organization – car repair and service. Research was performed in time period of one month in two directions: in direction of possibility to apply process approach “on the local principle” on one of the work activities – specialized subsystem and then, after proved possibility of application in direction of possibility to identify proposals of improvement of performing of specialized subsystem – car repair and service.

Based on performed research, the conclusion is that is possible to successfully apply process approach on the specialized subsystem – car repair and service, even more, characteristics of this working activity demonstrate necessity for applying of such approach for the successful monitoring of its performances.

After the identification of key process – car repair and service, performed decomposition on its subprocesses (creating of ID cards of subprocesses, identification of key performance indicators (I_u) for subprocesses, performed measuring of key performance indicators in defined time period, it was obtained measuring results and defined proposals for improvement of performing of main process – car repair and service.

In order to evaluate effectiveness of applying of defined proposals for improvement, it is necessary to implement defined proposals in performing of specialized subsystem of car dealership organization – car repair and service, in the car dealership organization which is subject of the research. Beside that, future research can include longer time period of subprocess KPI's measuring as well as introducing, beside time, other resources as parameters – material and financial, during the measuring i.e. calculating of KPI's of all subprocesses which determines performances of complete specialized subsystem – car repair and service.

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THE CHOICE OF TECHNIQUE AND METHODS OF ASSESSING THE INNOVATIVE POTENTIAL OF AN ENTERPRISE

L.N. Riedel^{1*}, T.V. Dubrovskaya¹, I.V. Shadrina²

¹ *Reshetnev Siberian State University of Science and Technology,*

² *Siberian Federal University, Russian Federation*

Abstract: The innovative way for the world economy development has caused the need for a comprehensive assessment of the innovative potential of different-level objects. All elements of the organization's production and economic system are developed through developing its innovative potential. A competent assessment of the innovative potential is very important as the correct choice of the innovation strategy and its implementation depends on its state. The relevance of this study\research is also due to the need for creating scientific and methodological materials for the analysis and assessment of the innovative potential. The purpose of this study is to form methodological approaches to solving the problem of assessing the innovative potential of an enterprise. To achieve the goal of the study, it is necessary to solve the following tasks: to determine the role of the innovative potential assessment in the development of the organization; to study the existing technique and methods of assessing the innovative potential; to develop methodological tools for assessing the organization's innovative potential. The main hypothesis of the study is the assumption that the generalized and structured characteristics of indicators for assessing the innovative potential will help ensure the effective management of the enterprise development and will significantly simplify the analysis and the assessment of the innovative potential. The practical significance of the research results is that the proposed method of component assessment of the innovative potential should ensure the determination of its level with a high degree of accuracy and objectivity. As a result, it becomes possible to identify problematic elements in each component of the innovative potential and quickly develop recommendations for improving the level of the innovative potential by its specific components. The developed methodology and methodological recommendations can be used in developing management decisions in order to increase the level of the innovative potential of an enterprise.

Keywords: innovative potential, methodology, methods, development, indicators

1. INTRODUCTION

Innovation processes are one of the main factors determining the strategic success of an organization in the market of goods and services, the viability and its steady development.

* Corresponding author: riedel.l@mail.ru

In the development of the innovation sphere of organizations, the main tasks are: replacing outdated forms of management, improving technologies, and introducing innovative business processes.

Innovative development is a comprehensive process that includes the development of the entire system of factors and conditions of production and economic activity of the enterprise. Therefore, an urgent need is to develop the basics of managing such an integral characteristic of the enterprise as its innovation potential (Ridel, L.N. & Dubrovskaya, T.V., 2020c; Riedel, L.N. & Pecheritsa, N.A., 2018).

Unfortunately, the information base on this problem is not structured, and the developments on the innovative potential of the enterprise and its assessments are not brought into a single system (Lapteva, E.A., 2014b).

The object of the study is the management of enterprise development based on the assessment of its innovation potential.

The subject of the research: methodology and methods of assessing the innovation potential.

The following objectives (tasks) have been set and solved in the study:

- the role of the assessment of the innovative potential in the development of the organization is defined;
- the existing methods (methodology) and methods (ways) of assessing the innovation potential are investigated;
- methodological tools for assessing the innovative potential of the organization is developed.

