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Engineering management

RISK MANAGEMENT IN THE COMPANY USING „SEPTRI“ METHOD

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Abstract

Risk is absolute and always present. All spheres of human life contain some form of risk. Given that risk cannot be eliminated, it is very important to manage risk properly to reduce the likelihood of negative events or the negative consequences of such events. For a business system, this means integrating the risk management function into the entire management system at all relevant levels. The aim of this paper is to identify risks and assess their impact using appropriate techniques and methods, as well as to influence the reduction of these impacts on the company's operations through the application of suitable control techniques. For this purpose, the statistical method for risk assessment and management called „SEPTRI“ (Risk Assessment and Proposed Risk Treatment System) will be used in this paper. This method transforms a large number of factors that affect a company's operations into exact data, providing clear information about the analyzed risk and guidelines for further risk treatment as a result of its application.

Keywords: *risk, risk assessment, SEPTRI, risk identification*

1. INTRODUCTION

Throughout their life cycle, technological systems and processes are subject to various destructive influences that can significantly reduce the quality of their performance. The possibility of unwanted events and the expected consequences of such events are considered risks within a system. Risk management involves the systematic identification, assessment, and prioritization of risks, followed by coordinated efforts to minimize, monitor, and control the probability or impact of unwanted events. Companies that fail to manage risks effectively may face significant financial losses, damage to their reputation, and operational disruptions. With the globalization of the world economy, the importance of risk management has increased to unprecedented levels over the past decade. Some authors go so far as to compare risk management to warfare: „what war is to generals, risk management is to managers“ (Crouhy et al., 2006). As a result, there is growing interest in adopting structured methodologies, such as the „SEPTRI“ method, which this paper will focus on, for systematically addressing and mitigating risks.

The „SEPTRI“ method (*Risk Assessment and Proposed Risk Treatment System*), an acronym for screening, evaluation, prioritization, treatment, reporting, and improvement, provides a comprehensive framework for risk management across various organizational contexts. By integrating both qualitative and quantitative techniques, the "SEPTRI" method allows companies to make informed decisions, efficiently allocate resources, and improve their ability to withstand potential disruptions.

Risk is a concept that involves the probability of specific undesirable outcomes or losses. The presence of a certain hazard, under specific circumstances (reduced to probability), can result in a particular loss. There are many definitions of risk, which vary depending on the context or circumstances of occurrence. Risk is described using two parameters:

- Probability, and
- Outcome (effect of the risk).

Business risk is the exposure of a company to threatening influences that can impair its ability to meet its strategic, financial, and/or operational goals. Therefore, it must be countered on both a strategic and operational level (Panić & Živković, 2024).

Risk management involves the management of purposeful activities that enable the elimination, at least partially, of an uncertain and unpredictable future, as well as the modification and redistribution of risks and opportunities along with their probabilities of occurrence, thereby making the future more certain and predictable. In its simplest form, risk management consists of four phases (Wideman, 1992):

1. Risk identification,
2. Risk assessment,
3. Risk response,
4. Documentation.

Although, in its simplest form, the risk management process includes all essential phases and the core of the management process itself, as companies and the external conditions in which they operate (market, competition, etc.) evolved, so did the risk management process through different frameworks. The most well-known frameworks include COSO 2004 and ISO 31000.

2. "SEPTRI" METHODOLOGY IMPLEMENTATION

The "SEPTRI" method, or the Risk Assessment and Proposed Risk Treatment System, is a method that enables quantitative risk assessment and provides guidelines on how to manage risk (Mapfre, 2008). The method is universal and applicable to all business activities, allowing quantitative comparison and hierarchical classification of different types of hazards. The general equation for risk, when applying this method, is modified by adding a factor that corresponds to the level of security present in a given company. The new equation is as follows:

$$\boldsymbol{R = \frac{P\ x\ E\ x\ I}{S}} \tag{1}$$

Where:

- **R** (Risk) – the value of the risk
- **P** (Probability) – the probability coefficient
- **E** (Exposure) – the exposure coefficient
- **I** (Intensity) – the consequence coefficient
- **S** (Security) – the security coefficient

The probability coefficient **P** is derived from data the company has from its own records or from national statistics for a given area. The Table 1 used for quantification is provided below (Vujović, 2009):

Table 1. Probability Coefficient P (Vujović, 2009)

Recurrence Period	**Coefficient P**
Less than a day	10
Less than a week	9
Less than a month	8
Less than a year	7
Less than 5 years	6
Less than 10 years	5
Less than 25 years	4
Less than 50 years	3
Less than 100 years	2
Less than 500 years	1
Less than 1000 years	0.5
More than 1000 years	0.1

The exposure coefficient **E** represents the frequency of performing a hazardous activity or operation. One activity may contain several operations or functions that can lead to a harmful event. The exposure coefficient is quantified by focusing on the operation that most frequently generates risk. The Table 2 for determining the exposure coefficient.

Table 2. Exposure Coefficient E (Vujović, 2009)

Operation Frequency	**Coefficient E**
Constant	10
1 hour	9
1 daily	8
1 weekly	7
1 monthly	6
Every 6 months	5
Annually	4
Every 10 years	3
Every 50 years	2
Every 100 years	1
Period longer than 100 years	0.5

The values for the intensity coefficient **I** are derived as the arithmetic mean of the Maximum Foreseeable Loss (MFL) and the Maximum Probable Loss (PML) (Table 4). The consequence coefficient is derived according to the Table 3 and Table 4.

- **Maximum Foreseeable Loss (***Impact Risk - Ir***)** is the value exposed to danger under the most unfavorable conditions and the most negative environmental impacts.
- **Maximum Probable Loss (***Impact Probability - Ip***)** is the value exposed to destruction from a harmful influence under conditions where the company's internal and external protective systems function normally.

Table 3. Maximum Foreseeable Loss MFL (Vujović, 2009)

MFL in euros	**MFL in %**	**Coefficient Ir**
Less than 100e	0.05	1
101 - 1000	0.1	2
1001 – 10,000	1	3

10,000-100,000	5	4
100,000-1,000,000	10	5
1,000,000-10,000,000	40	6
10,000,000-100,000,000	60	7
100,000,000 - 200,000,000	80	8
200,000,000-500,000,000	90	9
More than the net worth of the company	100	10

Table 4. Maximum Probable Loss PML (Vujović, 2009)

PML in euros	**PML in %**	**Coefficient Ip**
Less than 50e	0.01	1
50-100	0.05	2
100-1000	0.1	3
1000-10,000	1	4
10,000-100,000	5	5
100,000-500,000	7	6
500,000-1,000,000	10	7
1,000,000-10,000,000	30	8
10,000,000-50,000,000	35	9
More than 50,000,000	Over 40	10

The security coefficient **S** is derived by weighting the factors that determine the level of security in a company in relation to each type of risk. The security factor is common to all risks, so increasing its value significantly impacts the final risk value. The security coefficient is derived from the following table (Vujović, 2009):

Table 5. Security Coefficient S (Vujović, 2009)

Factor	**Coefficient S**
Security policy	0-1
Security system: Responsibilities, structure, and functions: safety manager, prevention representatives, safety department	0-0.6
Prevention program	0-0.6
Compliance with norms and regulations	0-0.4
Technical measures: active and passive	0-0.6
Human resources	0-0.4
Assessment, supervision, and control	0-0.4
Training and communication plans	0-0.4
Accident and contingency plans	0-0.4
Research, analysis, and accident records	0-0.2
Risk management program	0-1
Integration and prevention already provided by methods, processes, and procedures	0-1
Quality control program	0-1
Periodic external audits	0-1
External assistance services: police, fire department, medical services, etc.	0-1

Once the risk values are obtained using the given formula (1), risks are categorized into groups, and an appropriate approach is proposed for each:

- **Intolerable risks** with values greater than 300 – Risk must be removed or the operation generating the risk must be eliminated.
- **Extreme risks** with values between 200 and 300 – Permanent measures should be improved to reduce or eliminate the risk; methods for financing the risk should be established.
- **Serious risks** with values between 100 and 200 – Essential risk mitigation measures should be applied; partial financial retention may be established.
- **Moderate risks** with values between 30 and 100 – Usual risk reduction measures should be improved; risk retention is acceptable.
- **Minor risks** with values between 0 and 30 – No additional risk mitigation measures are needed.

3. APPLICATION OF THE METHOD AND DISCUSION

We will apply the method in a leading company specializing in the production and sale of industrial, medical, and specialty gases, as well as related equipment, including cutting and welding equipment. The focus will be on one of its production unit in Bor.

At the specific location, the following facilities and resources exist:

- Production of technical gases (oxygen, nitrogen, argon),
- Equipment for storing and vaporizing technical gases,
- Equipment for compressing and distributing gaseous oxygen to ZiJin Copper Bor,
- Operational buildings for housing control systems and compressors,
- Auxiliary services.

The air separation plant operates purely on thermodynamic principles, involving changes in pressure and temperature. Thanks to the different boiling points of the components in the gaseous mixture (air), they are separated and decomposed. No chemical reactions or changes in the chemical composition of raw materials or final products occur in the plant.

Most of the production output is transported by pipeline to the final consumer - ZiJin Copper Serbia's new plant. A smaller portion (the liquid phase) is stored in tanks for backup supply needs of ZiJin’s technical gases and for commercial sale.

To apply the SEPTRI method, we first need to determine the coefficients for probability, exposure, consequence, and safety to calculate the risk value using the formula (1).

When we look at the fire risk, it is the most prevalent risk in enterprises. Almost all companies in the industry face the risk of fire. The fire load of the factory in Bor is classified as high due to the type of plant (pressurized vessels and installations) and the characteristics of the hazardous substance oxygen, which does not burn but significantly enhances combustion.

There are several facilities critical in terms of exposure to this risk (compressor hall, storage tanks, cylinder filling station, bottle storage). Historical company data shows that in the past 25 years, there hasn't been a fire at any of these facilities, so the probability coefficient (P) is 4.

There are many causes that could contribute to the realization of the fire risk. Static electricity is a common phenomenon that occurs when gases flow through pipelines, on people's bodies, or on moving liquid or solid containers, so exposure to risk is constantly present. Therefore, the exposure coefficient (E) is 10.

Since the facilities are linked in the technological process, the maximum foreseeable loss in the event of this risk event would amount to up to 100,000,000 euros, as this event would affect all facilities, so Ir is 7.

The maximum probable loss, on the other hand, is related to a specific facility. If the risk event were to occur, the safety systems would localize it to just that facility, so the Ip coefficient is 5.

The consequence coefficient I represent the arithmetic mean of the previous two values (Ir and Ip) and amounts to 6.

The safety coefficient (S) is common to all risks and is derived by weighting the safety factors in the company. The safety coefficient is presented in Table 6.

Table 6. Safety Coefficient for the Company

Factor	**Coefficient S**
Security policy	1
Security system: Responsibilities, structure, and functions: safety manager, prevention representatives, safety department	0,6
Prevention program	0,6
Compliance with norms and regulations	0,4
Technical measures: active and passive	0,6
Human resources	0,4
Assessment, supervision, and control	0,4
Training and communication plans	0,4
Accident and contingency plans	0,4
Research, analysis, and accident records	0,2
Risk management program	0,9
Integration and prevention already provided by methods, processes, and procedures	1
Quality control program	1
Periodic external audits	1
External assistance services: police, fire department, medical services, etc.	1
SUM	9,9

Safety and protection in this company are considered from two aspects:

- **Macro aspect** – relating to risk and safety management at the company level,

- **Micro aspect** – relating to risk and safety management at the Bor plant level.

At the company level, in line with QMS, FSSC, and EMS policies, the company has adopted a Guide to the Requirements of SRPS ISO 9001:2015 standards. The manual covers the declared policy for product quality, safety, and environmental protection, integrating the requirements of ISO 9001:2015, FSSC 22000, and ISO 14001:2015.

The manual includes the following elements:

- Quality Management System (QMS),
- Certification standard for food safety systems, FSSC 22000, and
- Environmental Management System (EMS).

The manual describes the functioning of the quality and environmental management system in the company, following the requirements of the SRPS ISO 9001:2008 Quality Management System and SRPS ISO 14001:2005 Environmental Management System. The company is the first and only one in Serbia to hold EU GMP certificates for the entire production processes of liquid oxygen and nitrous oxide.

The plant in Bor is classified as a SEVESSO plant. A Sevesso plant is a technical unit within a complex where hazardous substances are produced, used, stored, or handled. The plant includes all equipment, buildings, pipelines, machines, tools, internal railways, depots, docks, and similar facilities required for the plant's functioning (Službeni glasnik, RS). As a Seveso plant of the lower order, the company is required to prepare a “Major Accident Prevention Policy” document.

Internally, the plant has clearly defined responsibilities, structures, and functions within the safety system. Employee training, including for new hires, is conducted regularly and documented appropriately.

The plant is fully automated, and its operations are controlled from a central control room via a Distributed Control System (DCS), which includes sensors and actuators for monitoring and controlling operations without local supervision, except during the loading of liquid products, when two operators are present. The DCS not only visualizes operating parameters and controls actuators but also implements control and shutdown logic, automatically switching equipment to a safe position in case of deviations. The plant is equipped with real-time surveillance cameras, and in case of a remote access failure, the system will continue to operate in its last position and enter a safe phase.

For security, the plant is protected from unauthorized access by 24-hour security monitoring and an electronic barrier system with alarms. It is also equipped with fire detection sensors and an early lightning detection system, while electrical devices are protected against surges. In the event of a fire, the alarm is forwarded to the guardhouse, where personnel can call the fire brigade if needed.

Inspection and audits, both external and internal, are conducted according to a prescribed schedule and documented accordingly.

General preventive measures include (Accident Prevention Policy, 2020):

- **Design and construction measures** – These measures include actions during the selection of technology, project preparation, construction of technological plants and buildings.
- **Technical and technological measures** – To prevent incidents in technological processes, preventive measures have been implemented, including proper process control with automation and supervision, professional maintenance, regular inspections of installations, and the use of work instructions and safety procedures. Technical protective measures include protection against injuries, proper insulation, and the prohibition of activities that can generate sparks or fires in hazardous material storage areas.
- **Fire protection measures** – The organization of fire protection encompasses measures related to occupational safety, fire protection, and environmental protection. The factory relies on the local fire brigade in Bor, which can reach the location within about 5 minutes. Technical preventive measures include an appropriate transport infrastructure, lightning protection systems, fire hydrant networks, fire alarm systems, and regular maintenance of firefighting equipment.
- **Organizational measures** – Organizational measures include training workers for safe operations, developing fire protection and recovery plans, regular equipment checks, and preparing employees for initial fire suppression and evacuation. Responsible individuals must pass professional exams, and those handling hazardous materials must be trained in proper procedures.

The safety factor S for the observed company is 9.9 (Table 6). All identified risks and their values, derived through the application of the SEPTRI method, are presented in Table 7.

Table 7. Results of "SEPTRI" method implementation

Risk	Probability Coefficient (P)	Exposure Coefficient (E)	Ir	Ip	Consequence Coefficient (I)	Safety Factor (S)	Risk Value (R)	Risk Categorization	Rank
Fire risk	4	10	7	5	6	9.9	24.24	Low risk (0-30)	2
Gas leakage risk	4	10	7	6	6.5	9.9	26.27	Low risk (0-30)	1
Natural disaster risk	2	10	7	6	6.5	9.9	13.13	Low risk (0-30)	4
Mechanical failure risk	6	10	5	4	4.5	9.9	22.73	Low risk (0-30)	3
Human error incident risk	5	10	5	4	4.5	9.9	22.73	Low risk (0-30)	3
Unauthorized access risk	4	10	3	1	2	9.9	8.08	Low risk (0-30)	5
Fire risk	4	10	7	5	6	9.9	24.24	Low risk (0-30)	2
Gas leakage risk	4	10	7	6	6.5	9.9	26.27	Low risk (0-30)	1
Natural disaster risk	2	10	7	6	6.5	9.9	13.13	Low risk (0-30)	4
Mechanical failure risk	6	10	5	4	4.5	9.9	22.73	Low risk (0-30)	3
Human error incident risk	5	10	5	4	4.5	9.9	22.73	Low risk (0-30)	3
Unauthorized access risk	4	10	3	1	2	9.9	8.08	Low risk (0-30)	5
Fire risk	4	10	7	5	6	9.9	24.24	Low risk (0-30)	2
Gas leakage risk	4	10	7	6	6.5	9.9	26.27	Low risk (0-30)	1

As shown in Table 7, all risks that could lead to significant accidents and losses in the company fall within the category of low risk, meaning no additional preventive measures are required.

The gas leakage risk has the highest value and priority according to the results. Even though it remains low, it demands constant attention due to its high exposure and potentially catastrophic consequences. Effective prevention measures keep this risk at an acceptable level, but it remains present because of the nature of operations involving pressurized vessels and continuous exposure.

Fire risk is one of the most prevalent risks in industrial plants, and this one is no exception given its operations. Although no major incidents have occurred in the past 25 years, the company remains vigilant, continuously monitoring and improving its fire prevention and protection systems.

Human error risks, though mitigated through process automation, remote control systems, regular training, and strict safety protocols, still pose a potential risk, especially in operations involving hazardous materials.

Mechanical failures, particularly in critical systems, are addressed through preventive maintenance, regular inspections, and detection systems. Additionally, maintaining supplies and collaborating with other plants ensures that production continues uninterrupted, even in the event of mechanical failures.

Natural disasters also represent relatively low risk, given the location and historical lack of occurrences. However, unpredictable events with high exposure and potentially devastating consequences, such as earthquakes, require ongoing preparedness and control measures.

Although incidents related to unauthorized access has not occurred, and the value of this risk is relatively low, the company remains on high alert to protect its property and personnel from third-party intrusions.

Despite the existence of risks that could severely jeopardize the company's operations and lead to significant material and non-material losses, effective prevention measures keep most of these risks under control and at an acceptable level. All prevention and reduction measures implemented by the company, both at the corporate level and within the production unit, have contributed to a high safety factor, which further reduces the risk values. Without these measures, considering the exposure factors and potential consequences, controlling these risks would be difficult, if not impossible.

4. CONCLUSION

Risk management plays a key role in ensuring safe operations in industrial plants, especially in high-risk facilities like the one described in this paper.

Through consultation with management and a review of historical data, risks that could lead to accidents and major incidents with serious losses have been identified. By applying the “SEPTRI” method, these risks have been thoroughly assessed. Each category of risk has been analyzed by evaluating the probability, exposure, consequences, and safety factors, resulting in values for critical events. This approach enables the company to understand, prioritize, and implement necessary control measures for these risks.

As demonstrated, the company shows a strong commitment to risk management by integrating safety protocols, technology, and continuous employee training. The combination of a proactive approach to risks, prevention, and mitigation strategies ensures operational continuity, promotes a safe working environment, and minimizes potential losses. By continuously improving these practices, the company not only meets regulatory standards but also fosters a culture of safety and operational excellence.

The method applied in this paper is universal and can be implemented in organizations of any type, size, and industry for the purpose of risk management.

UPRAVLJANJE RIZICIMA U KOMPANIJI PRIMENOM "SEPTRI" METODE

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Abstract

Rizik je apsolutan i uvek prisutan. Sve sfere ljudskog života sadrže neki oblik rizika. S obzirom na to da rizik ne može biti eliminisan, veoma je važno pravilno upravljati rizikom kako bi se smanjila verovatnoća negativnih događaja ili negativne posledice takvih događaja. Za poslovni sistem, ovo znači integraciju funkcije upravljanja rizicima u celokupan sistem menadžmenta na svim relevantnim nivoima. Cilj ovog rada je identifikacija rizika i procena njihovog uticaja korišćenjem odgovarajućih tehnika i metoda, kao i uticanje na smanjenje tih uticaja na poslovanje kompanije primenom odgovarajućih tehnika kontrole. U tu svrhu, u ovom radu će biti korišćena statistička metoda za procenu i upravljanje rizikom nazvana „SEPTRI" (Sistem procene rizika i predloženo tretiranje rizika). Ova metoda transformiše veliki broj faktora koji utiču na poslovanje kompanije u egzaktne podatke, pružajući jasne informacije o analiziranom riziku i smernice za dalji tretman rizika kao rezultat njene primene.

Ključne reči: *rizik, procena rizika, SEPTRI, identifikacija rizika*

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ASSESSMENT OF THE IMPACT OF TECHNOLOGICAL TOOLS ON THE WORK OF ARTISTIC ORGANIZATIONS IN SERBIA THROUGH THE APPLICATION OF THE FUZZY-DELPHI METHOD

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Abstract

This research paper aims to investigate the impact of technological innovations on the management of artistic organizations in Serbia. In today's contemporary digital environment, these organizations face numerous challenges. This study focuses on enhancing the management processes of these organizations, as well as increasing their efficiency and productivity. Special emphasis is placed on the importance of technological innovations in improving business operations and strengthening connections with the audience. The goal is to further explore the role of technological innovations in the Serbian artistic sector and to find the most effective ways to implement them. Plan is to develop a methodological framework for identifying crucial decision-making factors utilizing the Fuzzy-Delphi method (FDM). Additionally, an analysis of the impact of technological tools on the long-term sustainability of artistic organizations is planned, with a particular focus on the application of digital platforms, artificial intelligence, and blockchain technology. Through the analysis of expert opinions, a better understanding of the impact of technological innovations on the artistic sector and the identification of key success factors is expected.

Keywords: *art, technological tools, organizations of visual artists, FDM*

1. INTRODUCTION

This paper delves into the role and importance of arts management in contemporary literature. It explores the essence and objectives of arts management theory and practice, focusing on understanding and navigating the complexities of managing artistic organizations and their impact on culture. The aim is to provide deeper insight into arts management's dynamics in today's society through analyzing relevant literature, theoretical frameworks, and empirical research.