2. RESEARCH

When choosing an innovative development strategy, enterprises invest a lot of time and effort in analyzing their capabilities in the environment. This situation is compounded by the lack of regular strategic analysis (review) process.

The analysis of the innovation potential requires considering all aspects of the organization's activities. The main subsystems that characterize the innovation potential are (Babaeva, A.A., 2017; Gareeva, N.A., 2015):

- material and technical support,
- financial,
- personnel,
- information,
- organizational and managerial,
- marketing information.

The given (selected) subsystems allow us to give the reasonable assessment of the innovation potential of the organization, as they make it possible not only to assess the resource provision of the enterprise, but also the interaction of these resources and their impact on the effectiveness of innovation activities (Dubrovskaya, T.V. & Ridel, L.N., 2020a).

The following methods are proposed for the analysis of the innovation potential assessment:

1. Assessment by indicators,
2. Assessment of the attractiveness of the conditions for the implementation of innovative activities,
3. Assessment by integral blocks of parameters,
4. Assessment by components.

The existing methods of assessing the innovation potential were also considered;

- regarding the purpose of research,
- from the point of view of scientific studies,
- focused (directed) on a certain class of dependencies,
- by dynamics factors,
- from the point of view of the essence of the structure of «innovational potential» concept,
- according to the criterion of aspects.

It should be noted that the level of the innovative development of the enterprise is characterized by many elements, and all of them consist of a set of subsystems. The indicator of the level of the innovative potential of the company, as it was already mentioned above, includes 6 subsystems and necessary resources for their functioning.

According to these subsystems, the indicators shown in Table 1 are divided.

Table 1. Indicators of the organization's innovation potential (Kuzmina, O.E., 2014; Lapteva, E.A., 2014a)

Indicators	Calculation of indicators
1	2
1. Financial subsystem	
Share of own funds for research and development (R & D) and acquisition of new equipment and technologies in total production costs Goiter	$K = (R + D + Zt) / G$ <p>R & D – costs for research and development work; Zt – costs for the purchase of new equipment and technologies; Goiter – total production costs</p>
Knowledge intensity of manufactured products, works and services	$K = (R + D + Zt) / Vpr$ <p>Vpr – revenue from sales of products, works and services</p>
Intellectual property security	$K = NA / VNA$ <p>NA – value of intangible assets; VNA – value of non-current assets</p>
The share of the costs of professional development and training in the volume of the costs of research and development work	$K = Zpk / Zniokr$ <p>Zpc – costs for professional development and training of personnel</p>
The share of costs for the acquisition of intangible assets in total internal costs for research and development work	$K = Zna / Zniokr$ <p>Zna – costs of acquisition of intangible assets</p>
Share of state funding for research and development work	$K = GF / Zniokr$ <p>GF – state funding of research and development activities</p>
2. Material and technical subsystem	
Share of equipment intended for research and development work	$K = (About R + D) / (About about)$ <p>Oniokr – the average annual cost of equipment for research and development work; Oob – the average annual cost of the enterprise's equipment</p>
Innovativeness of the equipment	$K = (O da) / (About about)$ <p>Oda – the average annual cost of innovative equipment</p>
Modernization of equipment	$K = (O m) / (O ob)$ <p>Om – the average annual cost of upgraded equipment</p>

Coefficient of development of new equipment	$K = ((OPF)_n) / (OPF)$ <p>OPFn – the average annual cost of fixed assets at the beginning of the period; OPF – the average annual cost of fixed assets</p>
3. Personnel subsystem	
The share of personnel engaged in research and development in the total number of personnel	$K = SSCHNIOKR / (SSCH)$ <p>SSCHNIOKR – the average number of personnel engaged in research and development SCH – the average number of personnel of the organization</p>
Salary level of scientific and technical specialists	$K = ((PO)_{nts}) / ((PO)_p)$ <p>ZPnts – the average salary of personnel engaged in research and development; ZPp – average salary for the company</p>
4. Marketing subsystem	
Share of new products	$K = H_v / V_{pr}$ <p>Vn – revenue from sales of new products, works, and services; Vpr – gross revenue from sales of products, works, and services;</p>
Share of innovative products	$K = V_{in} / V_{pr}$ <p>Vin – revenue from sales of innovative products</p>
Profitability of innovative products	$K = P_{in} / S_{in}$ <p>Pin – profit from innovation activities; Ins – cost of innovative products</p>
5. Organizational and management subsystem	
Availability of highly qualified personnel	$K = SSCHVK / SSCHUPN$ <p>SSCHVK – the number of highly qualified personnel SSCHUPN – the average number of management personnel engaged in research and development</p>
6. Information subsystem	
Expenses for information activities	$K = Z_{id} / Z_{niokr}$ <p>Zid – information activity costs; R & D – R & D costs</p>
Personnel engaged in information activities	$K = Ch_{id} / Ch_{niokr}$ <p>Chid – the number of personnel engaged in information activities; R & D – the number of personnel engaged in research and development</p>

The assessment of the innovation potential allows us to adequately determine the state and readiness of the organization for innovative transformation and, as shown by the study, can be carried out in various ways.

3. RESULTS

The choice of methodology for assessing the innovative potential of an organization requires the development of the clear algorithm for conducting such an assessment.

First of all, the purpose of the analysis should be defined – this is a comprehensive assessment of the level of the innovation potential (Eremeeva, S., et. al., 2019).

To achieve the designated goal, the tasks are defined as follows:

- identification of potential opportunities for innovation activities;

- calculation of actual quantitative assessment of the level of the innovation potential;
- development of the innovative strategy.

To achieve the goal and given objectives (tasks), the following steps should be done (Lobkov, K. Yu., et. al., 2020b):

1. Selection of indicators for assessing (evaluating) the organization's activity (performance);
2. Collecting data on the selected indicators;
3. Evaluation of the organization's activities;
4. Selection of indicators for assessing innovation potential;
5. Collecting data on selected indicators;
6. Data processing and calculation of indicators;
7. Systematization of data (information) in the complex that characterizes the innovative potential of the enterprise;
8. Assessment of the innovation potential;
9. Making decisions on the use and development of the innovative potential.

All this should be combined into one general algorithm for assessing (evaluating) the innovative potential of the enterprise:

1. Setting goals and objectives (tasks);
2. Analysis of the organization's activities, analysis of the innovation potential;
3. Developing the innovation strategy;
4. Comparison of the effectiveness of the organization's activities before and after the implementation of the innovation strategy.

The method chosen for calculating and analyzing the assessment of the innovation potential is an assessment based on integral blocks of parameters. The choice of this method is justified by the fact that it reflects the specifics of the organization's activities: the products produced, investment attractiveness, as well as organizational and managerial, financial and economic, scientific and technical indicators of production and management. In addition, this method allows us to analyze in dynamics how much the organization is focused on its innovative development.

The chosen method allows you to choose a methodology for evaluating the analysis of innovative potential. From the methods listed and discussed above, we will base the analysis of the assessment of innovative potential using approaches to the assessment of innovative potential from the point of view of the essence and structure of the concept of innovative potential, namely, using an integrated approach.

The choice of this approach can be justified as follows:
first, it combines resource and process-effective components, which should give a clearer assessment of the company's innovative potential;
secondly, it allows us to bring a variety of heterogeneous indicators to the single generalizing indicator and compare the innovative potentials of different organizations.

Having assessed the level of the innovation potential, it is necessary to proceed to the development of the innovation strategy.

Choosing the organization's innovation development strategy is a conscious effort to prioritize and identify the most important innovation areas.

In the process of choosing a strategy, the main issues are the formation and the use of the most effective strategic portfolio, the identification of possible risks, and the consideration of uncertainty. At the same time, the identified competitive advantages and synergies are a significant addition [16].

An effective portfolio of innovative strategies allows us to efficiently allocate all resources and significantly improve the efficiency of the organization as a whole.

4. CONCLUSION

The application of the working methodological provisions on the formation and effective use of the company's innovation potential in practice allows us to reasonably revise the strategic guidelines and get an economic effect, which is expressed in increasing the level of the innovation potential and strengthening the organization's position in the market.