Technological innovations of the 20th and 21st centuries aim to enhance processes, improve productivity, and ensure safety across various aspects of life. Technology pervades every sphere of human activity in today's digital age, with rapid advancements constantly emerging. It significantly influences industrial development, facilitates communication,

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and enables the creation of new business models and products/services of higher quality (Štrbac, 2007). Technology permeates every aspect of human activity, from agriculture to healthcare, education, and even art. While it offers numerous advantages, it also presents challenges like data privacy concerns, identity theft, and digital security risks. Nevertheless, technology has become indispensable in our daily lives, driving innovation and shaping our future. In the artistic sector, technology poses both challenges and opportunities. The rapid digitization of cultural resources and shifts in consumer behavior demand innovative solutions from artistic organizations. Traditional funding and distribution models are inadequate in this evolving landscape. Therefore, integrating technological innovations into arts management is essential for enhancing efficiency, sustainability, and creativity. Online platforms enable artists and organizations to reach wider audiences, while artificial intelligence facilitates data analysis, personalization, and process optimization. These advancements streamline resource management and decision-making, fostering growth and adaptability in the artistic realm.

This paper explores how technological innovations impact organizations supporting visual artists in Serbia using the Fuzzy-Delphi method (FDM). In today's digital landscape, these organizations continually seek innovative technologies to enhance creativity and reach a broader audience. The FDM offers a structured approach to assess the impact of these technologies, gathering expert opinions to understand their potential benefits. This deeper understanding can improve efficiency, foster creativity, and contribute to overall success in the art industry. Through careful evaluation, organizations can make informed decisions about technology adoption, staying competitive in a demanding market.

2. LITERATURE REVIEW

The rapid advancement of technology profoundly influences various aspects of artistic creation, distribution, and organizational management. However, there's a dearth of empirical research on how technology affects organizations supporting visual artists. This gap underscores the need for further investigation in this area.

The European Parliamentary Research Service (EPRS) report, "*The relationship between artistic activities and digital technology development*" delves into the impact of digital technology on artistic processes and its role in driving innovation, particularly within the European Union. It examines trends and potential collaborations between artistic and technological domains (Davies et Dyer, 2019). One study specifically explores the challenges and opportunities of integrating digital art within Serbia's institutional framework. Many cultural institutions in Serbia are grappling with digitalization, preservation of digital art, and other related challenges. Through case studies like the Museum of Contemporary Art of Vojvodina, this research analyzes the integration of digital art practices into Serbia's cultural landscape, both at institutional and local levels (Mevorah, 2013). In the article "*The Role of Arts Management in the Modern World*" by Tamar Tavkhelidze, new methods in arts management and influential factors shaping arts organizations are explored. Additionally, the article examines why arts management has become a distinct discipline, defines the key role of arts management in the contemporary

art world, and discusses the skills that arts managers must apply in their daily work. Information sources that can help arts managers acquire knowledge are also analyzed (Tavkhelidze, 2016).

The literature review on "*Assessment of the Impact of Technological Tools on the work of Artistic Organizations through the Application of the Fuzzy-Delphi Method in Serbia*" revealed a scarcity of scientific research on this subject. One study focused on fostering youth creativity through innovative technologies in arts management, particularly within educational institutions. It explored the intersection of art and management, highlighting the potential of innovative arts management technologies to stimulate cultural and creative initiatives among students, especially through artistic project methods. The study emphasized an interdisciplinary approach and integration of structural and aesthetic elements in technology implementation. Notably, none of the reviewed papers utilized the Fuzzy-Delphi method to analyze technological trends or predict their impact on organizations supporting visual artists in Serbia. This underscores the necessity for further research to address the gaps in understanding and explore new technological advancements in enhancing artistic organizational management processes (Komandyshko, 2016).

2.1. Art Management

The introductory paragraph from the "Arts Management" entry in the 1998 edition of the International Encyclopedia of Public Policy and Administration offers a foundational framework for understanding the concept. It outlines the five fundamental management functions - planning, organizing, staffing, leading, and controlling they relate to the creation and presentation of performing or visual arts to audiences. This encompassing administration and support of the creative process extend to both public, nonprofit arts organizations (such as theaters, symphony orchestras, operas, dance troupes, museums, and performing arts centers) and private, commercial, for-profit artistic entities (Chong, 2010). Creative individuals are actively involved in the field of arts management. Art managers are precisely involved in this domain to enable art to reach a certain level. This area of management brings together various aspects of management, as already mentioned, and also encompasses a wide range of tasks, including leadership, distribution, marketing of cultural services, products, etc (Tavkhelidze, 2016). To grasp management in culture, we examine it through two lenses. Firstly, we identify key actors in this realm. The primary figure is the artist or cultural practitioner (actors, painters, sculptors, directors, etc.), pivotal in crafting works that enrich cultural development. These creations typically form part of cultural production presented to audiences. Cultural significance and creativity are fostered and endorsed by governmental bodies at national, regional, and local levels. Apart from governmental support, culture often receives backing from donors and sponsors, who also serve as co-financiers and audience members. Cultural experts monitor and analyze individual artistic works and creative trends, assessing their importance. In contemporary society, the media serves as a vital communication conduit, linking artists with audiences and shaping cultural supply and demand (Antolović, 2009).Top of Form Managing creative and cultural organizations demands managers to undertake various essential tasks,

including project management, financial planning, strategic decision-making, and human resource management. Managers in artistic institutions require specific skills tailored to the demands of creative and cultural industries. Effective project management is often emphasized in these organizations due to their frequent focus on specific projectsTop of Form (Raduški, 2016).

2.2. The role of technological innovations in the artistic sector

Daily, companies and their managers confront inevitable changes. Managers can resist, react to, or predict these changes. Depending on their scale and speed, changes can present challenges or opportunities. Managerial attitudes towards change are pivotal for an organization's future success or potential downfall. Creativity is increasingly crucial for organizational change and competitiveness, especially in cultural institutions and artistic organizations. These entities balance traditional values with the imperative for innovation and must adapt to remain relevant and vital. Openness to innovation, flexibility, and adaptability are essential for success, particularly for cultural and artistic organizations navigating specific challenges in a dynamic society (Stevanović, 2016). Technology and art have shared roots and are closely linked with societal trends. In the book "*Art and Technics*" historian Lewis Mumford delves into this connection, examining how both realms mirror human nature. Art delves into the inner world of humanity, expressing profound emotional and symbolic layers of life, while technology addresses the need to control external conditions and improve practical human action (Rajčetić, 2012). In today's digital age, contemporary art museums worldwide face specific high-tech demands, aiming to attract audiences amid abundant online information. However, complete digitization of operations remains a challenge. The rise of digital technology has disrupted traditional exhibition models and the relationship between artists and art institutions. Internet art, pioneered by a group of artists experimenting with computer and web aesthetics in the 1990s (net.art), utilizes the internet as its primary medium. This practice has evolved and gained acceptance, offering artists new avenues for expression, communication, promotion, and collaboration outside traditional institutional frameworks. This trend challenges conventional exhibition models, fostering exploration of innovative artistic forms Top of Form (Mevorah, 2013).

3. DATA AND METHODOLOGY

The research section involves conducting email surveys to facilitate communication with panelists. Before applying the Fuzzy-Delphi method, it's crucial to form an expert group, ideally comprising 10 to 50 members (Pua et al., 2017). 10 respondents with diverse backgrounds participated in the study, considered adequate for its objectives. The research aims to assess visual artists' attitudes, opinions, and perspectives on innovative technologies in art, including their experiences and perceptions. It also evaluates the impact of innovative technologies on the art market, such as changes in artists' sales, promotion, and distribution methods. A Fuzzy scale with seven degrees is used to gauge respondents' subjective feelings or opinions on these parameters.

3.1. Fuzzy-Delphi Method (FDM)

Proposed in 1960 by Dalkey and Helmer, the Delphi method offers a systematic approach to forming group opinions or making decisions through expert surveys. In 1985, Murray, Pipino, and Gigch introduced the Fuzzy-Delphi Method (FDM), integrating Fuzzy theory into the Delphi method for factor analysis. FDM provides several advantages over traditional Delphi methods, including allowing experts to express opinions in greater detail, utilizing expert knowledge more rationally, and being more time and cost-efficient (Yao et al., 2022). The Fuzzy Delphi method integrates Fuzzy theory into the Delphi method, serving as a predictive tool based on expert opinion and research conducted through expert meetings. It features several key aspects (Suzianti et al., 2021):

Anonymity: Experts remain anonymous to ensure objectivity and minimize influence.

Feedback: Participants receive feedback on group ideas, prompting reassessment and resubmission.

Statistical analysis: Statistical processes and graphs depict the majority opinion (50% of experts) as the team's prediction, while upper and lower quartiles indicate deviations.

Convergence: Multiple rounds of feedback lead to final predicted results.

Procedure for applying the Fuzzy-Delphi method, according to all authors, consists of several basic steps outlined below:

Step 1: Selection of Experts. This step involves the selection and engagement of experts. It is important to choose appropriate experts who will provide relevant opinions within the research framework. Authors' recommendations suggest that the optimal number of experts should be between 10 and 15, provided there is a high degree of consensus among them. This approach ensures diversity in insights and a quality contribution to the research team (Abdullah & Mohd Yusof, 2018).

Step 2: Determining the Linguistic Scale. After experts complete the survey and express their opinions, data collection follows, translating linguistic variables into a numerical system or fuzzy scale. In this master's thesis, a seven-point fuzzy scale was used (Table 1) ranging from (1) - Completely unimportant; (2) - Very weak / Very low; (3) - Weak / Low; (4) - Neutral; (5) - High; (6) - Extremely high / Extremely significant; (7) - Completely important / Completely significant.

Table 1. Seven-point Fuzzy Scale

Linguistic Variables	Ratings	Fuzzy Scale
Extremely important	7	0.9 ; 1 ; 1
Important	6	0.7 ; 0.9 ; 1
Moderately important	5	0.5 ; 0.7 ; 0.9
Neutral	4	0.3 ; 0.5 ; 0.7
Moderately unimportant	3	0.1 ; 0.3 ; 0.5
Unimportant	2	0.0 ; 0.1 ; 0.3
Completely unimportant	1	0.0 ; 0.0 ; 0.1

Step 3: Calculation of the Threshold Value (d). This is a crucial step or condition for determining consensus among experts. As authors Pua et al. state in their work: "Identifying Mental Health Elements among Technical University Students Using Fuzzy Delphi Method" the threshold value (d) should be less than or equal to 0.2 ($d \leq 0.2$). This value is calculated using the following formula:

$$d = \sqrt{1/3[(m1 - n1)^2 + (m2 - n2)^2 + (m3 - n3)^2]} \quad (1)$$

Triangular Fuzzy Numbers represent m1, m2, and m3, which are actually the ratings assigned by experts according to the seven-point fuzzy scale.

Step 4: Assessment of the Percentage Agreement Value of Experts. The next condition for determining whether consensus has been reached is a percentage value that should be greater than or equal to 75% to be considered consensus (Abdullah & Mohd Yusof, 2018).

Step 5: Defuzzification. This process involves determining the rank and rating of each criterion using one of three formulas as shown below (Pua et al., 2017):

$$A = 1/3 * (m1 + m2 + m3) \quad (2)$$

$$A = 1/4 * (m1 + m2 + m3) \quad (3)$$

$$A = 1/6 * (m1 + m2 + m3) \quad (4)$$

Specifically in this study, the first formula will be applied. The value of the defuzzification process or the Fuzzy Score (A) should be greater than or equal to 0.5 to be considered that consensus has been reached: α – cut value ≥ 0.5

4. RESULTS AND DISCUSSION

The Table 2 shows the criteria and letter designation of sub-criteria, i.e. technological tools and innovations, which the respondents evaluated.

Table 2. Digital Tools in the Art Sector Based on Criteria and Subcriteria (K1-K19)

Digital marketing	Online sales platforms	Virtual tools for exhibitions	Technologies for the authentication of works of art	Art inventory management systems
K1	K5	K9	K13	K16
K2	K6	K10	K14	K17
K3	K7	K11	K15	K18
K4	K8	K12		K19

Where:

K1 - Using social media campaigns through specific art platforms.
K2 - Focusing on email campaigns that directly engage the targeted artistic audience.
K3 - Organization of interactive webinars and workshops for the audience.
K4 - Creation of digital portfolios and online galleries.
K5 - Presence on e-commerce platforms specialized in works of art.
K6 - Using online auctions and marketplaces for works of art.
K7 - Cooperation with digital art galleries and distributors.

K8 - Developing your own online store for the direct sale of works of art.
K9 - Implementation of virtual exhibitions in reality for global audience accessibility.
K10 - Using AR technologies for more interactive exhibition experiences.
K11 - Creation of online art tours and virtual galleries.
K12 - Organization of digital artistic performances and interactive events.
K13 - Applying blockchain technology for secure authentication of works of art.
K14 - Using digital watermarks to track the authenticity of works of art.
K15 - Implementation of fingerprint recognition technology for artwork authentication.
K16 - Implementation of a cloud system for better availability of artwork inventory data.
K17 - Integration of RFID technology for accurate inventory tracking.
K18 - Development of mobile applications for inventorying works of art.
K19 - Using AI technologies to automate inventory management.

In todays art world, it's essential to examine the demographic traits, backgrounds, and inclinations of artists to grasp the impact of technological advancements on their creative methods. Scrutinizing the information offers valuable glimpses into the varied profiles and viewpoints present within the artistic sphere. The Table 3 shows the demographic statistics of the respondents.

Table 3. Analysis of demographic characteristics

Gender	
Male	Female
60%	40%
Age	
26-30 years old	30%
31-35 years old	20%
36-40 years old	30%
Over 41 years old	20%
Self-taught artist	20%
Employees in the museum	10%
Academic Artist	30%
Art association member	10%
Employees at a higher education institution in the field of art	20%
Curator	10%
Experience in using innovative technologies in artistic work	
No experience	0%
Slightly experienced	0%
Partially experienced	30%
Very experienced	70%
Painting	50%
Graphic design	10%
Photography	30%
Digital art	30%
Other (Design, Film...)	20%

Table 4 provides the final results after the FIRST round.

Table 4. Final table - FIRST round

Eligibility criteria	Threshold Consensus Value, d ≤ 0.2	% of Experts Group Consensus ≥75%	Fuzzy Score (A), α – cut value ≥ 0.5	Experts Threshold Consensus	Rank
K1	0.168	80.00%	0.75333	Accepted	10
K2	0.162	**70.00%**	0.68667	**Rejected**	17
K3	0.118	90.00%	0.83667	Accepted	4
K4	0.165	90.00%	0.87333	Accepted	1
K5	**0.201**	**70.00%**	0.66000	**Rejected**	18
K6	0.192	**70.00%**	0.64333	**Rejected**	19
K7	0.144	90.00%	0.82667	Accepted	5
K8	**0.202**	80.00%	0.69000	**Rejected**	16
K9	0.154	**70.00%**	0.75000	**Rejected**	11
K10	0.146	80.00%	0.72000	Accepted	13
K11	0.119	80.00%	0.74333	Accepted	12
K12	0.152	80.00%	0.77000	Accepted	9
K13	0.168	90.00%	0.84667	Accepted	2
K14	0.155	100.00%	0.84667	Accepted	2
K15	0.160	**70.00%**	0.78333	**Rejected**	7
K16	0.162	90.00%	0.72000	Accepted	14
K17	0.179	80.00%	0.78333	Accepted	8
K18	0.159	90.00%	0.80333	Accepted	6
K19	0.166	**70.00%**	0.70667	**Rejected**	15

Analyzing the obtained results in the first round, together with the criteria used to evaluate the acceptance or rejection of each individual criterion, we can conclude the following: Criteria: K1, K3, K4, K7, K10, K11, K12, K13, K14, K16, K17, and K18 have met all the specified conditions ($d \leq 0.2$; ≥75%; $A \geq 0.5$), thus passing the consensus, meaning that a second round is not required for them. Criteria: K2, K5, K6, K8, K9, K15, and K19 did not pass the consensus because not all conditions were met, therefore a second round is recommended for these criteria. Specifically, K2, K6, K9, K15, and K19 do not meet the second condition because the percentage of expert agreement is less than 75%, i.e., it is 70% for all criteria. While criteria K5 and K8 do not meet the first and second conditions, with a Threshold Value of 0.201 for K5 and 0.202 for K8. Additionally, the percentage value for criterion K5 is lower than the specified and is 70%. According to the results of the first round of analysis, the criteria are ranked based on the defuzzification process (Fuzzy Score - A), and accordingly, the most significant criteria after the first round are: K4 - Creation of digital portfolios and online galleries: It has the highest rank (1) and a high Fuzzy Score - A (0.87333), indicating high expert consensus and relevance. Other significant criteria: K13 - Applying blockchain technology for secure authentication of works of art: It has a high rank (2) and a high Fuzzy Score - A (0.84667), making it also very relevant. K14 - Using digital watermarks to track the authenticity of works of art: Also has a high rank (2) and a high Fuzzy Score - A (0.84667), making it also a significant

criterion. K3 - Organization of interactive webinars and workshops for the audience: It has a high rank (4) and a high Fuzzy Score - A (0.83667), placing it among the significant criteria. K7 - Cooperation with digital art galleries and distributors: It has a solid rank (5) and a high Fuzzy Score - A (0.82667), making it relevant. For more precise results, as already mentioned, a second round of the Fuzzy-Delphi method is required. Only those criteria for which consensus was not reached in the first round enter the second round. The criteria recommended for the second round are as follows: K2 – Focusing on email campaigns that directly engage the targeted artistic audience; K5 – Presence on e-commerce platforms specialized in works of art; K6 – Using online auctions and marketplaces for works of art; K8 – Developing your own online store for the direct sale of works of art; K9 – Implementation of virtual exhibitions in reality for global audience accessibility; K15 – Implementation of fingerprint recognition technology for artwork authentication; K19 – Using AI technologies to automate inventory management. Table 5 provides the final results after the SECOND round.

Table 5. Final table - SECOND round

Eligibility criteria	Threshold Consensus Value, d ≤ 0.2	Percentage of Experts Group Consensus, ≥75%	Fuzzy Score (A), α – cut value ≥ 0.5	Experts Threshold Consensus	Rank
K1	0.168	80.00%	0.753	Accepted	13
K2	0.096	90.00%	0.747	Accepted	15
K3	0.118	90.00%	0.837	Accepted	5
K4	0.165	90.00%	0.873	Accepted	1
K5	0.093	80.00%	0.773	Accepted	10
K6	0.116	80.00%	0.757	Accepted	12
K7	0.144	90.00%	0.827	Accepted	6
K8	0.168	80.00%	0.690	Accepted	19
K9	0.108	80.00%	0.750	Accepted	14
K10	0.146	80.00%	0.720	Accepted	17
K11	0.119	80.00%	0.743	Accepted	16
K12	0.152	80.00%	0.770	Accepted	11
K13	0.168	90.00%	0.847	Accepted	2
K14	0.155	100.00%	0.847	Accepted	2
K15	0.174	90.00%	0.837	Accepted	4
K16	0.162	90.00%	0.720	Accepted	18
K17	0.179	80.00%	0.783	Accepted	8
K18	0.159	90.00%	0.803	Accepted	7
K19	0.164	80.00%	0.783	Accepted	8

Analyzing the results obtained after the second round, along with the criteria used for assessing the acceptance or rejection of each individual criterion, we can conclude the following: Threshold values (d) range from 0.093 to 0.179. Most criteria have values below 0.2, indicating that all results are within the defined range. All criteria after the second round have expert consensus percentages greater than 75%, indicating a high level of agreement between experts and results. The defuzzification process (Fuzzy Score - A) varies from 0.69 to 0.847. Most criteria have high Fuzzy Score - A values, indicating that

the results are highly rated and relevant. Criteria K4, K13, and K14 are again among the most significant, with ranks (1, 2, and 2) and the highest Fuzzy Score - A values. These results indicate a high level of quality and relevance of criteria in the analysis. Specifically, K4, K13, and K14 in the second round of analysis suggest that these criteria are crucial and of primary importance for research or analysis in the given context. As for criteria with very low ranks, such as K8 - Developing your own online store for direct sale of artwork, ranked (19); K16 - Implementation of a cloud system for better availability of artwork inventory data, ranked (18); and K10 - Using AR technologies for more interactive exhibition experiences, ranked (17), the reasons why these and some other criteria received such low scores may include: lack of training, information, or understanding about certain technological tools, but there may also be resistance to new changes, which can hinder understanding and later adoption and implementation of these technological tools in practice. Strategies to overcome these challenges may include: enhancing education for skill improvement, investing in technological and human resources, tailoring criteria to specific goals, and involving stakeholders in decision-making for technology adoption and implementation to address issues effectively.

5. CONCLUSION

After a thorough analysis, it's evident that technological advancements are pivotal in shaping the art sector's future. The research highlights the critical need for embracing technology to stay competitive. High ratings for criteria like K4 (Creation of digital portfolios and online galleries), K13 (Applying blockchain technology for secure authentication of works of art), and K14 (Using digital watermarks) underscore technology's importance. Leveraging blockchain or digital watermarks enhances artwork authentication, necessitating organizations to integrate technology for authentication, distribution, and audience engagement. Overcoming challenges associated with technology adoption, such as staff training and resource alignment, demands focused efforts. Remaining adaptable and monitoring technological trends enable continuous innovation. Anticipating technological impacts aids in strategic decision-making, fostering long-term growth and competitiveness. Organizations embracing these strategies stand to expand influence, attract new audiences, and secure lasting success, recognizing technology's role in shaping the art sector's future.

PROCENA UTICAJA TEHNOLOŠKIH ALATA NA RAD UMETNIČKIH ORGANIZACIJA U SRBIJI PRIMENOM FAZI-DELFI METODE

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Izvod

Ovaj istraživački rad ima za cilj da istraži uticaj tehnoloških inovacija na upravljanje umetničkim organizacijama u Srbiji. U današnjem savremenom digitalnom okruženju, ove organizacije se suočavaju sa brojnim izazovima. Ova studija se fokusira na unapređenje procesa upravljanja ovim organizacijama, kao i na povećanje njihove efikasnosti i produktivnosti. Poseban akcenat je stavljen na značaj tehnoloških inovacija u unapređenju poslovanja i jačanju veza sa publikom. Cilj je dalje istraživanje uloge tehnoloških inovacija u srpskom umetničkom sektoru i pronalaženje najefikasnijih načina za njihovo sprovođenje. Plan je da se razvije metodološki okvir za identifikaciju ključnih faktora donošenja odluka koristeći Fazi-Delfi metodu (FDM). Pored toga, planirana je analiza uticaja tehnoloških alata na dugoročnu održivost umetničkih organizacija, sa posebnim fokusom na primenu digitalnih platformi, veštačke inteligencije i blokčejn tehnologije. Kroz analizu stručnih mišljenja očekuje se bolje razumevanje uticaja tehnoloških inovacija na umetnički sektor i identifikacija ključnih faktora uspeha.

Ključne reči: *umetnost, tehnološki alati, organizacije vizuelnih umetnika, FDM*

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Engineering management

ANALYSIS OF TEAMWORK BY SECTORS IN A MINING COMPANY

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Abstract

The primary goal of this paper is to analyze teamwork across sectors within a mining company. Given the complexity and specificity of the industry, teamwork plays a crucial role in achieving operational efficiency and long-term sustainability. This research will focus on evaluating the current state of teamwork in different sectors of the mining company and identifying best practices for improving team dynamics and efficiency. Special attention will be given to analyzing factors that influence the success of teamwork, such as organization and internal communication. The study will use a questionnaire as the methodological framework for data collection and employee opinion analysis, in order to provide recommendations for enhancing teamwork and contributing to the company's success.

Keywords: *teamwork, sector in the mining industry, efficiency, organization, communication, questionnaire*

1. INTRODUCTION

The modern business environment is highly dynamic and complex, demanding that companies adapt rapidly and effectively. In this context, organizations are moving away from traditional models and developing new approaches based on information and communication technologies, teamwork, innovation, and knowledge (Vujičić et al., 2022). Globalization has profoundly impacted global markets, the expansion of knowledge, and the growth of multinational corporations, leading to financial market integration and heightened competition. New technologies, including virtual teams and electronic communication, have become crucial for strategic decision-making. Globalization has also enabled organizations to exploit new market opportunities, enhancing their competitiveness and necessitating more efficient organizational structures and processes (Radović-Marković, 2008).

Teams, defined as small groups with specialized skills working together to achieve common goals, are a fundamental component of modern organizational structures. The shift from individual work to teamwork has become the prevailing organizational model, essential for adapting to market changes and overcoming challenges with the support of leaders and technology (Lafter, 2021). Effective teams are vital for organizations functioning in a global environment, allowing for swift responses to market fluctuations and emerging challenges. Leaders play a critical role in coordinating and motivating team

members, while advanced technological solutions facilitate better collaboration and problem-solving.

2. LITERATURE REVIEW

The modern business environment is dynamic and complex, requiring adaptation to new models that include information and communication technologies, teamwork, and innovation (Vujičić et al., 2022). Globalization impacts financial market integration and increases competition, while new technologies such as virtual teams become crucial for strategic decisions (Radović-Marković, 2008). Teamwork has become the dominant model, helping organizations rapidly adapt to changes and solve challenges with the support of leaders and technology (Lafter, 2021).

An organization is defined as a deliberate grouping of people to achieve goals efficiently. Key success factors include clear goals, adequate resources, and the ability to adapt (Radović-Marković, 2008). Teamwork, as a small group with specific skills, enables quicker adaptation and more effective problem-solving (Lafter, 2021).

Cultural differences can affect communication, decision-making, and conflict resolution within teams, so managers need to understand these differences for better management (Radojević et al., 2013). Dysfunctional leadership patterns can decrease team effectiveness and increase conflicts (Pavošević, 2021). Conflicts are a natural part of teamwork and can have both positive and negative consequences. Managers should use decision-making methods to manage conflicts (Maksimović, 2005; Dmitrović, 2021).

Communication within the team is crucial for cohesion and efficiency, including open and two-way communication (Štivin, 2020; Mitrović, 2022). Motivation is essential for team performance, and open communication helps address problems and improve motivation (Tomić, 2002; Babić, 2019). Teamwork offers benefits such as profit and efficiency, but also challenges like stress and communication issues (Lafter, 2021).

3. THEORETICAL FRAMEWORK

3.1. Organization

An organization is defined as a deliberate grouping of people aimed at accomplishing specific tasks with minimal effort. The term “organization” refers to both the process and result of organizing; it can denote a company or institution as well as a scientific discipline.

The primary task of every organization is to achieve its set goals, which are crucial for its functioning. These goals represent the organization's future and desired state. Without clearly defined goals, the organization lacks purpose. The main resource for achieving these goals is people or human potential. This includes all employees who need to be coordinated, directed, motivated, and guided toward achieving these goals. Human potential, through knowledge and skills, directly affects the organization and its management (Skledar, 2019).

Recent decades have brought challenges driven by technological progress, globalization, and various economic and non-economic factors. These challenges have necessitated significant changes in organizational and management structures, placing new demands on managers. The dynamic business environment requires rapid adjustments, improved

staffing, new work methods, and adaptable structures, all managed by a new generation of managers prepared to address emerging issues. Modern management relies on continuous practical knowledge acquisition, leveraging opportunities and avoiding risks within both the organizational context and external environment, applying a situational approach tailored to specific work scenarios. Success depends on people - on the managerial approach and behavior that generate appropriate feedback in employee behavior (Đergović et al., 2019).

According to Radović-Marković (2008), competitive advantage is defined as the unique position a company develops relative to its competitors. Many scholars assert that achieving a superior market position results in competitive advantage (Bamberger & Levi, R, 2009). This superiority depends on the consumer and can be analyzed from their perspective.

Successful companies that develop competitive advantages share these key characteristics:

- Diverse employee knowledge to handle various tasks and responsibilities.
- Employee rotation to foster ongoing professional development and advancement.
- Encouragement of teamwork, cooperation, and connections with business partners and clients.
- Increased employee involvement in the company's development activities.

3.2. Teamwork

A team is defined as a small group of people engaged in a work or business process, united by common goals, shared interests, a common mission, and tasks for which they are collectively responsible (Miljković & Rijavec, 2007). Teams can be categorized based on various criteria. According to the task criterion, they are distinguished as work teams and problem-solving teams (Petrović, 2021). Work teams, or operational teams, primarily focus on tasks performed by the organization, such as production or service delivery. Problem-solving teams address specific issues, improving quality, efficiency, or the work environment. For these teams to be effective, they require a clearly defined task and their size is usually limited (typically comprising 5 to 12 members) (Miljković & Rijavec, 2007).

The fundamental concepts behind creating teams and teamwork involve expanding the knowledge and experience of team members to find solutions to problems. Teamwork is necessary when the method for solving a problem is unknown, when there are multiple possible solutions, and when the task requires diverse opinions and expertise. Through the exchange of information and discussion, the best outcome can be achieved. The advantage of teamwork is that a group of people can accomplish tasks more efficiently than an individual, especially when the task requires a range of skills, judgment, and experience. One of the core reasons for teamwork is synergy. Synergy is defined as the phenomenon where two or more system factors, working together, produce a greater effect than what would be achieved by individual actions (Tudor & Srića, 2006).

Teamwork facilitates faster dissemination of information, leading to increased flexibility, productivity, and service quality. Additionally, teamwork enhances horizontal

communication compared to vertical communication. It is a more effective way of utilizing individual knowledge, which improves personal development and job satisfaction (Lafter, 2021). Effective teams achieve better results than individual efforts, are more flexible, take on more risks, generate more ideas, and make decisions faster and more easily.

Focus on teamwork:

- Reduces costs,
- Shortens deadlines,
- Provides satisfaction with achievements, etc.

Due to these factors, the company becomes more competitive, which is one of the most strategically important factors for success in the market (Maksimović, 2005).

3.3. Teams in organizations

One of the new forms of organizational design in the 21st century is the team organization. At the core of this new organizational structure are teams. The team organization differs significantly from other known organizational structures and is seen as a dynamic form and a completely new approach to organizational design. This new form of organizing can be incorporated into an existing organizational structure (Turkalj et al., 2012).

Introducing teams into organizations brings numerous benefits. Teams facilitate more efficient business expansion by speeding up the flow of information, which directly enhances productivity. Additionally, teamwork promotes the individual development of each member, as they continually work to improve their skills. The key to team success lies in unity members must work together cohesively to achieve common goals (Lafter, 2021).

The introduction of teamwork reduces hierarchical relationships in organizations and helps to define the roles and knowledge of individuals. The unity in teamwork ensures that all members collaborate effectively, leading to better outcomes compared to individual efforts (Lafter, 2021). According to Skledar (2019), the following types of teams can be identified in organizations:

- *Functional Operations Teams:* Members typically have specialized jobs but are part of the same core function. These teams often work longer hours and have relatively stable membership.
- *Cross-Functional Teams:* These teams are used to improve coordination between different organizational units. They usually include representatives from each involved unit and may also include external representatives such as suppliers, clients, and partners.
- *Self-Managed Teams:* A significant portion of managerial responsibilities is transferred to the team members. Most self-managed teams are responsible for specific projects or services.

In practice, different types of teams can be identified, and their divisions vary. According to (Žugaj et al. 1999), these divisions include:

- *Work Teams:* Responsible for tasks and objectives related to the company's business policy. They represent a significant form of teamwork organization, usually consisting of 10-15 members who perform closely related and interdependent tasks. Members of self-managed teams take on considerable responsibilities, including planning, scheduling work, assigning tasks, and monitoring progress.
- *Management Teams:* Known as management teams, these are characterized by a greater diversity of knowledge, abilities, and skills among team members compared to individual roles.
- *Virtual Teams:* Members communicate using electronic media rather than face-to-face interactions.

3.4. Team members

Every team comprises different members, and a successful team results from the combination of skills, roles, and knowledge of its members. Effective teams have members who can fill all roles and are selected based on their skills and expertise (Robins & Judge, 2009).

According to Lafter (2021), team members can assume various roles, each with distinct characteristics and potential weaknesses:

- *Leader:* Guides the team, assigns roles, and recognizes individual qualities. Possesses good communication, self-confidence, and the ability to leverage the team's potential.
- *Doer:* Practical and reliable, focused on completing tasks. Disciplined and organized but conservative and resistant to change. Ensures necessary tasks are completed, even those missed by others.
- *Creative:* Generates new, imaginative ideas but may overlook practical details and protocols. Prefers working independently over team tasks.
- *Researcher:* Collects and develops ideas from various sources. Sociable, enthusiastic, and skilled in negotiations. Works well with the Creative due to complementary approaches.
- *Team Worker:* Focuses on team relationships and creating a positive environment. Possesses strong social skills, resolves conflicts diplomatically, and may be a potential leader, though may struggle with decision-making.
- *Monitor:* Ensures that ideas are evaluated effectively and agreements are reached. Remains objective and intelligent, observing others without engaging in debates.
- *Coordinator:* Identifies members' abilities and directs them toward common goals. Calm, practical, disciplined, and optimistic, with the ability to handle various situations effectively.

3.5. Team building

Good leadership is essential for the successful implementation of assigned tasks and effective team management. If the dimensions of leadership are poorly set, the company cannot succeed. Good leadership should encourage discussion and innovation among team

members, support group cohesion, creates awareness of challenges, and identify solutions (Pavošević, 2021). The most important activities in the team formation process are (Vasić, 2004):

- Job analysis and determination of roles in the team,
- Determining the structure of the team,
- Creating a climate of trust, cooperation, and support,
- Determining the work strategy,
- Training and improvement of team plans,
- Adequate compensation of team members.

A team leader is someone who possesses the skills and abilities to properly select team members, trust them, encourage and reward them for successfully completed tasks, or punish them if they fail to meet expectations. To ensure the proper functioning of the team, the leader should direct their efforts in such a way as to inspire team members to make creative and innovative suggestions.

Given that teams performing certain tasks continuously on a daily basis may slowly lose sight of their purpose, one of the most important tasks of the team leader is to ensure that each individual's contribution aligns with the company's goals, rather than just focusing on individual tasks. A team leader must balance the degree of control and independence of each team member to ensure optimal team performance. Therefore, it is crucial for leaders to be energetic, to "radiate" positive energy, and to be persistent, active, and focused on the tasks they are performing. The main task of the team leader is to set precise and realistic goals for the team they lead (Jović & Jović, 2009).

Skledar (2019) identifies the skills needed to lead cross-functional project teams, which include:

- *Technical expertise:* The leader must be able to discuss technical issues with members from different functional areas.
- *Cognitive skills:* A leader must be capable of solving complex problems that require creativity and systems-level thinking, and must understand how different functions contribute to the success of the project.
- *Interpersonal skills:* A leader must understand the needs and values of team members, be able to influence them, resolve conflicts, and build cohesiveness.
- *Project management skills:* A leader must know how to plan and organize project activities, select and engage qualified team members, and manage financial affairs effectively.
- *Political skills:* A leader must have the ability and knowledge to build coalitions, obtain resources, and secure support and approval from top management and other relevant stakeholders.

3.6. Communication in the team

Communication is not merely passing information to another party. To meet the criteria of effectiveness, communication must be two-way, with constant feedback from both parties.

There are four basic functions within a group or organization: control, motivation, emotional expression, and information (Mitrović, 2022).

Control refers to adherence to the organization's policies and hierarchy, which involves informing superiors and management first.

Motivation is achieved through communication by explaining to employees what needs to be done, how to perform tasks, and how to improve work performance.

Emotional expression allows individuals to express their emotions and needs.

Information is conveyed to individuals and groups, providing them with the necessary details to make decisions.

Communication is the foundation of all relationships. Since it involves mutual exchange of information, it is fundamental to team functioning, which relies on the mutual dependence and cooperation of team members. The most immediate forms of communication include active listening, spoken, and non-verbal communication. The team manager or leader plays a crucial role in establishing communication within the team. They facilitate relationships and set standards for the team (Štivin, 2020).

Active listening enables establishing communication by demonstrating understanding and gaining the interlocutor's trust. This includes giving full attention, showing empathy, providing feedback, and avoiding interruptions. Active listening encourages cooperation and increases the likelihood of successful communication (Glavaš, 2021).

Verbal communication is achieved by exchanging ideas and information through words, either orally or in writing. It is often used in combination with written communication, such as additional explanations through telephone conversations (Mitrović, 2022).

Nonverbal communication includes body language and nonverbal signals, such as paralinguistic signals (intonation, emphasis), kinetic signals (movements, gestures), and proxemic signals (distance, control of personal appearance). These signals play a key role in communication and can influence the perception of the message (Glavaš, 2021).

When speaking, it is important to convey the message clearly and concisely, avoiding technical jargon and unnecessary digressions. To keep listeners' attention, it is necessary to address everyone present and ensure their involvement (Štivin, 2020).

3.7. Motivating team members

Motivation is crucial in the business world, and a team leader must understand motivation theories and recognize demotivation among team members. Motivation refers to the internal drive that influences an individual’s behavior and activities (Babić, 2019). Team members' motivations can vary: from the desire to contribute to problem-solving, to seeking personal prestige or influence. Social motives and personal dispositions, such as interests and values, also play a significant role (Tomić, 2002).

Even minor signs of demotivation in one member can negatively impact the entire team, so leaders must regularly monitor motivation levels and use contemporary theories to address demotivation issues (Babić, 2019). Open communication through regular meetings allows

members to express their problems and reasons for demotivation, which helps build trust and improve overall team motivation.

4. RESEARCH METHODOLOGY

The research will focus on analyzing teamwork within the ESG and Marketing – Procurement departments at mining company. A survey has been used as the primary tool for data collection, providing detailed insights into the attitudes and experiences of employees crucial for team functioning.

The aim of the research is to analyze the dynamics and characteristics of teamwork, identify factors contributing to team efficiency and sustainability, and explore the challenges teams face. Special emphasis will be placed on the impact of organizational culture, communication among team members, and the role of leadership in achieving high performance and collaboration.

Through survey analysis, the research expects to identify existing practices and areas for improvement, contributing to a better understanding of the importance of teamwork in the mining industry in Serbia. Employee feedback, based on their practical experience, will be crucial for forming relevant conclusions.

4.1. Mining industry and the company under study

Mining is one of the oldest industries, involving the extraction and processing of ores for industrial and daily use. In our region, mining dates back to Roman times and flourished during medieval Serbia. Many mines from this period are still operational today. Commonly extracted materials include bauxite, tin, zinc, diamonds, natural gas, magnesium, manganese, copper, nickel, lead, platinum, oil, salt, silver, titanium, uranium, coal, gold, and iron, as well as clay, sand, granite, and limestone (IKT, 2021).

Historically, mining has always been under special supervision due to its importance for economic, political, military, cultural, and spiritual development. It has brought both prosperity and hardship. Many countries have achieved high standards of living and technological advancement through mineral resources, though these have also led to colonization, wars, and migration (Radosavljević, 2016). Radosavljević (2016) highlights key features of modern Serbian mining:

- Rapid development from manual, low-productivity methods to levels equivalent to highly developed economies.
- Mining has been a major driver of economic and industrial development.
- By the end of the last century, mining faced a decline and collapse.
- Despite its current state, Serbian mining still has a significant mineral resource potential.

Multinational companies unify production and supply across multiple countries and are vital to the global economy. They embody globalization, characterized by the exchange of knowledge, goods, capital, and services beyond national borders (Buvač, 2015).

The case study company manages four copper mines and a smelter, producing copper and precious metals. As the sole producer of these metals in Serbia, it significantly impacts the local economy through collaboration with over 1,500 local suppliers and creating over 8,000 indirect jobs. The company invests in local infrastructure and economic development, adhering to international human rights standards, and supports community development through donations, medical equipment, educational projects, and youth training.

5. RESULTS AND DISCUSSION

The research was conducted in August 2024 using an online survey distributed to employees of mining company. The survey was sent to 48 email addresses of employees from the ESG (Environmental, Social, and Governance) and Marketing-Procurement sectors. Some employees did not respond, mainly due to being on vacation or because they were in higher positions, making personal contact difficult. The survey was available in both Serbian and English to ensure participation from all employees, considering the company's multinational structure.

Based on the online survey, which included 41 respondents, socio-demographic data were collected, including gender, age, education, employment status, work experience at the company, position within the sector, and the sector in which they currently work.

Additionally, data were collected on the work environment, frequency of meetings and workshops for improving teamwork, level of autonomy in work, support and resources from senior management, need for changes, employee satisfaction with teamwork, efficiency of teamwork, mutual support among team members, quality of communication with supervisors, openness to innovation, team diversity, flexibility of working hours, and sense of belonging to the team.

Below is a detailed analysis of the results obtained from the online survey of employees at mining company.

5.1. Socio-demographic characteristics of the sample

The survey included 41 respondents, of which 22 were women and 19 were men (Figure 1). Gender distribution among respondents was relatively balanced. The largest portion of respondents, 41.5%, fell within the age group of 25 to 34 years, while 29.3% belonged to the 35 to 45 age group. Less represented age groups were 18-24, 45-54, and 55-64 years, each accounting for 9.8% of the respondents (Figure 2).

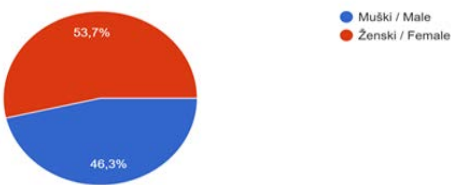

Figure 1. Gender of respondents

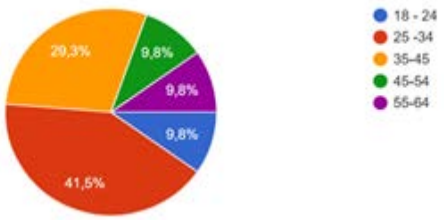

Figure 2. Age of respondents

In terms of education, 48.8% of respondents held a university degree, while 34.1% had a master's degree. The share of those with a high school diploma was 17.1%, while no respondents had only elementary education or a doctoral degree (Figure 3).

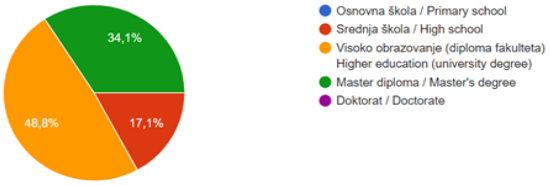

Figure 3. Education of respondents

Most respondents, 65.9%, were permanently employed, while 22% were temporarily employed, and 12.2% were interns. The largest group of respondents, 31.7%, had between 1 and 3 years of work experience in the company, while 24.4% had been with the company for over 10 years. Employees with 4 to 6 years of experience made up 22%, while those with less than a year (12.2%) and those with 7 to 10 years of experience (9.8%) were less represented (Figures 4 and 5). According to Figure 6, the majority of respondents, 23 of them, work in the Marketing – Procurement department, while a significant number of 18 respondents belong to the ESG department.