Currently, there are many methods for assessing the innovation potential, but none of them is universal and complete, so there is a necessity to analyze the existing methods and generalize them. In accordance with that, the study made:

1. Theoretical and methodological approaches to the management of the enterprise development based on the assessment of the innovation potential are summarized.
2. Methodological approaches to the assessment of the innovation potential are identified.
3. The indicators on the basis of which the assessment of the innovation potential is carried out, are defined and supplemented.
4. The algorithm for assessing (evaluating) the innovation potential is developed and proposed. The algorithm considers not only the sequence of steps, but also includes indicators which (that) characterize the innovative potential of enterprises.

The practical significance of the research results is in the fact that the proposed method of component assessment of the innovation potential should ensure the determination of its level with a high degree of accuracy and objectivity. As a result, it becomes possible to identify problematic elements in each component of the innovation potential and quickly develop recommendations for improving the level of the innovation potential for its specific components. The developed methodology and methodological recommendations can be used in the development of management decisions in order to increase the level of the innovative potential of the enterprise.

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MULTI CRITERIA ASSESSMENT OF FREE ZONES IN VOJVODINA

Bojan Stojčetić^{1*}, Đorđe Nikolić², Milan Mišić¹

¹*Academia of vocational studies of Kosovo and Metohija, Serbia*

²*Technical faculty in Bor, Serbia*

Abstract: The goal of this paper is to assess the locations of free zones in Serbian autonomous province of Vojvodina from the aspect of potential investors. The work covers five free zones in Vojvodina (Subotica, Zrenjanin, Novi Sad, Sabac and Apatin). For the assessment of free zones, it is necessary to consider a number of criteria, which requires the application of an appropriate method of multi-criteria decision-making. An analytical hierarchy process was applied in this paper. According to the decision-making results, the free zone Novi Sad (alternative A4) is ranked the best. In order to check the stability of the results, a sensitivity analysis was performed. Minimal changes in the weight coefficient of the criteria that affect changes in the range of observed alternatives are analyzed. At the same time, the position of the first-ranked A4 does not change in any case. The lowest ranked alternative is the Apatin Free Zone (A3).

Keywords: free zone, AHP, Vojvodina

1. INTRODUCTION

Globalization, rapid market changes and technological changes are just some of the challenges facing today's economies. In such circumstances, countries are forced to develop different models and benefits for investors. Free zones are one of the ways many countries try to attract foreign investment whereby companies are exempt from the usual (tax and / or customs) taxes of the host country. In return for this concession and other benefits, countries expect these companies to create large numbers of jobs, stimulate domestic exports and help diversify the economy by introducing new sectors of activity into it (Bost, 2010).

Free zones are generally defined as geographically designated areas of a country that are set aside for specially targeted economic activities, and supported through special arrangements and systems that are often different from those that apply to the rest of the country (Nyakabawo, 2014).

According to (Law on Free Zones, 2006), a free zone is a part of the territory of the Republic of Serbia that is specially fenced and marked, on which activities are performed under the conditions determined by law. The founder of the zone may be a local self-government body, a company, or an entrepreneur who, upon request, receives approval from the competent institutions. According to the mentioned law, the users of the zone can be the founder of the zone, the company for the management of the zone, as well as other domestic and foreign legal and individual. Exports of goods and services from the zone and imports of

* Corresponding author: bstojcetovic@yahoo.com

goods and services into the zone are free and not subject to quantitative restrictions, nor are commercial policy measures applied to those imports and exports (Law on Free Zones, 2006). There are currently 15 free zones in Serbia. The total area of free zones is 21 km² 43ha 80a 29m², and the total value of realized turnover of goods and services of free zones in 2019 is 4,571,641,071 euro (Report on the operation of free zones in the Republic of Serbia, 2019).