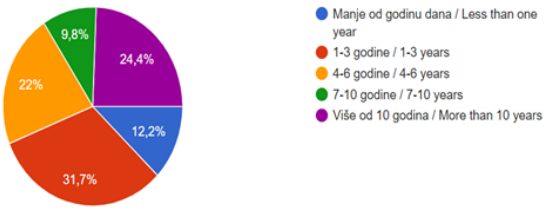

Figure 4. Employment status

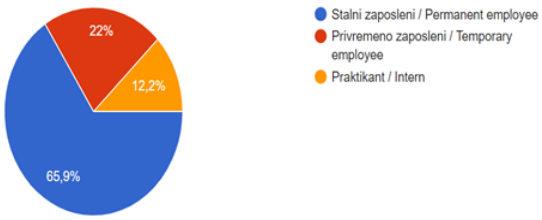

Figure 5. Work experience in the company

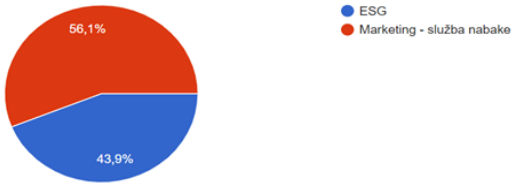

Figure 6. Department in the company

5.2. Analysis of respondents' answers

Work Environment: Figure 7 shows that the majority of respondents (41.5%) rate their work environment in their sector with a score of 4, while the fewest (7.3%) give it a score of 2.

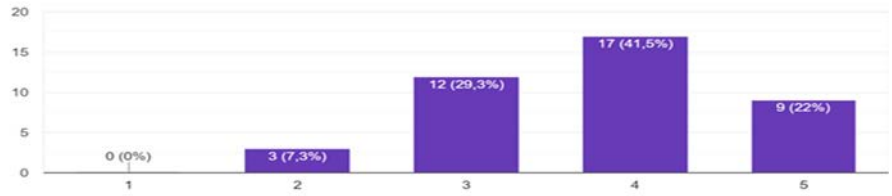

Figure 7. Work environment

Frequency of Teamwork Meetings: Figure 8 shows that most respondents (31.7%) rate the frequency of meetings aimed at improving teamwork with a score of 3, while the fewest respondents (9.8%) give a score of 1.

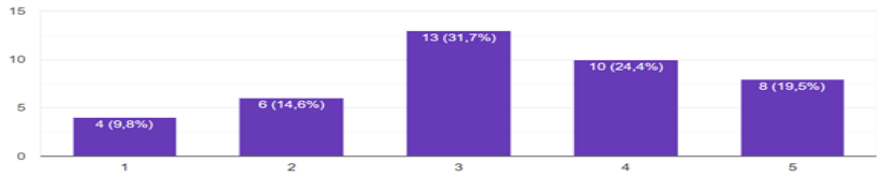

Figure 8. Frequency of teamwork meetings

Support from Upper Management: Figure 9 shows that most respondents (33.3%) rate the support and resources from senior management with a score of 4, while the least (2.6%) give a score of 1.

Figure 9. Support from upper management

Teamwork Efficiency: Figure 10 shows that most respondents (39.5%) rate teamwork efficiency as good (score 4), while no respondent gives a very low score (1).

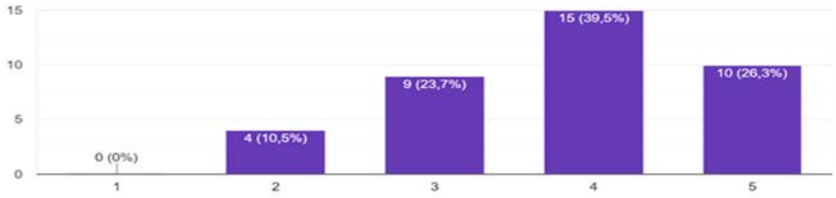

Figure 10. Teamwork efficiency

Mutual Support Among Team Members: Figure 11 shows that most respondents (39%) rate the level of mutual support as good (score 4), while no respondent considers it very low (score 1).

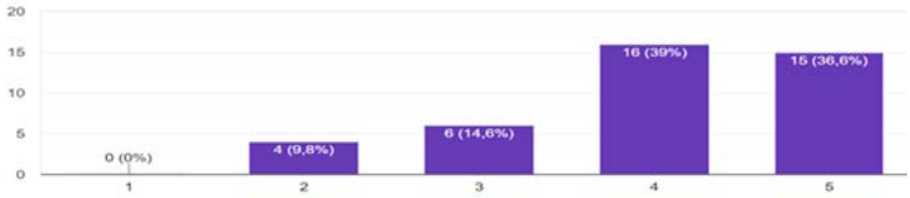

Figure 11. Mutual support among team members

Autonomy in Work: Figure 12 shows that the largest percentage of respondents (36.8%) rate their autonomy level as high (score 4), while the fewest respondents (2.6%) rate it very low (score 1).

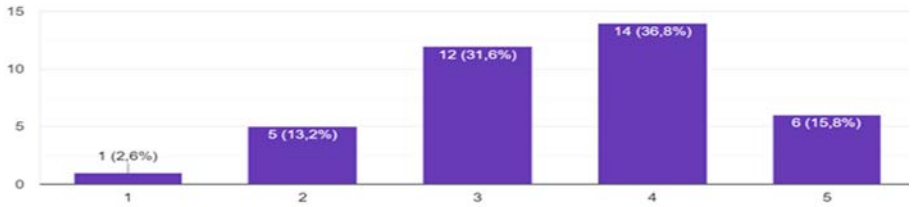

Figure 12. Autonomy in work

6. DISCUSSION OF RESULTS

Within the framework of the research, employees increasingly recognize the importance of teamwork for the survival and success of the company. Team members acknowledge the significance of mutual support and sharing information. The company occasionally organizes team-building events, but more frequent organization is recommended to improve cohesion and efficiency.

The analysis shows that the quality of collaboration and mutual support play a key role in achieving organizational goals. Results indicate that respondents are highly educated, which positively affects the dynamics of teamwork and the adoption of innovations. Although the work environment is rated positively, there is a need for additional meetings and resources from upper management.

The effectiveness of teamwork is high, but it can be improved through greater mutual support. The quality of communication with superiors and a high level of autonomy contribute to employee satisfaction. Diversity within the team is positive, but flexibility in working hours requires improvement.

7. CONCLUDING REMARKS AND RECOMMENDATIONS

Teamwork is becoming imperative for the competitiveness of organizations in today's market. By providing a sense of security, teamwork facilitates task resolution. Effective teamwork requires proper organization, a good atmosphere, and a strong leader.

The research confirms the importance of teamwork and mutual support for achieving goals. Investing in team skills, enhancing communication, and fostering openness to innovation can significantly improve the work atmosphere. It is recommended to organize meetings more frequently, increase support from upper management, and hold events that will enhance communication and cohesion. Additionally, exploring new ways to encourage innovation can bring new ideas that will help the company remain competitive.

ANALIZA TIMSKOG RADA PO SEKTORIMA U RUDARSKOJ KOMPANIJI

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Izvod

Primarni cilj ovog rada je analiza timskog rada po sektorima u rudarskoj kompaniji. S obzirom na složenost i specifičnost industrije, timski rad igra ključnu ulogu u postizanju operativne efikasnosti i dugoročne održivosti. Ovo istraživanje će se fokusirati na procenu trenutnog stanja timskog rada u različitim sektorima rudarske kompanije i identifikovanje najboljih praksi za poboljšanje dinamike i efikasnosti tima. Posebna pažnja biće posvećena analizi faktora koji utiču na uspeh timskog rada, kao što su organizacija i interna komunikacija. Studija će koristiti upitnik kao metodološki okvir za prikupljanje podataka i analizu mišljenja zaposlenih, kako bi se dale preporuke za unapređenje timskog rada i doprinos uspehu kompanije.

Ključne reči: *timski rad, sektori u rudarstvu, efikasnost, organizacija, komunikacija, upitnik*

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Izvod

Korporacija kao jedan od najsloženijih oblika organizovanja preduzeća u savremenom društvu dobija posebno mesto i ulogu. Ovaj oblik društva kapitala nalazi se u neposrednoj vezi sa svojim bližim i daljim okruženjem. Okruženje se shvata kao kompleks elemenata, načina povezivanja elemenata i stanja koja se uspostavljaju, pri čemu je korporacija-preduzeće, kao deo kompleksa okruženja sa nužno pridobijenim jednakim osobinama, takođe kompleks koji se menja. U tom kontekstu shvatanje korporacija pretpostavlja spoznavanje trenda promena, s jedne strane, i spoznavanje elemenata, povezivanja elemenata te potencijalnih i aktuelnih stanja, s druge strane. Ova druga strana može se shvatiti kao strukturalna i procesualna kompleksnost. Korporacija i savremeno okruženje su ključni koncepti u akademskom proučavanju odnosa poslovanja i društva. Ovaj rad ispituje budućnost korporativne društvene odgovornosti u savremenom okruženju. U savremenoj akademskoj literaturi i menadžerskim stavovima o najboljim praksama postoje izraziti trendovi protiv korporativne odgovornosti. Ovi trendovi izazivaju značajne sumnje u budući status teorije i prakse korporacije. Vitalna promena je da princip stvaranja bogatstva progresivno dominira menadžerskom koncepcijom odgovornosti. Rad pruža istoriju razvoja korporacija od progresivne ere pa do okvira korporativnog društvenog učinka i Kerolove piramide korporativnih društvenih odgovornosti i procenjuje izglede za poslovnu odgovornost u globalnom kontekstu savremenog okruženja.

Ključne reči: *korporacija, savremeno okruženje, korporativni sistem i kriza uspeha*

1. UVOD

Korporacije su prestale da budu samo legalni instrumenti preko kojih se mogu obavljati privatne poslovne transakcije pojedinaca. Iako se i dalje koristi u ove svrhe, korporativni oblik je dobio veći značaj. Korporacija je, u stvari, postala i metod posedovanja imovine i sredstvo organizovanja ekonomskog života. Njen rast velikih razmera, evoluirao je u „korporativni sistem“, koji je privukao kombinaciju atributa i moći, i koji je dostigao stepen istaknutosti dajući mu pravo da se njime bavi kao glavnom društvenom institucijom.

Istraživači i dalje zastupljaju mišljenje da menadžeri imaju poseban odnos prema akcionarima u firmi. Pošto akcionari poseduju akcije u firmi, oni imaju određena prava i privilegije koje im mora dodeliti menadžment, kao i drugi. Smatra se da sankcije, u obliku „zakona korporacija“ i drugih zaštitnih mehanizama u obliku društvenog običaja, prihvaćene upravljačke prakse, mita i rituala, jačaju pretpostavku o primatu akcionara.

Ovaj rad treba da objasni proces transformacije korporacija u savremenom okruženju i ukaže na posledice krize kao kompleksnosti okruženja u kojem korporacija posluje.

2. RELEVANTNE PROMENE OBELEŽJA KORPORACIJA

Jednako tako kao što se u ovom veku menjalo okruženje, i kao što je ono pridobilo nove drugačije osobine, tako je i preduzeđe na kraju, kao deo okruženja, takođe poprimilo osobine koje su bitno drugačije od onih s početka veka. Neke relevantne promene su sledeće: Promena tradicije je uslovljena činjenicom da savremeno preduzeće nije samo ekonomski sistem usmeren na zarađivanje, već je istovremeno i socijalni sistem sa zadatkom ostvarivanja socijalnih ciljeva (Damnjanović et al., 2020; Cvjetković et al, 2021; Avakumović et al., 2021). Ono, ako je ili želi biti uspešnim, mora imati jasnu viziju i prihvatljive ciljeve koje ostvaruje oslanjajući se na rezultate analize, ali i na instinkt i intuiciju, te suvlasnički i preduzetnički odnos svojih zaposlenih. Ono je orjentisano prema individualnim kupcima ili grupama kupaca i njihovim zahtevima, koje zadovoljava stalnim promenama i inovacijama, a imovinu uvećava kao posledicu, nusprodukt takvog poslovnog delovanja.

Poređenje postulata, prema istraživanju nemačkih autora skraćeno prikazanom u Tabeli 1 (Cliford & Cavanagh, 1990; Mihajlović et al., 2021), kojim su se vodila i orjentisala preduzeća do 70-tih godina, i postulata uz "nove tradicije", svedoče višeznačnost promena. Uopšteno, može se reći da je današnje preduzeće rezultat promena koje su usmerene na višeznačno oblikovanje nove celovitosti, pa se, na pred njih postavljene izazove, može odgovoriti samo sistemskim upravljanjem i podeljenim odgovornostima".

Tabela 1. Pregled - deset postulata za uspeh preduzeća

POSTAVKE IZ 70-TIH GODINA	"NOVA TRADICIJA"
- Za natprosečni rast i zaradu moraš pronaći nove branše koje su upravo aktualne i najviše ekspanziraju.	- To nije važno. Dobitnik se susreće u svakom sektoru..., u delatnosti lepila i tekstila kao i kod softvera u zdravstvu i u informacionoj tehnologiji.
- Veličina je svakako značajna kao i sektor (branša). Nađi i zauzmi najveće tržište.	- najbolje postupaš kada stvoriš i podigneš tržišnu nišu.
- Iskoristi krivu učenja i obimom ostvari degresiju.	- Inovacijom ostvari novu krivu učenja. Kooperišij sa drugim i pretekni konkurenciju zastarom njihovih proizvoda.
- Niske cene donose visok tržišni udeo.	- Vrednost odlučuje
- A. Nađi dobar posao (delatnost) i ostani u njemu.	- Opstajanje nije stajanje na istom mestu ali nije ni kretanje bez smera. Prekorači granice prema sličnim proizvodima ili sličnim tržištima ili prema jednima i drugima.
- B. Diverzifikuj! Budi mešovit korporacija – koncern.	- Pokažite svojim nameštencima vrednost i viziju.Učinite ih vlasnicima udela, oni će se, jer su vlasnici, ponašati kao vlasnici.

- Tvoji službenici su birokrate koji čekaju instrukcije - daj im instrukcije.	- Zadatak preduzeća je stvarati instituciju, nešto osobito postići i u nasleđe ostaviti. Dobro vođeno preduzeće stvara imovinu kao sporedni efekat.
- Zadatak preduzeća je stvarati imovinu vlasnicima.	- O čemu ne brinete to je propalo.
- Što nije propalo za tebe nije izgubljeno.	- U svojem radu uspešan vođa je besomučan
- Uspešna sposobnost vođenja je hladna, racionalna radna profesija.	- U svom radu uspešan vođa je besomučan zanesen). On se u pravilu najmanje jednako oslanja na vlastiti instinkt i intuiciju kao i na činjenice i analize.
- Uspešna preduzeća vode izuzetni preduzetnici koji stalno destruišu i dezorganiziraju udarne poslove.	- Uspešna preduzeća vode ljudi koji poznaju prioritete i vrednosti preduzeća, koji su sigurni u ciljnu usmerenost preduzeća i koji snažno održavaju kulturu preduzeća.

U sistemskom načinu mišljenja sve te promene mogu se kvalifikovati: kao promene koje se odnose kako na shvatanje ciljeva tako i na konfiguraciju elemenata i na način povezivanja elemenata. U sva tri sistemska aspekta promene nisu udarne, one su postupno nastajale i postupno su menjale preduzeće.

Promene strukture delovanja, koje su u našem veku bile izražene, su kvalitativne promene, pri čemu teče proces snažne diferencijacije preduzeća (Horvath, 1991), i to sa aspekta zavisnosti organizacije od okruženja, ciljeva preduzeća, te strukture upravljačke moći. Naime, jedna proizvodna linija, pa i za višebrojna tržišta, iz 1900-te godine, nasuprot višebrojnim proizvodnim linijama čiji su proizvodi namenjeni brojnim zemljama s različitim kulturama i različitim suvereno postavljenim zahtevima, bitna je promena. Tim razlikama preduzeće se nužo prilagođava između ostalog i diferenciranjem delovanja i zaposlenih. Doda li se tome i najnovije diferenciranje potrošača različitih socijalnih grupa ili bar diferenciranje njihovih navika, nužnost diferenciranja proizvoda je još više uvećana. Proširivanje usko ekonomskih ciljeva na socijalne u uslovima sociopolitičkih restrikcija, koje proizilaze iz sužavanja ali istovremeno i naglašavanja suvereniteta na tom području, u daljoj meri zahteva diferenciranje u delovanju preduzeća. Nosioci moći u organizovanju i upravljanju centralizaciju nužno zamenjuju decentralizacijom (Stuebs & Sun, 2015; Kurnaiti, 2019; Ivanova & Ristić, 2020). U upravljanju učestvuju ne samo vodeće strukture nižih razina već i vođstva saradničkih eksternih jedinica, zajednica ili udruženja. Navedeni uzroci diferencijacije ne izazivaju samo adekvatna prilagođavanja koja rešavaju probleme povećanja efikasnosti, već i probleme održanja efektne celine preduzeća.

Promena upravljačkih problema se izvodi iz stanja okruženja (privrednog, socijalnog, političkog, ekološkog i sl.) ili se izvodi iz potreba prakse u datim istorijskim uslovima. Ziegenbein (Ziegenbein, 1992) uočava menjanje težišta u upravljanju (Tabela 2) Periodizacija je zasnovana na osobinama privrednih i drugih uslova u kojima su poslovali privredni subjekti zapadno-evropskog obeležja.

Tabela 2. Pregled - težišta u upravljanju

Faze razvoja	Period	Opis karakteristika	Težište upravljanja
IZGRADNjA	50-te godine	Preduzeća su mogla više prodati nego proizvesti pa se pažnja usmerava na oblikovanje tokova, procesa proizvodnje.	UPRAVLjANjE PROIZVODNjOM
DOGRADNjA	60-te godine	Upravlja se potrebama, utiče se na ukus potrošača i pobuđuju se nove potrebe - dalji rast i povećanje snage prihoda.	UPRAVLjANjE MARKETINGOM
KONSOLIDOVANjE	70-te godine	Usporavanje privrednog rasta s povećanim pritiskom konkurencije i porastom cena energije i sirovina dovelo je do stagnacije prometa uz remanenciju troškova, pada produktivnosti i prekapacitiranosti. Nasuprot tome kod potrošača raste svest o cenama i kvalitetu.	UPRAVLjANjE FINANSIJAMA
DIFERENCIRANjE	80-te godine	Globalna nestabilnost u uslovima povećane saturacije na tržištu prodaje, visoke inflacije i oskudnih resursa zahteva odgovarajuće strategije inoviranja i variranja ili eliminisanja proizvoda, te segmentiranja međunarodnog tržišta.	STRATEŠKO UPRAVLjANjE

Pregled odnosa preduzeća i okruženja pokazuje da menjanje okruženja izaziva menjanje pre svega polazišta upravljanja, koje je izazivalo promenu u shvatanju ciljeva i u utvrđivanju primarnih zadataka. Kvalitativno gledano ova poslednja promena ima mutatitivnu narav - primarni parcijalni ciljevi zamenjeni su skupom ciljeva, a problem upravljanja je od podređivanja primarnom cilju zamenjen problemom harmonizacije ciljeva.

Krajnji zaključak sleda promena upravljanja sastoji se u tome da su promene u okruženju izazvale promene u preduzeću, koje se reflektuju kao diferencijacija upravljačkog procesa / podsistema i informacionog procesa / podsistema kao elemenata preduzeća.

Organizacione promene (Vapa-Tanasković et al., 2021) zahtevaju promenu klasične organizacione strukture zasnovane na hijerarhijskom i funkcionalnom principu. Novim zahtevima može odgovarati preduzeće organizovano u vidu tzv. organizacionih „nivoa“ sa malo hijerarhijskih nivoa i uskom interfunkcionalnom saradnjom. U takvom obliku organizacije preduzeće mora stvoriti informacionu osnovu koja će omogućiti da se organizacija održi i postignu željene performanse. Drugim rečima, ono treba da struktuira informacionu bazu primerenu toj organizacionoj strukturi preduzeća, uvažavajući potrebe komuniciranja, kako unutar tako i između organizacionih nivoa (Eunice et al., 2023). Naime, merenje performansi i komuniciranje se sada prenosi na procese, odnosno aktivnosti unutar tih procesa, koji su neophodni za zadovoljenje očekivanja i zahteva potrošača (Sarolyte et al., 2023). Sve navedeno odražava promene uslova poslovanja, a promenjeno okruženje zahteva promenu organizacione strukture i načina upravljanja preduzećem. Engleski autor Peters (1988) na sledeći način vidi osobine uspešnog preduzeća u savremenim uslovima:

- više horizontalno (sa manje nivoa u organizacionoj strukturi), sastavljeno od više autonomnih jedinica manje centralnog, a više lokalnog autoriteta u uvođenju i određivanju cena proizvoda), usmereno na diferenciranje proizvoda i usluga visokog kvaliteta.
- tržišne niše, svestan značaj kvaliteta, svesno važnosti usluga, više odgovorno, mnogo brže u inovacijama, i koristi dobro obučene i elastične ljude koji u principu stvaraju dodatnu vrednost.

Ako se organizacija posmatra sa aspekta uređivanja odnosa među elementima, može se konstatovati da promene u okruženju izazivaju i promene u organizacionoj strukturi koja teži promenjenom načinu povezivanja i rastu autonomije elemenata (Pavlović et al., 2021).

3. KRIZA KORPORACIJA KAO POSLEDICA KOMPLEKSNOSTI OKRUŽENJA

U jednoj od navedenih definicija iskazana je tvrdnja po kojoj "preduzeće je... sistem" što, prema opšteprihvaćenom shvatanju, podrazumeva izdvojen skup sa određenim ciljem međusobno povezanih elemenata. Postojanje elemenata i njihove međupovezanosti podrazumeva kompleksnost, a kompleksnost višeznačno definišu dve komponente: strukturalna i procesualna komponenta. U strukturalnom smislu kompleksnost označava mnoštvo povezanih elemenata pri čemu se svaki element u svako vreme može povezati sa svakim drugim elementom. U procesualnom smislu kompleksnost se vremenski definiše kao sposobnost sistema da u datom vremenu poprimi neki broj različitih stanja.

Postoje četiri bitne dimenzije strukturalne kompleksnosti preduzeća i to: dimenzija komponente, dimenzija oblikovanja, dimenzija sinergija i dimenzija vreme. Dakle, eksplikacija nužnih svojstava preduzeća i principa oblikovanja tih svojstava cilj je sistemskog načina analize kompleksnosti preduzeća. Objašnjenje stanja koristi za sintezu polazišta promatranja procesualne kompleksnosti. Može se reći da polazište predstavlja tvrdnja po kojoj se procesualna kompleksnost preduzeća shvata kao proces rasta i/ili razvitka, u kojem se sukcesivno menjaju stanja (odnosi i položaj) preduzeća i njegovih podsistema. U kontekstu takvog polazišta, pored koncepcije objašnjenja razvoja ili procesualne kompleksnosti, ističe se značaj pitanja o (Tintor, 2000) shvatanju ili definiciji razvoja, oblicima razvoja ili o načinu savladavanja kompleksnosti i pretpostavkama ili svojstvima preduzeća sposobnog za razvoj. Zajedničko obeležje ove koncepcije dovodi do zaključka da je za uspostavljanje i održavanje sposobnosti za preživljavanje nužno uvažavanje principa kontinuiranog generisanja novih informacija. Može se uočiti da sva pomenuta svojstva i pripadajući principi čine temelj dugotrajnog uspešnog delovanja preduzeća, naime oni su garancija kontinuiranog razvoja preduzeća. Međutim, teorija životnog ciklusa pokazuje mogućnost specifičnih stanja, koja ograničavaju ili prekidaju kontinuitet razvoja pa, u krajnjem slučaju, ograničavaju ili prekidaju opstanak preduzeća. Takva stanja se uobičajeno nazivaju kriznim stanjima.

3.1. Kriza korporacije, specifično stanje razvoja korporacije

Ukratko, može se konstatovati da kriza kao specifično stanje preduzeća ima brojne uzroke, samosvojna obeležja i da se razvija kao proces. Iz toga sledi i temeljni problem razumevanja i savladavanja krize. Temeljni problem krize svodi se u prvom redu na razumevanje njene prirode, a zatim, ili u drugom redu, na pravovremeno indiciranje i identifikovanje, čime se stvaraju pretpostavke za upravljanje preduzećem u kriznom stanju.

Kriza znači prelom, prolazno teško stanje u svakom, prirodnom, društvenom i misaonom procesu. U staroj Grčkoj reč „kriza“ označavala je „odluku“. U samoj suštini krize je da treba odlučiti, a još nije odlučeno. U savremeno doba kriza označava prvenstveno razlikovanje ili sposobnost razlikovanja, izbor, sud, odluku, takođe i izlaz, rešenje, konflikt, pojašnjenje. Prema istom izvoru kriza je „... odluka o stanju u kojem se međusobno svađaju novo i staro, bolest i zdravlje“, odlučujući obrt u nečemu, preciznije, tačka obrta u razvoju. U poslovnoj ekonomiji kriza označava stanje koje dovodi u pitanje opstanak preduzeća, stanje ugroženosti njegove egzistencije. Stoga se ne mogu svi neželjeni problemi označavati kao poslovna kriza. Poslovna kriza (Mihajlović et al., 2020) se definiše kao „neplaniran i neželjen proces ograničenog trajanja i mogućnosti uticanja, koji šteti primarnim ciljevima s ambivalentnim ishodom“.

Neostvarivanje prvog cilja vodi nelikvidnosti, preduzeće više nije u mogućnosti podmirivati nastale obaveze. Nelikvidnost nije samo kratkotrajni problem plaćanja već je trajna slabost preduzeća, pa se govori i o krizi likvidnosti. Neostvarivanje minimalne dobiti ili čak poslovanje sa gubitkom vodi smanjenju vlastitog kapitala (ako nema priliva dodatnih sredstava), pa u krajnjem do prezaduživanja. Prezaduženost je vrlo čest uzrok nelikvidnosti, prvi na listi uzroka poslovne krize (Tešić et al., 2021). Neostvarivanje drugog cilja, tj. poslovanje s gubitkom, održava krizu uspeha. Ako međutim nedostaju potencijali uspeha, tada to vodi gubitku konkurentske sposobnosti i/ili tržišta, što znači gubitak sposobnosti za budući uspeh u određenim poslovnim područjima. Nedovoljna učinkovitost umanjuje dobit i često je uzrok gubitaka.

U definiciji krize naglašena je ambivalentnost ishoda. Opasnosti za opstanak, i u ekstremnom slučaju gašenja preduzeća, suprostavlja se uspešno ovladavanje krizom i uspešna sanacija preduzeća. Uspe li preduzeće izgraditi bolji sastav sprečavanja krize i ovladavanja njome nego konkurencija, krizni menadžment može postati konkurentska prednost preduzeća.

Krizni menadžment definiše se kao aktivnost usmerena na ovladavanje situacijom opasnom za opstanak preduzeća, planiranje i sprovođenje mera za osiguranje temeljnih ciljeva preduzeća (Avakumović et al., 2021). Radi li se o aktivnostima sprečavanja krize, tada se govori o preventivnom ili anticipativnom kriznom menadžmentu, dok se o reaktivnom kriznom menadžmentu govori u smislu osiguranja temeljnih, egzistencijalnih varijabli nakon pojave krize i obeležavaju ga jasni ciljevi poput ostvarenja određene likvidnosti ili uspeha. Uz krizni menadžment, za upravljanje krizom sve više na važnosti dobija i krizni kontroling, iako je kontroling redovna pratnja uspešnog poslovanja. U kriznim situacija kontroling je nezamenjiv. Krizni kontroling ima svoju ulogu u svakoj fazi upravljanja krizom (Osmanagić-Bedenik, 2003):

- pri anticipativnom upravljanju krizni kontroling uvodi i osigurava korišćenje instrumenata proaktivnog prilagođavanja
- pri identifikaciji krize kontroling pruža stručnu pomoć i podršku u određivanju indikatora krize i njihovog praga vrednosti pri reaktivnom upravljanju krizni kontroling je stručno odgovoran za jasnoću situacije, alternativne predloge i jasnoću posledica.

Kontroling je u krizi nezaobilazan, budući da svojim instrumentima pridonosi jasnoći situacije i posledicama pojedinih odluka. Koordinacija i integracija, kao temeljna načela kontrolinga u procesu poslovne krize, imaju vitalnu važnost. Može se zaključiti da krize vode novoj orjentaciji, odlučujućoj promeni, izvođenju zaključaka i posledica koji vode promeni dosadašnjeg ponašanja, sve do preispitivanja dosadašnjih ciljeva. To se odnosi na sve koji su u vezi sa preduzećem u krizi, kako interne subjekte, zaposlene i vlasnike preduzeća, tako i eksterne subjekte koji su poslovno ili drugačije povezani sa preduzećem.

4. ZAKLJUČAK

Današnje preduzeće je rezultat prilagođavanja i promena koje su usmerene na oblikovanje nove celovitosti, usled čega je povećana kompleksnost preduzeća, jer (Dogandžić, S & Dogandžić A., 2021):

- upravljački problem izbora i podređivanja jednom parcijalnom cilju kao primarnom, zamenjen je problemom harmonizacije višebrojnih i ravnoznačnih ciljeva.
- organizaciona struktura teži promenljivom načinu funkcionisanja i povećanoj autonomiji delova.
- sve je izrazitija diferencijacija poslovnih procesa i
- u uslovima promenjivog načina funkcionisanja, labilne organizacione strukture i povećane autonomije delova, harmonizacija ciljeva nužno je izazvala jasnu diferencijaciju, i to: temeljnog procesa-podsistema, upravljačkog procesa-podsistema i informacionog procesa-podsistema.

Pri tome se podrazumeva sistemska analiza i kibernetski pristup upravljanju u kojima se preduzeće shvata kao racionalni ekonomsko tehnički i odgovorni socijalni „fuzzy“ sistem. Sistemskom analizom otkrivaju se inherentna svojstva i principi koje valja uvažavati radi uspostavljanja i održavanja svojstva preduzeća. Stanje preduzeća, kao izraz oblika uspostavljenih veza i tome identičnog načina funkcionisanja, s jedne strane, i položaja u vezama uspostavljenim funkcionalnim odnosima, s druge strane, opisuje se stanjem opstanka i razvoja ili stanjem krize, kao krajnjim obeležjima, pri čemu je realno očekivati neku njihovu kombinaciju kao izraz jedinstva suprotnosti.Spoznaja i prepoznavanje situacije podrazumeva raspolaganje apriornih informacija o okruženju i o sebi, koje se čuvaju u obliku svojevrsnih slika ili modela, te sposobnost asimilacije spoljnih uticaja kao informacija na temelju kojih se formira nekakva slika ili model odnosa sa okruženjem.

Razlike upravljanja u dosadašnjim uslovima koncetrisane su na promene načina mišljenja, načina ponašanja i orjentacije. U tom kontekstu funkcija planiranja, kontrolisanja, informisanja i analize, odnosno upravljački problemi su drugačije striktuirani, jer je umesto transparentnosti nastupila kompleksnost.

CORPORATION AND MODERN ENVIRONMENT

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Abstract

The corporation, as one of the most complex forms of organizing a company in modern society, has a special place and role. This form of capital society is in direct relation with its immediate and distant environment. The environment is understood as a complex of elements, ways of connecting elements and the conditions that are established, whereby the corporation-enterprise, as a part of the complex of the environment with necessarily acquired equal characteristics, is also a complex that changes. In this context, the understanding of corporations presupposes knowledge of the trend of changes, on the one hand, and knowledge of the elements, the connection of elements, and potential and current conditions, on the other hand. This other side can be understood as structural and procedural complexity. The corporation and the contemporary environment are key concepts in the academic study of the relationship between business and society. This paper examines the future of corporate social responsibility in the contemporary environment. There are distinct trends against corporate responsibility in contemporary academic literature and managerial views on best practices. These trends raise significant doubts about the future status of corporate theory and practice. The vital change is that the principle of wealth creation is progressively dominating the managerial conception of responsibility. The paper provides a history of the development of corporations from the progressive era to the framework of corporate social performance and Carroll's pyramid of corporate social responsibilities and assesses the prospects for business responsibility in the global context of the contemporary environment.

Keywords: *corporation, contemporary environment, corporate system and crisis of succes*

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OPTIMIZACIJA MULTIPROJEKTA IZGRADNJE INKLUZIVNOG DEČIJEG IGRALIŠTA

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Izvod

Očigledno je da je praćenje napredovanja projekta jedini način za uspešnu realizaciju plana projekta i ispunjavanje ciljeva projekta. Pravilno praćenje odvijanja projekta, kao i njegovo poređenje sa inicijalnim planom omogućava menadžerima projekta da efikasno upravljaju njime. Bez obzira o kojoj se vrsti projekta radi, svi imaju specifičan cilj koji treba ostvariti u određenom vremenu sa planiranim troškovima i resursima. U tom smislu je važno vršiti optimizaciju resursa jer se može desiti da su resursi koji su angažovani na projektu i suviše preopterećeni. Uspeh projekta u mnogome zavisi od postavljanja i planiranja realnih troškova, vremena i resursa. Mnogi projekti propadaju samo zato što se podcenjuju vremenska ili novčana ograničenja. Kroz ovaj naučni rad je obrađen projekat izgradnje inkluzivnog dečijeg igrališta, primenom softverskog programa MS Project.

***Ključne reči**: projekat, resursi, optimizacija projekta, planiranje troškova*

1. UVOD

Istraživanja o tradicionalnim igralištima sugerišu da izbor i raspored opreme za igru mogu uticati na to kako se deca igraju na igralištu. Važno je da istraživanja o tradicionalnim igralištima ističu da dizajn i raspored igrališta takođe utiču na to ko može da ih koristi. Na primer, tradicionalna igrališta mogu predstavljati fizičke prepreke za igru, što često dovodi do toga da deca sa smetnjama u razvoju doživljavaju marginalizaciju kao deo svog iskustva na igralištu. U nekim slučajevima, deca sa smetnjama u razvoju mogu biti potpuno isključena. Prepoznajući važnost pružanja jednakih i pravičnih mogućnosti za igru za svu decu, bez obzira na uzrast, pol ili nivo sposobnosti, zajednice nastavljaju da se zalažu za izgradnju inkluzivnih igrališta. Inkluzivno igralište je definisano kao prostor koji omogućava deci sa i bez smetnji u razvoju, da pristupe igralištu i igraju se zajedno (James et al., 2022). Ovakvo namensko igralište je dizajnirano da stvori inkluzivno okruženje za igru kako bi se promovisalo zdravlje i osećaj blagostanja za decu sa širokim spektrom smetnji u razvoju, posebno za one sa slabijim fizičkim sposobnostima i one sa većim senzornim potrebama (Luk, 2015). Na Slici 1, prikazana je površina koja je predviđenja za izgradnju inkluzivnog dečijeg igrališta u Boru. Stara stabla biće zamenjena novim zelenilom, takođe će ovakvo dečije igralište imati sve moderne sprave koje će biti bezbedne i pogodne za korišćenje od strane sve dece (različitog pola, uzrasta i psohofizičkih sposobnosti). Kada igralište bude uređeno onako kako je to projektom osmišljeno, Bor će dobiti ne samo zelenu oazu za sadašnje žitelje već prostor koji će koristiti i naredne generacije dece.

Slika 1. Prikaz površine za izgradnju preko Google Mapa

Pitanje osvetljenja budućeg igrališta je izuzetno važno, jer ovaj prostor treba da predstavlja bezbedno mesto u svako doba dana. Pre nego se otpočne sa uređenjem i izgradnjom ovog prostora, neophodno je definisati ovu oblast i uraditi sve prethodne radove u cilju ispunjenja preduslova za potpunu realizaciju projekta izgradnje inkluzivnog dečijeg igrališta u ovoj oblasti. Planiranje realizacije projekta predstavlja početnu fazu procesa upravljanja projektom, koja omogućava dalje odvijanje i postizanje ciljeva upravljanja projektom, a to je da se projekat realizuje u određenom vremenu i sa predviđenim, planiranim troškovima (Stefanović, 2015).

2. TEORIJSKI OKVIR

Često igralište nije uvek inkluzivno za decu svih fizičkih i mentalnih sposobnosti. To znači da dizajn igrališta zanemaruje ili obraća manje pažnje na zahteve dece sa smetnjama u razvoju (Lilawati et al., 2022). S tim u vezi je svrha ovog rada da se definiše projekat koji bi podrazumeva izgradnju inkluzivnog dečijeg igrališta. Utvrđeni su sledeći ciljevi, a to su da se razviju standardi pristupačnih i inkluzivnih igrališta za korišćenje od strane dece sa smetnjama u razvoju i da se ispita sadašnja dostupnost i inkluzivnost igrališta za decu sa smetnjama u razvoju. Ispitivanjem tržišta, utvrđeno je da u Boru ne postoji igralište koje bi ispunjalo uslove i standarde koje podrazumeva uključenost u igru sve dece sa smetnjama u razvoju. Oprema kao i celokupan teren (Slika 2), biće prvenstveno prilagođeni deci sa određenim smenjama u razvoju, ali ovakvo igralište svakako mogu koristiti i ostala deca.

Slika 2. Oprema na inkluzivnom dečijem igralištu

Da bi se uspešno ostvarili ciljevi svakog projekta, potrebno je uskladiti širok spektar faktora za čije formiranje se podrazumeva skup znanja o upravljanju projektima, čime se nastoji da se uvedu i ojačaju potrebne veštine za upravljanje projektima. Optimizacija je alat koji pomaže menadžerima projekata da donesu optimalne odluke kao što su odabir najprikladnijeg projekta od mogućih opcija, određivanje najboljeg vremena za projektne aktivnosti i nivoa prekovremenog rada, stope naručivanja i nivoa skladištenja, potrebni materijali i oprema (Moghadem, 2019). Menadžeri projekata bi trebalo da donose komplikovane izbore uzimajući u obzir raspored aktivnosti koje su povezane sa prethodnim aktivnostima projekta. Mogućnosti upravljanja resursima obuhvataju planiranje potreba za materijalom, procenu i odabir dobavljača za preuzimanje materijala, nabavku, rashode, otpremu, prijem materijala, skladištenje i inventar, kao i distribuciju materijala (Subramani & Karthnick, 2018). Uspešno izvođenje i završetak projekata u velikoj meri zavisi od adekvatnog vremenskog rasporeda projektnih aktivnosti. Prilikom implementacije vremenskog rasporeda, najčešće se traži da se načini izvođenja aktivnosti podese na način koji omogućava postizanje minimalnih ukupnih troškova projekta (Valenko & Klanšek, 2017). Naime, za izvođenje projektnih aktivnosti potrebno je angažovanje određenih resursa i direktnih troškova (Carli & Peroni, 2015). Naročito kada količina radnog vremena koje troše radna snaga i mašine predstavlja uticajan indikator koji se mora uzeti u obzir u pripremi planova izgradnje, te se direktni troškovi posledično povećavaju. Sa druge strane, indirektni troškovi se obično smanjuju kada se implementacija projekta ubrza. Obe navedene činjenice podstiču postizanje realizacije projekta u optimalnom trajanju i uz minimalne ukupne troškove. Još jedan kritični faktor uspeha koji takođe može doći do izražaja je da se raspoloživi budžet projekta zadrži u granicama i da se ne prekorači ugovoreni rok za završetak projekta. Projekti se često sastoje od složenog sistema aktivnosti koje treba koordinirati da bi se ostvarili definisani ciljevi (Valenko & Klanšek, 2017).

3. OPTIMIZACIJA MULTIPROJEKTA IZGRADNJE INKLUZIVNOG DEČIJEG IGRALIŠTA

3.1. Kratak opis multiprojekta

Multiprojekat je namenjen za realizaciju izgradnje inkluzivnog dečijeg igrališta instalaciju osvetljenja, instalaciju mobilijara, klupa i korpi kao i ozelenjavanje čitave površine. Predviđena lokacija za izgradnju je površina koja se nalazi iznad srednjih škola, Gimnazije Bora Stanković i Mašinsko-elektrotehničke škole u Boru. Za realizaciju ovog projekta predviđene su brojne aktivnosti kako bi ovaj projekat bio uspešno realizovan. Tu spadaju:

procene budžetskih sredstava, mobilizacija zajednice i konsultacija sa ključnim akterima, izrada projekata, nabavka opreme, pripremni, zemljani, radovi niskogradnje, betonski, elektro radovi i završni radovi. Mnoga postojeća dečija igrališta ne zadovoljavaju uslov pristupačnosti sadržaja za decu sa različitim oblicima senzornog, motoričkog ili intelektualnog invaliditeta i smetnji u razvoju. Ono što karakteriše inkluzivno igralište jeste pre svega mogućnost da se deca sa smetnjama i/ili invaliditetom i deca bez invaliditeta ravnopravno i zajedno igraju. Multiprojekat izgradnje inkluzivnog dečijeg igrališta, sastoji se od tri ključna projekata, što se može i videti u Tabeli 1.

- Projekat 1 – Budžetiranje i mobilizacija.
- Projekat 2 – Dizajn i priprema.
- Projekat 3 – Građevinski radovi.

Tabela 1. Pregled projekata

PROJEKAT	**Budžetiranje i mobilizacija**	**Dizajn i priprema**	**Građevinski radovi**
OPIS	Projekat podrazumeva definisanje planova budžeta, analizu i istraživanje terene, formiranje projektnog tima, učešće lokalne zajednice i medija.	Projekat podrazumeva analizu i razradu koncepta igrališta i pisanje zahteva i izdavanje potrebnih dozvola, kao i nabavku opreme.	Projekat podrazumeva radove na izgradnji uključujući zemljane, betonske, radove nisko gradnje i završne raodove ozelenjavanja i postavljanja mobilijara, klupa i korpi.

Glavni ciljevi multiprojekta su:

- **Cilj 1**: Otvaranje inkluzivnog dečijeg igrališta do kraja oktobra 2024. godine.
- **Cilj 2**: Završetak projekta za maksimalno 7.5 meseci.
- **Cilj 3**: Uklopiti se u predviđeni budžet od 150.000 €.
- **Cilj 4**: Prilikom realizacije projekta pridržavati se propisa vezanih za Zakon o izgradnji i spoljnu rasvetu.
- **Cilj 5**: Angažovati odgovarajući stručni kadar.

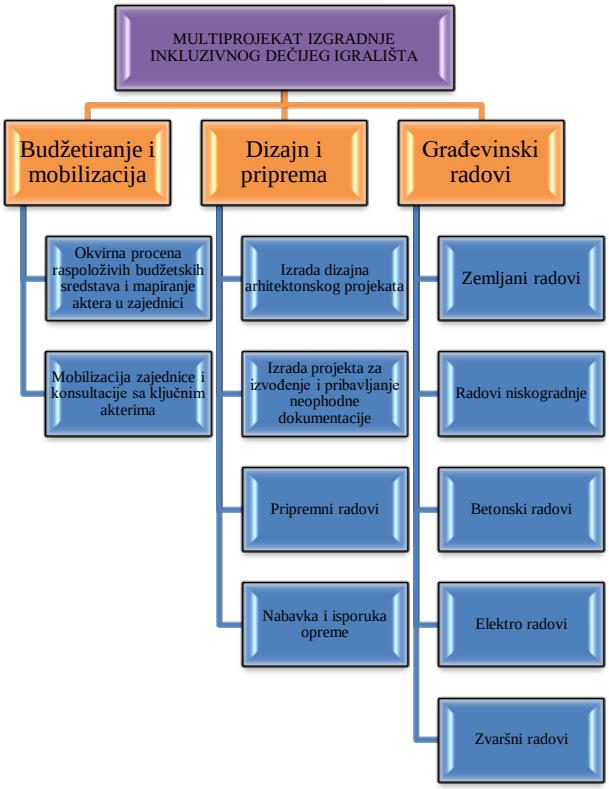
Analiza projektih stejkholdera prikazana je u Tabeli 2.