The goal of this paper is to assess the locations of free zones in Vojvodina (autonomous province in Serbia) from the aspect of potential investors. When choosing a business location, investors consider a large number of criteria. The proximity of airports, ports, highways, but also the availability of labor are some of the most commonly used criteria for choosing a business location. Bearing in mind that for the selection of a location it is necessary to analyze a larger number of criteria, the application of multicriteria decision-making methods is imposed as a logical choice. Numerous MCDM methods are used in the literature and practice: Preference ranking organization method for enrichment evaluation (PROMETHEE), Analytical hierarchy process (AHP), Analytical network process (ANP), Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS). AHP is one of the most commonly used methods in various fields: manufacturing (Baswaraj et al., 2018), energy (Stojčetočić et al., 2016), tourism (Stojčetočić et al., 2019). Having in mind the works in which AHP has been successfully applied, but also its practicality and simplicity in use, in this paper the AHP methodology has been applied for the assessment of free zones in Vojvodina.

2. RESEARCH AREA

Vojvodina is an autonomous province located in the north of Serbia. It covers an area of 21,614 km² and according to the 2011 census has a total population of 1,931,809. Out of a total of 15 free zones that exist in Serbia on the territory of Vojvodina, there are 5 free zones (Subotica, Sabac, Apatin, Novi Sad, Zrenjanin). Investments in these free zones in 2018 and 2019 are shown in Figure 1.

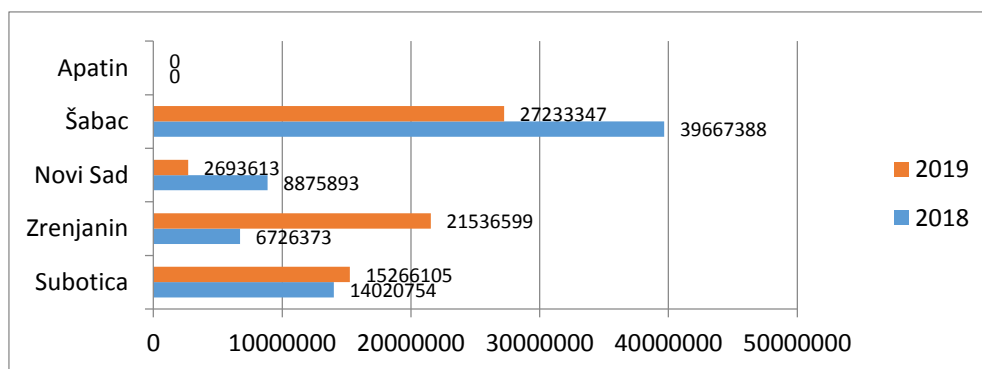


Figure1. Investments (euro) by free zones in Vojvodina in 2018 and 2019 (Report on the operation of free zones in the Republic of Serbia, 2019)

Significant turnover is also generated in free zones. The largest turnover but also the growth of turnover in Vojvodina in 2019. was realized in free zone Subotica, while the lowest turnover was realized in free zone Apatin (Figure 2).

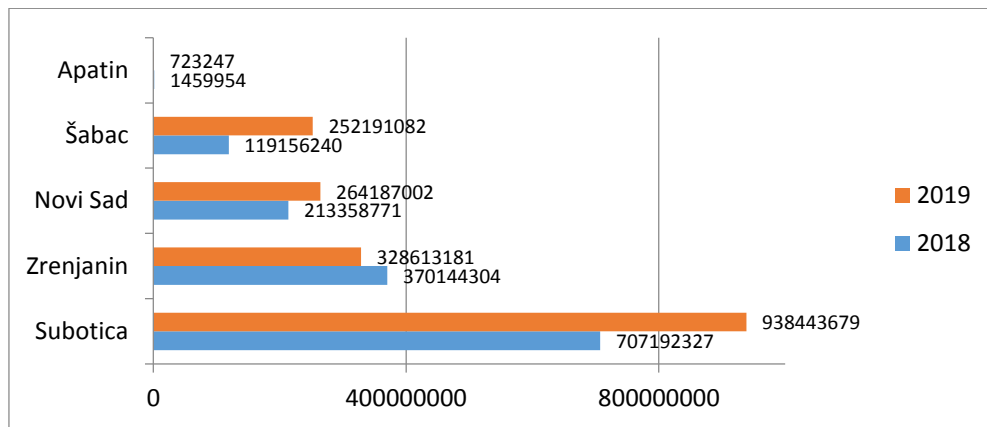


Figure 2. Total turnover (euro) in free zones in 2018 and 2019 (Report on the operation of free zones in the Republic of Serbia, 2019)