Tabela 2. Analiza projektinh stejkholdera

Učesnik	**Karakteristika**	**Interes**	**Doprinos**	**Šta je im je potrebno zauzvrat?**	**Aktivnosti**
GU Bor	Opština Bor	Popularizacija inkluzivnog dečijeg igrališta	Finansiranje 60% projekta	Obezbeđeni resursi	Definisanje plana budžeta
GEOURB Group	Analiza tržišnih cena	Profit od naplaćenih usluga	Ispitivanje i analiza tržišta	Isplata po izvršenom radu	Istraživanje površine terena
VMS Kompanija	Izrada dizajna arhitektonskog projekta	Profit od naplaćenih usluga	Istraživanje tematskog okvira	Isplata po izvršenom radu	Anliza i koncepcija tematskog okvira
Sekreterijat za urbanizam i građevinske poslove	Sekreterijat za izdavanje dozvola za gradnju i uređenje urbanističkih	Profit od naplaćenih usluga	Izdavanje dozvole za izgradnju	Isplata po izvršenom radu	Poslovi oko projektne dokumentacije

	poslova				
Put 030	Preduzeće za izvođenje zemljanih radova	Profit od naplaćenih usluga	Obavljanje zemljanih radova	Isplata po izvršenom radu	Priprema zemljišta za izgradnju
Bormonto Bor	Preduzeće za izvođenje betonskih radova	Profit od naplaćenih usluga	Obavljanje betonskih radova	Isplata po izvršenom radu	Građevinski poslovi betoniranja
Energoprojekat Beograd	Preduzeće za izradu projekata	Profit od naplaćenih usluga	Izrada pojedinačnih projekata	Isplata po izvršenom radu	Projektovanje pojedinačnih projekata
Fondeco	Preduzeće za implementaciju dranežnog sistema	Profit od naplaćenih usluga	Obavljanje radova niskogradnje	Isplata po izvršenom radu	Implementacija drenažnog sistema
Modular DOO	Preduzeće za izvođenje elektro radova	Profit od naplaćenih usluga	Obavljanje elektro radova	Isplata po izvršenom radu	Instalacija osvetljenja
Green Element	Preduzeće za uređenje i odrzavanjezelenih povrsina	Profit od naplaćenih usluga	Ozelenjavanje površina	Isplata po izvršenom radu	Poslovi ozelenjavanja
Urban Park	Instalacija mobilijara	Profit od naplaćenih usluga	Postavljanje opreme	Isplata po izvršenom radu	Završni poslovi
Happy Park	Instalacija mobilijara	Profit od naplaćenih usluga	Postavljanje opreme	Isplata po izvršenom radu	Završni poslovi
JKP Bor	Opština Bor	Tehnička podrška	Rasčišćavanje prostora za izgradnju	Obezbeđeni resursi	Priprema terena
INFANO	Nabavka i isporuka mobilijara	Profit od naplaćenih usluga	Proizvodnja i transport mobilijara	Isplata po izvršenom radu	Proizvodnja i transport opreme

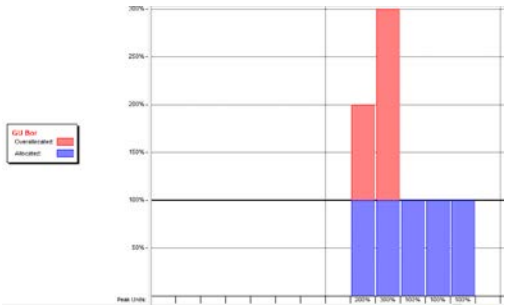
WBS multiprojekta izgradnje inkluzivnog dečijeg igrališta prikazana je na Slici 3.



Slika 3. WBS multiprojekta

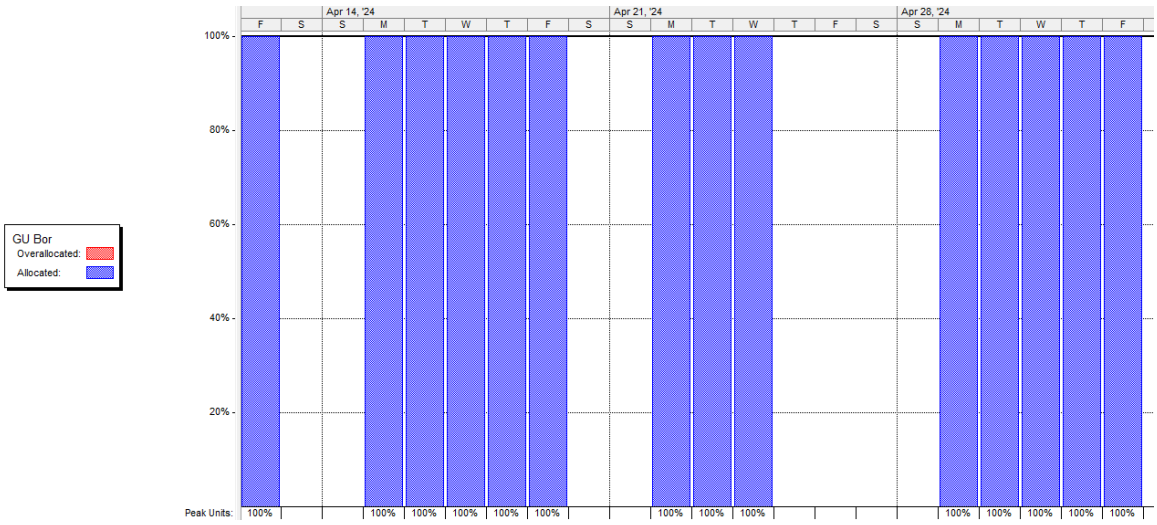
4. OPTIMIZACIJA RESURSA MULTIPROJEKTA

Treba napomenuti da se resursi odnose na ljude koji su uključeni u projekat, na opremu i materijale koji se koriste, kao i troškove povezane sa projektom. Za izvršavanje projektnih aktivnosti potrebni su resursi. Optimalno raspoređivanje resursa je ključ uspešnog upravljanja projektima. Analizom ovog multiprojekta utvrđeno je da su određeni resuri bili preopterećeni u vremenskom smislu, te je bilo neophodno izvršiti optimizaciju, tako da svi resursi budu angažovani do najviše 100% što jeste maksimum, ali ne više od toga. Analizom svakog pojedinačnog resursa utvrđeno je preopterećenje od 200, 300, pa čak i 400%. U tom smislu je bilo neophodno prilagoditi vreme angažovanja resursa. Jedan od primera je predstavljen u nastavku na Slici 4, 5 i 6. Projekat može automatski da izjednači ukupno raspoređeno radno opterećenje resursa odlaganjem ili podelom zadataka. U tom smislu je izvršeno pomeranje vremena početka odnosno kašnjenja zadatka kada resurs ima više dodeljenih zadataka nego što se može završiti tokom datog vremenskog perioda. Najjednostavniji način da se ispravi ta ukupna raspodela je odlaganje jednog od zadataka, idealno, zadatak sa nižim prioritetom od ostalih. Resurs se ukupno dodeljuje ako je resurs raspoređen za više posla na svim dodeljenim zadacima nego što resurs može da uradi u okviru normalnog radnog kapaciteta. Radni kapacitet resursa je određen kalendarom resursa i postavkama dostupnosti resursa.



Slika 4. Preopterećenost resursa GU Bor

Slika 5. Prikaz upotrebe resursa



Slika 6. Grafički prikaz angažovanja resursa nakon optimizacije

U Tabeli 3 navedene su ključne aktivnosti potrebne za realizaciju projekta, uključujući njihovo trajanje (vremenski okvir za svaku aktivnost), procenjene troškove (budžet po aktivnostima) i odgovornosti (ko je zadužen za izvršenje). Tabela 3 daje jasan pregled plana implementacije projekta, što omogućava bolju koordinaciju, praćenje i evaluaciju.

Tabela 3. Aktivnosti projekta *Izgradnja inkluzivnog dečijeg igrališta, njihovo trajanje, troškovi i odgovornosti*

Aktivnost	Trajanje	Trošak	Odgovornost
Početak projekta	**0 days**	**0.00 €**	
1. Okvirna procena raspoloživih budžetskih sredstava i r	**24 days**	**19,500.00 €**	
1.1. Definisanje plana budžeta za nabavku opreme i izvođenje g	2 days	685.00 €	GU Bor[25%],Skreterijat za urbanizam i građevinske poslove[38%]
1.2. Definisanje plana troškova participativnog procesa	2 days	685.00 €	GU Bor[25%],Skreterijat za urbanizam i građevinske poslove[38%]
1.3. Definisanje plana troškova komunikacije	5 days	3,870.00 €	GU Bor,Skreterijat za urbanizam i građevinske poslove
1.4. Definisanje plana troškova tehničke podrške	5 days	3,600.00 €	GEOURB Group
1.5. Istraživanje površine terena	7 days	5,040.00 €	GEOURB Group
1.6. Analiza karakteristika lokacije i opreme	5 days	0.00 €	
1.7. Analiza tržišnih cena građevinskih radova i materijala	5 days	3,600.00 €	GEOURB Group
1.8. Mapiranje svih aktera u lokalnoj zajednici koji imaju interes	5 days	2,020.00 €	GU Bor
2. Mobilizacija zajednice i konsultacije sa ključnim akter	**29.5 days**	**10,100.00 €**	
2.1. Formiranje projektnog tima	7 days	2,828.00 €	GU Bor
2.2. Utvrđivanje nadležnosti i uloga članova tima	1.5 days	606.00 €	GU Bor
2.3. Obezbeđivanje učešća jedinice lokalne samouprave	5 days	1,515.00 €	GU Bor
2.4. Mobilizacija privatnog i korporativnog sektora	7 days	2,323.00 €	GU Bor
2.5. Uključivanje medija i korišćenje društvenih mreža	7 days	2,828.00 €	GU Bor
3. Izrada dizajna arhitektonskog projekata	**22 days**	**19,712.00 €**	
3.1. Analiza adekvatnosti lokacije	5 days	6,160.00 €	VMS Kompanija,Energoprojekt Beograd
3.2. Istraživanje tematskog okvira	6 days	7,392.00 €	VMS Kompanija,Energoprojekt Beograd
3.3. Razrada koncepta igrališta	5 days	6,160.00 €	VMS Kompanija,Energoprojekt Beograd
4. Izrada projekta za izvođenje i pribavljanje neophodne	**22.5 days**	**13,380.00 €**	
4.1. Izrada projekta izgradnje parka	10 days	10,440.00 €	GU Bor,Energoprojekt Beograd
4.2. Pisanje zahteva za idejno rešenje	0.5 days	844.00 €	GU Bor,Energoprojekt Beograd,Skreterijat za urbanizam i građevinske poslove
4.3. Pisanje zahteva za izradu projekta	1 day	1,048.00 €	GU Bor,Skreterijat za urbanizam i građevinske poslove
4.4. Izdavanje dozvole za izgradnju	1 day	1,048.00 €	GU Bor,Skreterijat za urbanizam i građevinske poslove
5. Pripremni radovi	**3 days**	**3,372.00 €**	
5.1. Obezbeđivanje pristupa lokaciji	1 day	1,124.00 €	Skreterijat za urbanizam i građevinske poslove,JKP Bor
5.2. Obezbeđivanje sigurnog skladištenja materijala	2 days	1,124.00 €	Skreterijat za urbanizam i građevinske poslove[50%],JKP Bor[50%]
5.3. Omogućavanje bezbednog izvođenja građevinskih radova	2 days	1,124.00 €	Skreterijat za urbanizam i građevinske poslove[50%],JKP Bor[50%]
6. Nabavka i isporuka opreme	**30 days**	**35,840.00 €**	
6.1. Nabavka opreme	14 days	17,920.00 €	INFANO
6.2. Transport i isporuka opreme	14 days	17,920.00 €	INFANO
7. Zemljani radovi	**4 days**	**3,420.00 €**	
7.1. Raščišćavanje prostora za izgradnju	1.5 days	1,710.00 €	Put 030,JKP Bor
7.2. Raspoređivanje zemljišta	2 days	630.00 €	Put 030[50%]
7.3. Trasiranje zemljišta	1 day	360.00 €	Put 030[50%]
7.4. Skidanje površinskog sloja zemlje	1 day	360.00 €	Put 030[50%]
7.5. Utabavanje zemlje	0.5 days	360.00 €	Put 030
8. Radovi niskogradnje	**7 days**	**4,640.00 €**	
8.1. Priprema temelja	2 days	1,120.00 €	Bormonto Bor
8.2. Iskop rupa za stubove za osvetljenje	0.5 days	320.00 €	Energoprojekt Beograd
8.3. Implementiranje odgovarajućeg drenažnog sistema	5 days	3,200.00 €	Fondeco
9. Betonski radovi	**12.5 days**	**4,060.00 €**	
9.1. Rasipanje peska	0.5 days	140.00 €	Bormonto Bor[50%]
9.2. Raspoređivanje peska	0.5 days	140.00 €	Bormonto Bor[50%]
9.3. Postavljanje armirane betonske žice	1 day	420.00 €	Bormonto Bor
9.4. Betoniranje površine	4 days	2,240.00 €	Bormonto Bor
9.5. Postavljanje udarne podloge	2 days	1,120.00 €	Bormonto Bor
10. Elektro radovi	**15 days**	**6,570.00 €**	
10.1. Iskop kanala	0.5 days	360.00 €	MODULAR DOO
10.2. Polaganje zaštite za kablove	0.5 days	90.00 €	MODULAR DOO[25%]
10.3. Polaganje gvozdene pocinkovane trake	0.5 days	270.00 €	MODULAR DOO[75%]
10.4. Postavljanje kablova	0.5 days	360.00 €	MODULAR DOO
10.5. Zatrpavanje kablova slojem usitnjene zemlje	1 day	720.00 €	MODULAR DOO
10.6. Postavljanje razvodnih kutija	2 days	1,440.00 €	MODULAR DOO
10.7. Postavljanje stubova za osvetljenje	4 days	1,890.00 €	MODULAR DOO
10.8. Povezivanje kablova sa stubovima	2 days	720.00 €	MODULAR DOO[50%]
10.9. Betoniranje stubova za osvetljenje	1 day	720.00 €	MODULAR DOO
11. Završni radovi	**8 days**	**5,022.50 €**	
11.1. Radovi na ozelenjavanju	4 days	2,256.00 €	Green Element
11.2. Postavljanje mobilijara	1.5 days	1,147.50 €	Urban Park[50%],Happy Park
11.3. Postavljanje korpi	0.25 days	165.50 €	Happy Park[50%],Urban Park[50%]
11.4. Postavljanje klupa	3 days	1,453.50 €	Urban Park
11.5. Postavljanje informacione table za lokaciju u skladu sa up	0 days	0.00 €	Urban Park[50%]
Kraj projekta	**0 days**	**0.00 €**	
Ukupno		**125,616.5**	

U Tabeli 4 su prikazani potrebni resursi za izvršenje multiprojekta izgradnje inkluzivnog dečijeg igrališta, uključujući raspoložive resurse i količinu. Tabela pruža pregled svih resursa kako bi se osigurala efikasna alokacija i uspešna implementacija projekta.

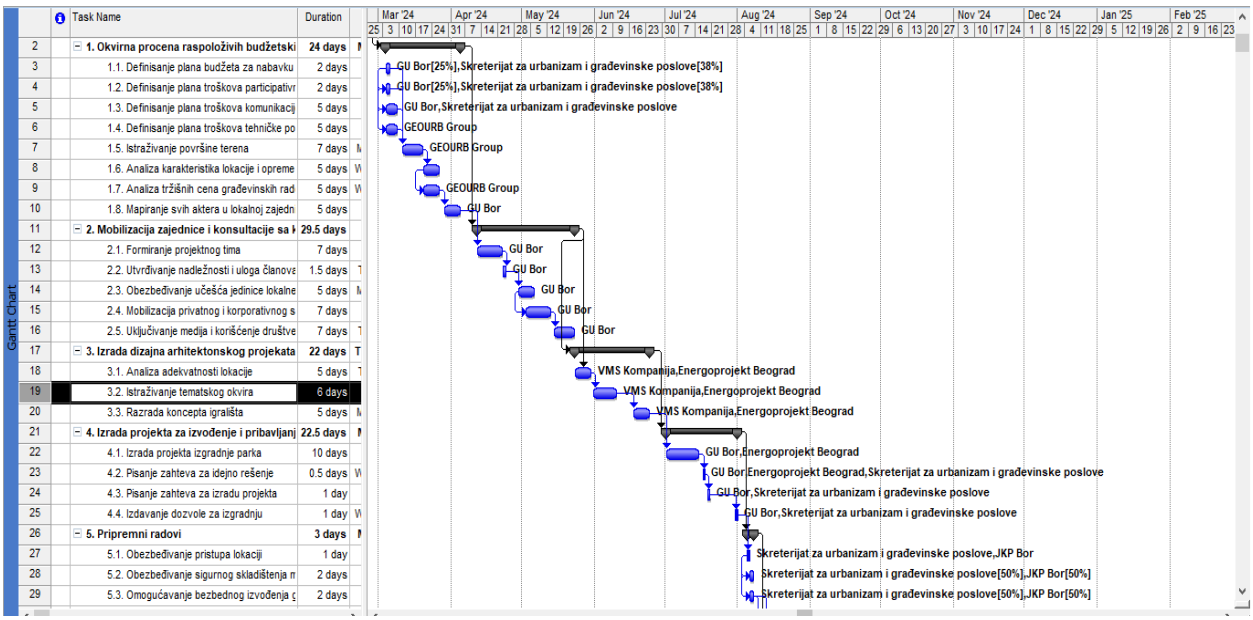
Tabela 4. Potrebni resursi za izvršenje multiprojekta izgradnje inkluzivnog dečijeg igrališta

Redni broj	Resurs	Količina	Napomena
1.	Finansijski resursi	150.000,00	€
2.	Sastav projektno-nadzornog tima	7	specijalista
3.	Sastav izvršilaca	46	radnika

U Tabeli 5 je prikazana lista ključnih događaja (engl. *milestone*-a) u okviru projekta, zajedno s predviđenim vremenom njihovog završetka. Tabela 5 omogućava praćenje napretka projekta, identifikaciju važnih prekretnica i usklađivanje aktivnosti s planiranim rokovima, čime se osigurava pravovremena realizacija svih faza projekta.

Tabela 5. Lista ključnih događaja sa predviđenim vremenom završetka

Ključni događaj	Ciljni datum
Početak projekta	4-Mar-24
1. Okvirna procena raspoloživih budžetskih sredstava i mapiranje aktera u zajednici	4-Apr-24
2. Mobilizacija zajednice i konsultacije sa ključnim akterima	23-May-24
3. Izrada dizajna arhitektonskog projekata	24-Jun-24
4. Izrada projekta za izvođenje i pribavljanje neophodne dokumentacije	31-Jul-24
5. Pripremni radovi	7-Aug-24
6. Nabavka i isporuka opreme	18-Sep-24
7. Zemljani radovi	16-Aug-24
8. Radovi niskogradnje	27-Aug-24
9. Betonski radovi	18-Sep-24
10. Elektro radovi	9-Oct-24
11. Završni radovi	30-Oct-24
Kraj projekta	30-Oct-24



Slika 4. Gantogram sumarnih aktivnosti multiprojekata

Na Slici 4 je prikazan gantogram sumarnih aktivnosti multiprojekta, koji grafički prikazuje redosled, trajanje i međusobne zavisnosti ključnih aktivnosti. Ovaj vizuelni prikaz

omogućava jasan pregled vremenskog okvira projekta, olakšava planiranje i koordinaciju aktivnosti, te pomaže u praćenju napretka u odnosu na planirane rokove.

	Resource Name	Type	Initials	Max. Units	Std. Rate	Ovt. Rate	Cost/Use	Accrue At	Base Calendar	Cost
1	GU Bor	Work	G	100%	50.50 €/hr	0.00 €/hr	0.00 €	Prorated	Standard	19,190.00 €
2	GEOURB Group	Work	G	100%	90.00 €/hr	0.00 €/hr	0.00 €	Prorated	Standard	12,240.00 €
3	VMS Kompanija	Work	V	100%	74.00 €/hr	0.00 €/hr	0.00 €	Prorated	Standard	9,472.00 €
4	Skreterijat za urbaniz	Work	S	100%	80.50 €/hr	0.00 €/hr	0.00 €	Prorated	Standard	6,762.00 €
5	Put 030	Work	P	100%	90.00 €/hr	0.00 €/hr	0.00 €	Prorated	Standard	2,700.00 €
6	Bormonto Bor	Work	B	100%	70.00 €/hr	0.00 €/hr	0.00 €	Prorated	Standard	5,180.00 €
7	Energoprojekt Beogra	Work	E	100%	80.00 €/hr	0.00 €/hr	0.00 €	Prorated	Standard	17,280.00 €
8	Fondeco	Work	F	100%	80.00 €/hr	0.00 €/hr	0.00 €	Prorated	Standard	3,200.00 €
9	MODULAR DOO	Work	M	100%	90.00 €/hr	0.00 €/hr	0.00 €	Prorated	Standard	6,570.00 €
10	Green Element	Work	G	100%	70.50 €/hr	0.00 €/hr	0.00 €	Prorated	Standard	2,256.00 €
11	Urban Park	Work	U	100%	85.50 €/hr	0.00 €/hr	0.00 €	Prorated	Standard	1,966.50 €
12	JKP Bor	Work	J	100%	60.00 €/hr	0.00 €/hr	0.00 €	Prorated	Standard	2,160.00 €
13	INFANO	Work	I	100%	160.00 €/hr	0.00 €/hr	0.00 €	Prorated	Standard	35,840.00 €
14	Happy Park	Work	H	100%	80.00 €/hr	0.00 €/hr	0.00 €	Prorated	Standard	800.00 €

Slika 5. Multiprojektni stejkholderi i ugrađeni materijali

Na Slici 5 su prikazani multiprojektni stejkholderi i ugrađeni materijali, naglašavajući ključne učesnike u projektu, njihove uloge i odgovornosti, kao i vrstu i količinu materijala koji će biti korišćeni. Ovaj dijagram omogućava bolju koordinaciju među stejkholderima i daje pregled resursa koji su integrisani u realizaciju projekta.

Primenom softverskog paketa MS Project je urađen osnovni plan projekta, sa početkom realizacije projekta na dan 04.03.2024. godine. Planiran je završetak projekta na dan 30.10.2024. godine. Ukupna vrednost ovakvog projekta je 125 616 50 eura. Pomenuti podaci mogu se pronaći i u prozoru project statistics prikazanom na Slici 6 ispod paragrafa.

Project Statistics for 'Projekat izgradnje inkluzivnog dečijeg igrališta'

	Start	Finish
Current	Mon 3/4/24	Wed 10/30/24
Baseline	NA	NA
Actual	NA	NA
Variance	0d	0d

	Duration	Work	Cost
Current	172.5d	1,486h	125,616.50 €
Baseline	0d?	0h	0.00 €
Actual	0d	0h	0.00 €
Remaining	172.5d	1,486h	125,616.50 €

Percent complete:
Duration: 0% Work: 0%

Close

Slika 6. Statistika multiprojekta

U Tabeli 6 je prikazan pregled rizičnih događaja povezanih s multiprojektom za urbanističko uređenje i izgradnju šetališta, procenu njihove verovatnoće nastupanja i analizu potencijalnog uticaja na projekat. Ovaj pregled omogućava identifikaciju kritičnih rizika, prioritizaciju njihovog upravljanja i planiranje odgovarajućih mera za minimizaciju negativnih posledica, čime se povećava šansa za uspešnu realizaciju projekta.

Tabela 6. Rizični događaji, verovatnoća nastupanja i uticaj određenog rizika na multiprojekat

Redni broj	Uticaj rizika	Opis rizika	Verovatnoća nastupanja	Uticaj	Značaj rizika	Plan reagovanja
1.	Veoma mali	Greške u projektnoj dikumentaciji	0.2	0.5	0.05	Angažovan je geodetski zavod kako bi se rizik minimizirao
2.	Mali	Povećanje budžetskih rashoda	0.3	0.5	0.10	Ukoliko dođe do povećanja troškova za 15% , naručilac projekta će obezbediti dodatna sredstva
3.	Veoma mali	Prodženje trajanja projekta zbog kašnjenja isporuke opreme i mobilijara	0.4	0.4	0.09	Ugovorom sa dobavljačima predviđena je naplata penala ukoliko se kasni sa isporukom materijala
4.	Veoma mali	Greške zbog neodgovarajućeg kvaliteta završnih radova	0.1	0.4	0.08	Ugovorom sa dobavljačima osigurana je zamena materijala ukoliko kvalitet ne odgovara naručenom
5.	Umeren	Prekoračenje roka zbog nepovoljnih vremenskih prilika	0.5	0.5	0.20	Odložiće se realizacija projekta za pogodnije vremenske prilike
6.	Veoma mali	Prekoračenje roka zbog grešaka u administraciji	0.3	0.3	0.09	Odgovornost za prekoračenje će preuzeti naručilac projekta

Najveći stepen rizika kod ovog projekta se zapaža u fazi građevinskih radova. Naime, može doći do prekoračenja roka zbog kašnjenja isporuke mobilijara, odnosno, opreme koja je neophodna da bi se okončali poslovi, instalirala oprema i park postao funkcionalan. Analizom projekta, takođe je uočen rizik od kašnjenja isporuke materijala za betoniranje koji je neophodan za završetak betonskih radova. S tim u vezi posledice bi bile kašnjenje faze uvođenja elektro instlacija, što bi potom dovelo i do prekoračenja roka završetka projekta, a samim time i do povećanja ukupnih troškova.

Jedna od efikasnih preventivnih akcija koja bi se preduzela kako ne bi došlo do odlaganja projekta jeste zaključenje ugovora sa dobavljačima, u kojem bi bilo naglašeno da ukoliko isporuka materijala kasni, dolazi do plaćanja penala, kao i naknade štete za prekoračenje roka. Ukoliko materijal dobavljač ne isporuči, neće se izvršiti naknadna primopredaja materijala niti plaćanje. Što znači da će u tom slučaju dobavljači morati da isporuče resurse na vreme.

U slučaju da dođe do nastupanja ovog rizičnog događaja, ne bi bilo većih problema jer bi sektor nabavke unapred pripremio spisak potencijalnih ostalih dobavljača koji će isti materijal odmah isporučiti, naravno po nešto višoj ceni. Viša cena bi uslovila u startu veće rashode. Rashodi bi se nadoknadili od plaćenih penala, koje će isplatiti prethodni dobavljač

koji nije ispunio ugovorne obaveze. I na ovaj način projekat bi bio završen na vreme i ne bi postojali naknadni troškovi.

4. ZAKLJUČAK

Nema sumnje da je danas razvoj softverskih alata vezanih za oblast upravljanja projektima od izuzetnog značaja. Uz pomoć njih se mogu pratiti projekti, raspoređivati resursi, analizirati troškovi, ali se mogu i pregledati i štampati izveštaji vezani za budžete, resurse, vremena realizacije i ostalo. Upravljanje projektima je danas savremena tendencija i može se realizovati uz pomoć niza poslovnih procesa, poduhvata, odnosno, projekata. Kao izuzetno korisno rešenje za uspešno poslovanje u savremenom društvu smatra se projektni pristup, kojim se obezbeđuju rešenja za razne ciljeve koji se moraju realizovati u okviru jedne organizacije. Multiprojektno upravljanje je istovremeno upravljanje sa više projekata ili poduhvata. U ovom naučnom radu prikazan je multiprojekat izgradnje inkluzivnog dečijeg igrališta. Projekat je definisan uz pomoć softverskog programa – MS Project. Realizacija ovog multiprojekta planirana je do 30.10.2024. godine ukoliko ne bude nekih nepredviđenih okolnosti i velikog zastoja. Kako bi se mogli izbeći pojedini rizični događaji neophodno je pridržavati se pravila, zakona i propisa. Isto tako je važno i primenjivati najoptimalnije tehnike i metode upravljanja rizicima. Ukoliko se dese nepredviđene okolnosti, važno je primeniti korektivne mere, kako bi se rizični događaji rešili u što kraćem vremenu čime bi se Multiprojekat izgradnje inkluzivnog dečijeg igrališta mogao realizovati u predviđenom vremenskom roku sa utvrđenim i neophodnim resursima.

OPTIMIZATION OF THE MULTIPROJECT OF BUILDING AN INCLUSIVE CHILDREN'S PLAYGROUND

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Abstract

Monitoring the project's progress is the only way to implement the project plan and meet the project objectives successfully. Proper monitoring of the project's progress, as well as its comparison with the initial plan, allows project managers to manage it effectively. Regardless of the type of project, they all have a specific goal that needs to be achieved in a certain time with planned costs and resources. In this sense, it is important to optimize resources because it may happen that the resources engaged in the project are too overloaded. The project's success largely depends on setting and planning realistic costs, time and resources. Many projects fail simply because time or money constraints are underestimated. This paper processed the project of building an inclusive children's playground using the MS Project software program.

Keywords: *Project, Resources, Project optimization, Cost planning*

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BEZBEDNOST I ZDRAVLJE ZAPOSLENIH NA RADU KAO OBAVEZA I ZADATAK MENADŽMENTA PROIZVODNO - POSLOVNOG SISTEMA

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Bor, Srbija

Izvod

Današnje promene u proizvodnji i poslovanju proizvodno - poslovnog sistema ukazuju na sve veći značaj čoveka, tj. radne snage u procesu proizvodnje. Daljim napredovanjem procesa proizvodnje uočeno je da poboljšanje uslova rada i usmerenje pažnje prema zaposlenima dovode do višestruke isplativosti, koja se sa jedne strane ogleda u povećanju produktivnosti, a sa druge u smanjenju povreda na radu. Ovo je uslovilo razvoj novog pristupa u okviru proizvodno - poslovnog sistema a to je bezbednost i zdravlje na radu. Osnovni cilj ovog istraživačkog rada je sticanje informacija o zdravlju i bezbednosti zaposlenih u proizvodno - poslovnom sistemu. Za postizanje ličnih i profesionalnih ciljeva, unapređenje organizacione strukture i održavanje uslova života na odgovarajući način, potrebno je voditi računa o zdravlju i bezbednosti zaposlenih. Zaposleni će, kada se budu osećali bezbedno i zdravo, moći dobro da komuniciraju sa ostalim članovima organizacije, kao i da obavljaju svoje radne zadatke na dobro organizovan način. Samim tim, od velikog je značaja da se u radnom okruženju preduzmu mere predostrožnosti za unapređenje zdravlja i bezbednosti, posebno kada su zaposleni angažovani na opasnim poslovima. Takođe, kada se komunikacija između članova organizacije odvija na pristojan način i sa puno poštovanja, onda se članovi organizacije osećaju sigurno. Jako je bitno da sve organizacije imaju u vidu pristup bezbednosti i zdravlju na radu, jer će tako, proizvodno – poslovni sistem poslovati uspešnije i bolje. Cilj istraživanja je i da se uvrdi u kojoj meri se zaposleni i menadžment preduzeća pridržavaja pravila i procedura o bezbednosti na radu, uspostavljanja i unapređenja sistema zaštite, zdravlja i bezbednosti na radu. U ovom radu izvršeno je posmatranje radne okoline zaposlenih, stepen zaštite zaposlenih od negativnih uticaja (buka, vibracije) i mikroklimatski uslovi u radnom prostoru. Dodatno, istražena je primena programa za sprovođenje bezbednosne prakse i korišćenje propisanih sredstava za ličnu zaštitu. Za obradu podataka je korišćen softverski paket SPSS 19.0. Rezultati kvantitativnog istraživanja su obrađeni primenom ANOVA testa.

Ključne reči: *zdravlje na radu, bezbednost zaposlenih, proizvodno – poslovni sistem*

1. UVOD

Zdravlje i bezbednost na radu su relevantni za sve grane industrije, poslovanja i trgovine, uključujući: tradicionalnu industriju, kompanije informacionih tehnologija, nacionalnu zdravstvenu službu, domove za starenje, škole, univerzitete. Zdravlje i bezbednost utiču na sve aspekte rada. U organizaciji male opasnosti, zdravlje i bezbednost može nadgledati kompetentan pojedinac. U proizvodnom pogonu visoke opasnosti, mnogo različitih stručnjaka, kao što su inženjeri (električni, mašinski i civilni), advokati, lekari i medicinske

sestre, treneri, planeri rada i supervizori, moraju da pomognu u nadgledanju profesionalnog zdravlja i bezbednosti. Postoje mnoge prepreke za postizanje dobrog standarda. Pritisak proizvodnje ili ciljeva učinka, finansijska ograničenja i složenost organizacije su tipični primeri takvih prepreka. Međutim, postoje neki snažni podsticaji za organizacije da teže visokim standardima zdravlja i bezbednosti. Ovi podsticaji su moralni, pravni i ekonomski. Korporativna društvena odgovornost, izraz koji se široko koristi u svetu rada 21. veka, pokriva širok spektar pitanja. Uključuje efekte koje organizacija ima na životnu sredinu, ljudska prava i svetsko siromaštvo. Zdravlje i bezbednost na radnom mestu je važno pitanje korporativne društvene odgovornosti (Carroll, 1999). Korporativna društvena odgovornost ima različite definicije. Međutim, uopšteno govoreći, pokriva načine na koje organizacije upravljaju svojim osnovnim poslom kako bi dodale društvenu, ekološku i ekonomsku vrednost u cilju proizvodnje pozitivnog održivog uticaja i na društvo i na sam posao (Carroll, 1999).

U pogledu korporativne društvene odgovornosti, organizacije trebaju da (Mullerat, 2010):

- poboljšaju sisteme upravljanja radi smanjenja povreda i lošeg zdravlja;
- pokažu važnost zdravlja i bezbednosti;
- javno izveštavaju o pitanjima zdravlja i bezbednosti u okviru svoje organizacije.

Efikasno upravljanje zdravljem i bezbednošću (Mullerat, 2010):

- je od vitalnog značaja za dobrobit zaposlenih;
- ima ulogu u jačanju ugleda preduzeća i pomaže mu da postigne visoke performanse je finansijski koristan za poslovanje.

2. TEORIJSKE OSNOVE

2.1. Pojam bezbednosti na radu

Pre objašnjenja pojma bezbednosti, treba objasniti pojam sistema. Pojam sistema ima više definicija, a neke od njih su:

- „Sistemi su grupe elemenata u međusobnom i uzajamnom delovanju na koje se sistemski zakoni mogu primeniti“ (Von, 1951).
- „Sistem je skup objekata zajedno sa odnosima između objekata i atributa tih objekata“ (Hall & Fagen, 1956).
- ,,Sistem je skup elemenata (delova) ili procesa koji su međusobno povezani, funkcionišu prema određenim pravilima i prema određenom cilju, a predstavljaju relativno izolovanu celinu“ (Beers, 2016).

Na osnovu ovih definicija, pojam sistema se može definisati kao odvojen skup međusobno povezanih pojava koji se ponaša prema nekim svojim zakonima. Sistemom se može smatrati sve ono što sa nekog gledišta ima tri osnovne karakteristike sistema: elemente, strukturu i funkciju.

Obzirom da ne postoji opšte prihvaćena definicija bezbednosti, nekoliko poznatih definicija bezbednosti su:

- „Bezbednost je stanje i stepen otpornosti na sve i zaštićenosti od svih ugroženosti i opasnosti“ (Beers, 2016).
- ,,Bezbednost je stanje u kojem se ne narušava normalno stanje stvari različitim ugroženostima i opasnostima“ (Beers, 2016).
- ,,Bezbednost je stanje u kojem je moguće normalno odvijanje svih prirodnih i društvenih funkcija i održavanje i razvoj stvorenih i stečenih vrednosti i kvaliteta“

(Beers, 2016).

- ,,Bezbednost je stanje pune ravnoteže između čoveka i prirode i njihove interakcije, koja ne dovodi do derogiranja prirode i kvaliteta života ljudske zajednice“ (Beers, 2016).
- ,,Bezbednost je stanje u kojem je osiguran uravnotežen fizički, duhovni, društveni i materijalni opstanak i razvoj pojedinca i društvene zajednice u odnosu prema drugim pojedincima, društvenoj zajednici i prirodi“ (Beers, 2016).
- Bezbednost je stanje ravnoteže između konstruktivnih i destruktivnih sila u kojem se ne narušava niti se degradira postojeće stanje (Beers, 2016).

Pojam bezbednosti može se definisati na više načina. Bezbednost jeste stanje u kojem pojedinac može normalno obavljati svoje funkcije, odnosno, poslove: životne, društvene, radne. Mnogi faktori, među kojima se kao najznačajniji izdvajaju, razvoj društveno ekonomskih odnosa, kao i pitanja o mestu i ulozi konkretnih pojmova i izraza u raznim naukama i naučnim disciplinama, utiču na definisanje termina zaštita na radu, bezbednost, zaštita zdravlja, kao i na njihovo prihvatanje i usvajanje od strane određene društvene zajednice. Bezbednost na radu je stanje koje omogućava normalan tok poslovnih aktivnosti i funkcionisanje poslovnih sistema, a na osnovu toga i postizanje boljih ekonomskih rezultata. Obzirom da je za sprovođenje bezbednosti na radu u poslovnim sistemima odgovoran poslodavac, zahtevi vezani za bezbednost na radu postaju neodvojiva komponenta funkcije savremenog menadžmenta poslovnih sistema, pa se može govoriti o menadžmentu bezbednosti na radu (Beham et al., 2012).

2.2. Obuka o zdravlju i bezbednosti

Obuka o zdravlju i bezbednosti je veoma važan deo kulture zdravlja i bezbednosti na radu i potrebno je da poslodavac obezbedi takvu obuku. Obuka je potrebna za zapošljavanje, tokom prijema u radni odnos ili prilikom povećanja rizika zbog:

- premeštanja na drugo radno mesto ili promene neke odgovornosti;
- uvođenja nove opreme za rad ili promene korišćenja postojeće radne opreme;
- uvođenja nove tehnologije;
- uvođenja novog sistema rada ili revizija postojećeg sistema rada;
- povećanja zaposlenosti mladih;
- posebne obuke koju zahteva organizacija osiguravajućeg društva – npr. požari (McInnes, 2018).

Možda će biti potrebna dodatna obuka nakon nekoliko nezgoda ili promašaja, kao rezultat uvođenja novog zakonodavstva ili kao rezultat procene rizika ili revizije bezbednosti. Važno je da se tokom razvoja obuke vodi računa o ciljnoj publici. Ako u ciljnu publiku spadaju mladi, izabrani pristup mora biti u stanju da zadrži njihov interes i svi ilustrativni primeri koji se koriste moraju biti u okviru njihovog iskustva. Trener takođe mora biti svestan spoljnih uticaja, kao što su npr. pritisci vršnjaka.

Na primer, ako svi nose ličnu zaštitnu opremu, onda će se to smatrati stvarima koje treba uraditi. Nivoi pismenosti i računanje su drugi važni faktori. Trebalo bi pokušati izmeriti efikasnost obuke putem obrazaca za evaluaciju kursa koji se izdaju: tokom sesije, naknadnom sesijom i poboljšanjem performansi zdravlja i bezbednosti (kao što je

smanjenje specifičnih nezgoda). Postoje nekoliko različitih vrsta treninga, uključuju uvod u posao, specifičan posao, nadzor i upravljanje i specijalistu. Održane neformalne sednice na mestu rada poznate su kao „razgovori u kutiji alata“. Takve sesije treba koristiti samo za pokrivanje ograničenog broja pitanja (McInnes, 2018).

2.3. Značaj bezbednosti na radnom mestu

Bezbednost na radnom mestu postala je jedan od glavnih prioriteta za organizacije širom sveta. Kako su bezbedna radna mesta takođe i produktivna, poslodavci pokušavaju da pronađu nove načine da svoje udaljene zaposlene i zaposlene u kancelariji zadrže bezbednim i zdravim. Bezbednost na radnom mestu postala je jedna od glavnih briga mnogih poslodavaca. Ne samo da pandemija COVID-19 dovodi do većeg broja bolesti, već i pojava rada na daljinu i raštrkanih radnih mesta otežavaju poslodavcima da dođu do svojih zaposlenih. Iako organizacije imaju moralnu obavezu da obezbede bezbedne uslove rada, nebezbedna radna mesta mogu imati ozbiljne pravne i finansijske posledice po menadžere proizvodno – poslovnih sistema. Bezbedne radne sredine imaju koristi od manjeg broja nezgoda, što rezultira manjim troškovima zdravlja na radu, zadovoljstvom zaposlenih, manjim brojem zastoja zaposlenih i manjim vremenom za prekvalifikaciju (Garben, 2017).

Zaposleni cene bezbedno radno okruženje, što je znak da je njihovom menadžeru stalo do njihovog zadovoljstva na radu. Zbog toga su zaposleni koji se osećaju bezbedno na poslu takođe lojalniji svojim menadžerima i duže ostaju u svojim organizacijama. S' druge strane, oni koji se ne osećaju bezbedno ili su doživeli nesreću na radnom mestu verovatno će tražiti nove menadžere i novo radno okruženje, odnosno, novu organizaciju u kojoj će raditi. Takođe, kompanija bi mogla upasti u ozbiljne finansijske probleme ako se zaposleni povredi na poslu. Zakon o bezbednosti i zdravlju na radu (*engl.* OSHA) zahteva od svih menadžera da prate posebne smernice u stvaranju bezbednih radnih mesta. Nepoštovanje OSHA pravila i smernica može dovesti do ozbiljnih pravnih i finansijskih gubitaka (Driscoll, 2018).

Zaposleni koji se osećaju bezbedno u svom radnom okruženju su produktivniji od onih koji su bili povređeni u prošlosti koji su zbog toga su razvili određeni nivo anksioznosti i straha. Eliminisanje opasnosti na radnom mestu omogućava zaposlenima da ostanu da obavljaju svoj posao i daju sve od sebe na radnom mestu. Kompanije koje ne ulažu u bezbednost na radnom mestu brzo razvijaju reputaciju nesigurnog poslodavca, što ima veliki uticaj na brendiranje poslodavaca i napore za privlačenje talenata. Štaviše, kupci kompanije, konkurenti i šira javnost često takve kompanije doživljavaju kao neprofesionalne. Kao posledica toga, manje zaposlenih se prijavljuje za posao, a najkvalifikovaniji radnici često traže posao negde drugde (Frick, 2019).