3. METHODOLOGY

The AHP is a method to select one alternative from a given set of alternatives, where there are multiple decision criteria involved, and to rank available alternatives in a desirability order based on a rational framework of quantitative comparisons (Saaty, 1990). The AHP was developed by Thomas Saaty (1980). The AHP methodology can be explained step by step approach as following:

1. In the first step, the problem is formulated in a hierarchical manner. In this step, the aim, main criteria, sub criteria and alternatives should be identified clearly.
2. Paired comparisons are performed and the relative importance are determined.
3. The consistency of pair wise comparison matrices is determined. If the consistency ratio (CR) is equal or smaller than 0.1 value, the comparisons are consistent.
4. In the final step, priorities of alternatives are found by combining the weights of criteria and the ratings of the alternatives.

In AHP method criteria weight is determined by pair wise comparisons using scale (Table 1).

Table 1. Saaty's scale

Intensity of importance	Definition
1	Equal importance
3	Weak importance of one over another
5	Essential or strong importance
7	Demonstrated importance
9	Absolute importance
2, 4, 6, 8	Intermediate values between the two adjacent judgments

The general form of pairwise comparison matrix is shown in

$$A = \begin{pmatrix} 1 & a_{12} & \dots & a_{1n} \\ 1/a_{12} & 1 & \dots & \vdots \\ \vdots & \vdots & \dots & \vdots \\ 1/a_{1n} & 1/a_{2n} & \dots & 1 \end{pmatrix} \quad (1)$$

Where a_{ij} is the relative importance of element i on element j ,

$$\begin{aligned} A &= (a_{ij}) & a_{ij} > 0 \\ a_{ji} &= 1/a_{ij} & a_{ij} \neq 0 \\ a_{ii} &= 1 \\ i, j &= 1, 2, \dots, n \end{aligned}$$

4. RESULTS AND DISCUSSION

The following were selected as criteria for the assessment of free zones in Vojvodina: the distance of Nikola Tesla Airport, distance of the highway, area of the free zone, the number of inhabitants, ie the potential workforce in the area and the nearest seaport. Basic data on free zones according to the above criteria are shown in Table 2.

Table 2. Free zones data (www.usz.gov.rs)

Free zone	Distance to Nikola Tesla airport	Distance to the highway	Free zone area	Population / potential workforce	Nearest seaport
	(C1)	(C2)	(C3)	(C4)	(C5)
Subotica (A1)	175 km	15 km	72ha 14a 28m ²	150.000	680 km
Šabac (A2)	88 km	35 km	419ha 62a 49m ²	120.000	457 km
Apatin (A3)	183 km	65 km	122ha 17a 04m ²	28.929	564 km
Novi Sad (A4)	79 km	1 km	89ha 30a 45m ²	340.000	537 km
Zrenjanin (A5)	80 km	45 km	100ha 44a 42m ²	130.000	586 km

After defining the decision criteria, the AHP methodology was applied. In the first step, the criteria were compared to the goal (Table 3).

Table 3. Comparison of criteria in relation to the goal

	C1	C2	C3	C4	C5
C1	1	1/3	4	2	2
C2		1	3	3	3
C3			1	1/2	1/3
C4				1	2
C5					1
Inconsistency 0.06					

Then, a comparison of alternatives was performed in relation to all defined criteria (Tables 4 to 8).

Table 4. Comparison of alternatives in relation to C1

	A1	A2	A3	A4	A5
A1	1	1/5	2	1/6	1/5
A2		1	5	1/3	1/2
A3			1	1/6	1/5
A4				1	1
A5					1
Inconsistency 0.04					

Table 5. Comparison of alternatives in relation to C2

	A1	A2	A3	A4	A5
A1	1	4	6	1/2	5
A2		1	4	1/5	3
A3			1	1/7	1/3
A4				1	4
A5					1
Inconsistency 0.07					

Table 6. Comparison of alternatives in relation to C3

	A1	A2	A3	A4	A5
A1	1	1/7	1/4	1/2	1/3
A2		1	5	6	5
A3			1	3	3
A4				1	1/3
A5					1
Inconsistency 0.07					

Table 7. Comparison of alternatives in relation to C4

	A1	A2	A3	A4	A5
A1	1	3	5	1/4	3
A2		1	4	1/5	1/2
A3			1	1/7	1/5
A4				1	4
A5					1
Inconsistency 0.08					

Table 8. Comparison of alternatives in relation to C5

	A1	A2	A3	A4	A5
A1	1	1/5	1/3	1/4	1/3
A2		1	3	3	3
A3			1	1/2	2
A4				1	2
A5					1
Inconsistency 0.04					

In the end, by synthesizing all the results, the final ranking list of free zones in Vojvodina was obtained. According to the obtained results, the best ranked alternative is A4, ie free zone Novi Sad (0.380).

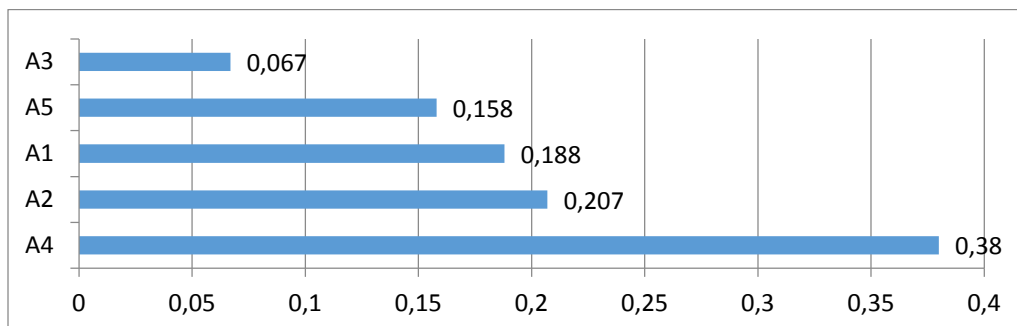


Figure 3. Final rank (Inconsistency 0.06)

Also, a sensitivity analysis was performed. Minimal changes in the weight coefficient that affect changes in the range of observed alternatives are analyzed. Minimal changes that lead to a change in the rank of alternatives in all cases affect A1 and A2 where A1 moves from the third to the second position replacing A2. At the same time, the position of the first-ranked A4 does not change in any case.

Table 9. Sensitivity analysis

Criteria	Reference value	New criteria weight	New rank
C1	0.232	0.101	A4 (0.381) A1 (0.210) A2 (0.209) A4 (0.131) A3 (0.07)
C2	0.412	0.470	A4 (0.386) A1 (0.201) A2 (0.200) A5 (0.150) A3 (0.064)
C3	0.074	0.036	A4 (0.393) A1 (0.194) A2 (0.193) A5 (0.159) A3 (0.061)
C4	0.154	0.263	A4 (0.396) A1 (0.193) A2 (0.192) A5 (0.155) A3 (0.063)
C5	0.129	0.078	A4 (0.389) A1 (0.196) A2 (0.194) A5 (0.160) A3 (0.061)

5. CONCLUSION

Free zones can contribute to the economic development of a country, especially the region in which it is located. In the previous period, significant turnover was realized in free zones in Vojvodina. However, the potential has not been fully exploited. Also, certain free zones (Apatin) have incomparably less turnover but also investments than other zones. One of the possible reasons for the poor performance of the Apatin free zone is the poor fulfillment of the criteria used in this research. According to the obtained results, Apatin (A3) is the least desirable free zone from the aspect of investors, which coincides with the results of this zone in terms of turnover and investments realized in 2018 and 2019. Based on that, it can be concluded that the criteria used in this study should be considered before the establishment of a particular free zone.

According to the results of the research, the free zone Novi Sad is ranked first, which imposes the conclusion that the availability of labor force and a good position is of key importance in choosing a location for business. The reliability of the obtained results was checked by conducting a sensitivity analysis. It was found that the minimum changes in weighting factors that lead to a change in the range of alternatives in no way affect the first-ranked alternative A4.

In future works, it is necessary to rank free zones at the level of the whole of Serbia. Also, more decision criteria and a larger number of decision makers should be included. Although the decision-making model has proven to be stable, future works can be realized in a fuzzy environment in order to further reduce inaccuracies.

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