3. METODOLOGIJA ISTRAŽIVANJA

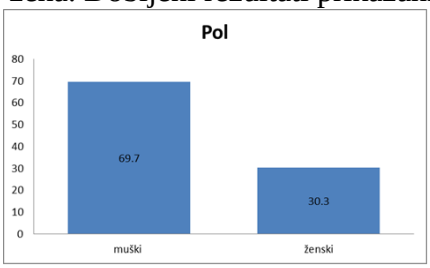
Osnovni cilj ovog rada jeste da se analizira kako se zaposleni ponašaju u vezi bezbednosti i zdravlja na svom radnom mestu. Saznanja dobijena istraživanjem ove vrste mogu značajno doprineti menadžerima proizvodno – poslovnih sistema da na pravi način pristupe sprečavanju i pojavi povreda i nesrećnih događaja na radu koji bi mogli poremetiti njihovo poslovanje.

Istraživanje na temu „Bezbednost i zdravlje zaposlenih na radu kao obaveza i zadatak menadžmenta proizvodno - poslovnog sistema“ sprovedeno je u avgustu 2023. godine metodom anketiranja, a zatim metodom ANOVE, što je predstavljeno u nastavku nakon analize rezultata dobijenih anketiranjem. U anketiranju je učestvovalo 109 ispitanika koji su činili zaposleni u borskim osnovnim školama i zaposleni u jednoj rudarskoj organizaciji. Upitnik koji se tokom anketiranja koristio sastavila je autorka Sheri Sangji 2019. godine. Anketa sadrži dve grupe pitanja. Prva grupa pitanja se odnosi na opšte podatke o ispitanicima (demografska pitanja). Druga grupa pitanja se odnosila na to kako se ispitanici snalaze u vezi zdravlja i bezbednosti na radu. Prvi deo druge grupe pitanja odnosi se kako se zaposleni snalaze na svojim radnim mestima što se tiče zdravlja i bezbednosti, da li koriste opasne supstance tokom rada, da li rade u nezgodnom položaju na poslu, da li rade na velikoj visini, itd... Ponuđeni odgovori na ova pitanja su: nikada, jednom godišnje, svakih 6 meseci, svaka 3 meseca, svakog meseca, svake nedelje, svakog dana ili NZM (što znači ne znam). Anketirani su imali pravo da samo jedan odgovor izaberu.
Drugi deo druge grupe pitanja odnosi se na to kakva je komunikacija između menadžera i zaposlenih o pitanjima bezbednosti, da li radnici dobijaju adekvatnu obuku o zdravlju i bezbednosti na radu, da li se incidenti i nezgode na radu brzo istražuju, itd... Ponuđeni odgovori na ova pitanja su: u potpunosti se slažem, slažem se, ne slažem se, u potpunosti se ne slažem i NZM (ne znam). Anketirani su imali pravo da samo jedan odgovor izaberu.
U nastavku sledi grafički prikaz rezultata svih pitanja sadržanih u anketi, sa odgovarajućim komentarima, koji su rezultati deskriptivne analize koja je sprovedena u prethodnom periodu.

3.1. Analiza i interpretacija rezultata istraživanja

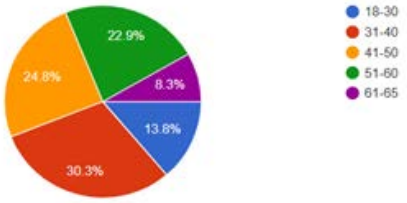
I grupa pitanja (demografska pitanja) se odnose na opšte podatke o ispitanicima. Ovde se nalaze podaci o: polu ispitanika, godinama starosti, godinama radnog staža, školskoj spremi i poziciji ispitanika u preduzeću.

Prema rezultatima ankete, od 109 ispitanika, njih 33 (30.3%) je muškog, a 76 (69.7%) ženskog pola. Dolazi se do zaključka da je duplo manji broj muškaraca učestvovao u istraživanju u odnosu na broj žena. Dobijeni rezultati prikazani su na Slici 1.



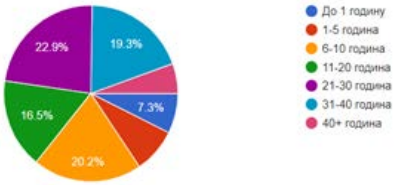
Slika 1. Pol ispitanika

Najviše ima ispitanika od 31 do 40 godina starosti, procentualno 30.3% od ukupnog broja ispitanika, pa se može zaključiti da su ispitanici mlađe osobe. Zatim slede ispitanici od 41 do 50 godina starosti, odnosno, procentualno 24.8%. Od 51 do 60 godina ima ukupno 22.9% ispitanika. Ispitanici od 18 do 30 godina čine 13.8%. I na kraju, 8.3% ukupnog broja ispitanika čine oni koji imaju od 61 do 65 godina, gde se dolazi do zaključka da najmanje ima anketiranih najstarijih osoba u organizacijama. Dobijeni rezultati prikazani su na Slici 2.



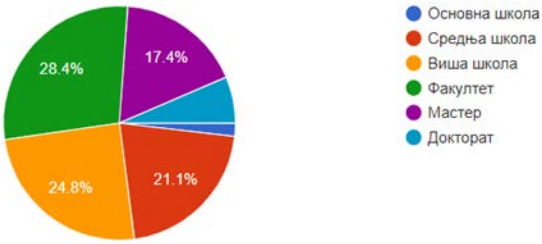
Slika 2. Godine starosti ispitanika

Što se tiče godina radnog staža ispitanika, najveći procenat je sa radnim stažom od 21 do 30 godina (22.9%). Na drugom mestu su ispitanici koji imaju imaju između 6 i 10 godina radnog staža (20.2%). Zaposleni sa radnim stažom dužine од 31 do 40 godina predstavljaju 19.3% ispitanika, dok je najmanji broj ispitanika radnog staža od 40 godina i preko (5.5%). Može se primetiti da je ispitani uzorak sastavljen pretežno od zaposlenih sa većim brojem godina radnog iskustva. Dobijeni rezultati prikazani su na Slici 3.



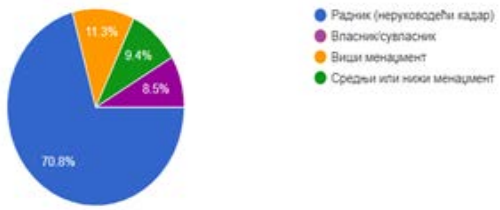
Slika 3. Radni staž ispitanika

Što se tiče školske spreme ispitanika, dominiraju oni koji imaju fakultet (28.4%). Višu školu ima 24.8% ispitanika. Na trećem mestu po broju anketiranih su ispitanici sa srednjom školom (21.1%). Završene master studije ima 17.4% ispitanika, a doktorske studije imaju završen 6.4% ispitanika. Najmanje ima anketiranih koji imaju završenu osnovnu školu i oni čine 1.8% anketiranih. Dobijeni rezultati prikazani su na Slici 4.



Slika 4. Školska sprema ispitanika

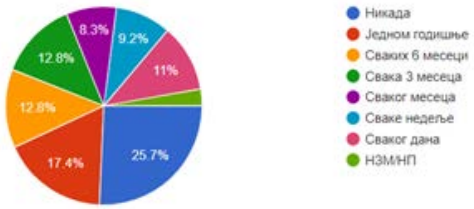
Što se tiče pozicije ispitanika u preduzeću, dominiraju radnici ili nerukovodeći kadar, odnosno 70.8% ispitanika. 11.3% ispitanika jesu ispitanici koji u svojoj organizaciji čine viši menadžment, a 9.4% ispitanika čine srednji ili niži menadžment. Najmanji procenat ispitanika jesu vlasnici/suvlasnici, koji čine 8.5% ispitanika. Dobijeni rezultati prikazani su na Slici 5.



Slika 5. Pozicija ispitanika u preduzeću

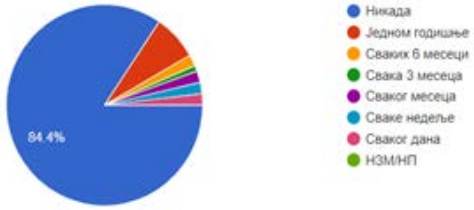
Druga grupa pitanja se odnosi na to kako se ispitanici snalaze u vezi zdravlja i bezbednosti na radu. U nastavku su predstavljeni neki od pitanja i odgovora ispitanika.

Veliki broj ispitanika (25.7%) nikada ne obavlja radne zadatke i ne koristi metode rada sa kojima nisu upoznati. 17.4% ispitanika jednom godišnje, a 14.7% ispitanika na svaka 3 meseca obavljaju zadatke ili koriste metode rada sa kojima nisu upoznati. Jako mali broj ispitanika (11%) svakog dana obavljaju ove zadatke, što raduje, jer mali broj zaposlenih su izloženi riziku da koriste metode tokom rada sa kojima nisu upoznati (Slika 6).



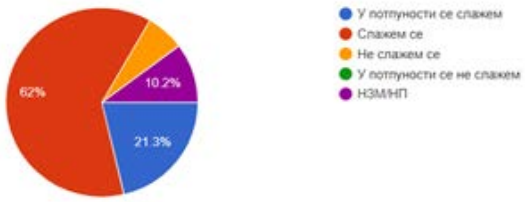
Slika 6. Obavljanje radnih zadataka ili korišćenje metoda rada sa kojima radnici nisu upoznati

Raduje činjenica da je ogroman broj ispitanika odgovorio da nikada nije maltretiran ili uznemiravan na poslu (84.4%). 7.3% ispitanika odgovorilo je da je jednom godišnje maltretirano ili uznemiravano na poslu, a po 1.8% ispitanika odgovorili su da su: svakog meseca, na svakih 6 messeci, svake nedelje i svakog dana uznemiravani na poslu. To znači da je 15.6% ispitanika barem jednom u godinu dana uznemiravano na poslu. Stoji činjenica da to nije veliki broj ispitanika, ali se moraju preduzeti mere u organizaciji kako nijedan zaposlen ne bi bio maltretiran ili uznemiravan na poslu. Zaposlenima treba sve omogućiti kako bi se na svom radnom mestu osećali prijatno, kako bi bili maksimalno posvećeni svom poslu i kako bi u najboljim uslovima obavljali svoje radne zadatke. Dobijeni rezultati prikazani su na Slici 7.



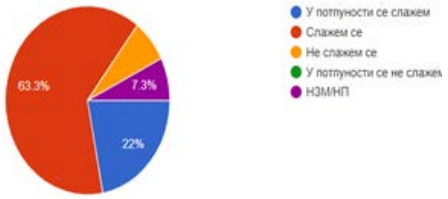
Slika 7. Maltretiranje ili uznemiravanje na poslu

Redovna komunikacija o pitanjima bezbednosti između zaposlenih i menadžmenta postoji kod 83.3% ispitanika, pošto su oni odgovorili da se slažu i u potpunosti slažu sa datom tvrdnjom. 10.2% ispitanika ne znaju, a 6.5% ispitanika se ne slažu sa datom tvrdnjom, odnosno kod njih ne postoji redovna komunikacija o pitanjima bezbednosti sa njihovim zaposlenima ili menadžerima. Što pre je potrebno da komunikacija bude redovna o pitanjima bezbednosti na radu, jer će samo na taj način zaposleni ostati bezbedni i skroz fokusirani na radnom mestu. Dobijeni rezultati prikazani su na Slici 8.



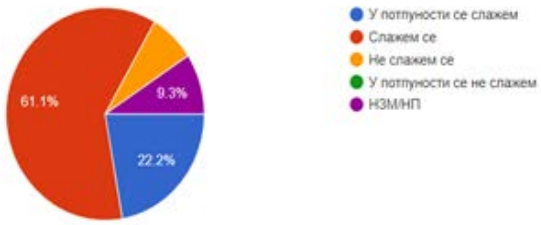
Slika 8. Redovna komunikacija o pitanjima bezbednosti između zaposlenih i menadžmenta

85.3% ispitanika znaju kako da obavljaju posao na bezbedan način. 13% ispitanika ne znaju šta da odgovore na ovu tvrdnju, a 7.3% ispitanika ne znaju kako da obavljaju posao na bezbedan način. Jako je dobro što preko 85% ispitanika znaju kako da obave posao na bezbedan način, a ovih 7.3% što ne znaju bi trebali da možda pohađaju neki kurs ili obuku kako bi što pre stekli znanja i veštine da posao obave bezbedno i da ne ugroze ni sebe a ni ostale radnike. Dobijeni rezultati prikazani su na Slici 9.



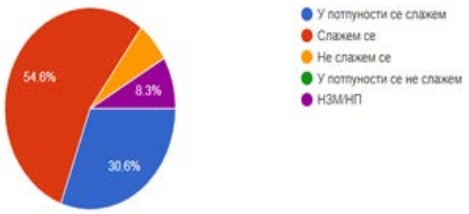
Slika 9. Znanje o obavljanju posla na bezbedan način

83.3% ispitanika imaju znanja da pomognu u reagovanju na bilo kakve zdravstvene i bezbednosne probleme na radnom mestu. 9.3% ispitanika ne znaju, a 7.4% ispitanika nemaju znanja da pomognu u reagovanju na bilo kakve zdravstvene i bezbednosne probleme na radnom mestu. Taj mali procenat od 7.4% moraju što pre da steknu znanje kako da pomognu u regovanju na zdravstvene i bezbednosne probleme na radu. Dobijeni rezultati prikazani su na Slici 10.



Slika 10. Znanje da se pomogne u reagovanju na bilo kakve zdravstvene i bezbednosne probleme na radnom mestu

Tokom obavljanja radnih zadataka, 85.2% ispitanika nemaju dovoljno vremena da bezbedno završe radne zadatke. 8.3% nisu znali šta da odgovore na ovo pitanje, a 6.5% ispitanika nemaju dovoljno vremena da bezbedno završe njihove radne zadatke. Ovaj procenat ispitanika mora da nađe vreme da bezbedno završi svoje radne zadatke, jer tako neće rizikovati da se desi neka nezgoda u obavljanju svojih zadataka, a i takođe će uspešno obaviti svoje radne zadatke. Dobijeni rezultati prikazani su na Slici 11.



Slika 11. Vremena koje je potrebno da se bezbedno završe radni zadaci

4. DISKUSIJA REZULTATA ISTRAŽIVANJA

Istraživački deo rada se sastojao od ankete koja je bila podeljena ispitanicima. U anketi je učestvovalo 109 ispitanika, od čega su 76 ženskog, a 33 muškog pola. Najviše ima ispitanika od 31 do 40 godina starosti. Što se tiše školske spreme ispitanika, najveći broj ispitanika ima fakultet, a što se tiče godina radnog staža ispitanika, najveći procenat ispitanika je radnog staža od 21 do 30 godina. Raduje činjenica da veliki broj ispitanika obavlja radne zadatke i koristi metode rada sa kojima su upoznati. Mali broj ispitanika koji koristi metode rada sa kojima nisu upoznati bi trebalo da se što pre upoznaju sa tim metodama, jer će tako posao obaviti na bezbedan način, a takođe i na efikasan način.
Jako veliki broj ispitanika nikada nisu maltretirani ili uznemiravani na poslu, a onaj mali broj ispitanika koji je uznemiravan na poslu to što pre treba da prijavi kako bi posao obavljao neometano i u bezbednim uslovima.

U organizacijama kod velikog broja ispitanika radnici dobijaju neophodnu obuku o zdravlju i bezbednosti na radnom mestu, a takođe i postoji aktivan i efikasan komitet za zdravlje i bezbednost na radu. Takođe, dobro je to što između zaposlenih i menadžmenta postoji redovna komunikacija o pitanjima bezbednosti i zdravlja na radu.

Jako je bitno to što se u preko 80% organizacija incidenti i nezgode brzo istražuju kako bi se poboljšalo zdravlje i bezbednost na radnom mestu i kako bi se što pre sprečili nemili događaji na radu, a samim tim i povrede na radu. Jako je dobro i to što veliki broj ispitanika znaju kako da obavljaju svoj posao na bezbedan način, znaju da mogu da prekinu posao ako smatraju da nešto nije bezbedno i imaju znanja da pomognu u reagovanju na bilo kakve zdravstvene i bezbednosne probleme na radnom mestu.

Jedna od najbitnijih činjenica jeste da preko 85% ispitanika imaju dovoljno vremena da bezbedno završe svoje radne zadatke. To znači da na vreme i efikasno izvršavaju svoje radne obaveze, a pored toga ih obavljaju na bezbedan način, odnosno, bez ikakvih povreda na radu ili incidenata.

Zaključak jeste da svima u organizaciji (i menadžerima i zaposlenima) zdravlje i bezbednost na radnom mestu treba biti glavni prioritet. Menadžeri trebaju da obezbede

svojim zaposlenima da obavljaju poslove u bezbednom i zdravom okruženju bez rizika da može doći do povrede na radu. Sa druge strane, ako zaposleni uoče da njihovo radno okruženje nije bezbedno odmah trebaju da kontaktiraju svoje nadređene i da prijave to, kako bi im nadređeni što pre omogućili da svoje poslove neometano obavljaju u bezbednom okruženju bez rizika da će doći do povrede na radu, do incidenata ili do nekih negativnih događaja ili situacija.

Zdravlje treba biti svima na prvom mestu, a samim tim, radno okruženje treba svima biti bezbedno i bez rizika da će doživeti povredu na radu ili da će im zdravlje biti ugroženo. Bezbedno radno okruženje i bezbedno izvršavanje radnih zadataka su svima prioritet kako bi uspešno obavili radne zadatke i kako bi sama organizacija bila uspešna i imala dobru reputaciju.

5. ZAKLJUČAK

Svet rada prolazi kroz duboke promene zbog pojave novih tehnologija, promenljive demografije i klimatskih promena i pomeranje ka zelenoj privredi. Ove promene će doneti nove izazove i mogućnosti za bezbednost i zdravlje svetskih radnika.

Iako je posao jedna od ključnih stvari za normalan život, izvlači ljude iz siromaštva i daje mnogima osećaj identiteta i svrhe, takođe, može biti opasno i nezdravo ako se rizicima u vezi zdravlja i bezbednostine upravlja na odgovarajući način. Važno je raditi ka budućnosti u kojoj se najviše radi kako bi se osigurala bezbednost i zdravlje radnika u svetu, odnosno, potrebno je radnicima obezbediti bezbedno radno mesto kako bi radnici na svom radnom mestu bili zdravi i bezbedni.

Mogu se pojaviti neki novi rizici, dok drugi rizici mogu biti u porastu. Naročito bi moglo biti zabrinjavajuće ako dođe do pojave stresa i psihosocijalnih rizika na poslu i nastanka bolesti na radnom mestu koje rezultiraju promenu u načinu života. U isto vreme, mnogi svetski radnici su izloženi stalnim zdravstvenim rizicima, koji zahtevaju napore da bi se radnici izborili sa tim rizicima.

Iako put koji je pred nama predstavlja mnogo novih izazova za bezbednost i zdravlje na radu, on je važan za vladu, poslodavce i radnike i druge zainteresovane strane da iskoriste prilike da stvore sigurnu i zdravu budućnost na radu za sve, kako bi posao obavljali na bezbednom i zdravom radnom mestu, a samim tim kako bi posao obavili na što bolji i efikasniji način.

THE SAFETY AND HEALTH OF EMPLOYEES AT WORK AS AN OBLIGATION AND RESPONSIBILITY OF THE MANAGEMENT IN THE PRODUCTION - BUSINESS SYSTEM

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Abstract

Todays changes in the production and business operations of the production and business system show the greater importance of people, i.e. labor force in the production process. With the further advancement of the production process, it has been found that improving working conditions and focussing on employees lead to a multiple profitability, which is reflected on the one hand in increasing productivity and, on the other hand reduced workplace injuries. This has led to the development of a new approach within the production and business system, namely health and safety in the workplace. The main objective of this research is to obtain information about the health and safety of employees in the production and business system. In order to achieve personal and professional goals, improve the organisational structure and maintain living conditions in an appropriate manner, it is necessary to take care of the health and safety of employees. When employees feel safe and healthy, they will be able to communicate well with other members of the organisation and perform their work tasks in a well-organised manner. Therefore, it is very important to take precautions in the work environment to improve health and safety, especially when employees are engaged in dangerous jobs. Also, when communication between members of the organisation is done in a polite manner and with great respect, those members of the organisation also feel very safely. It is very important that all organisations have a health and safety concept at work, because this way the productionand business system will function more successfully and better. The aim of the survey is also to determine the extent to which employees and management comply with the rules and procedures related to workplace safety, the establishment and improvement of the occupational health and safety system. Additionally, the working environment in which the employees are employed will be observed, the degree of protection of employees from negative influences (noise, vibrations) and the microclimatic conditions at the workplace. The implementation of a programme of safety practises and the use of the prescribed personal protective equipment was investigated. For data processing, the SPSS 19.0 software package will be used. The results of the quantitative research were processed using the ANOVA test.

Keywords: *occupational health, employee safety, production-business system*

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ANALIZA I PRAKTIČNA IMPLEMENTACIJA DIREKTNIH METODA MEŠOVITIH MATRIČNIH IGARA

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Izvod

U ovom radu prikazana je primena direktnih metoda za rešavanje problema mešovitih matričnih igara na kroz primer samostalne zanatsko trgovinske radnje. Optimalne strategije igrača u igri i vrednost igre dobijene su putem analitičkog i grafičkog metoda, dok je kao potvrda validnosti rezultata korišćen softverski paket Lindo v.6.1. Rešavanjem problema zaključeno je da su optimalne strategije igrača P*=(14,29 %, 85,71 %) i Q*=(28,57 %, 71,43 %), a vrednost igre je V=15,71 (izraženo u hiljadama RSD). Vrednost igre predstavlja najvišu prodajnu cenu i istovremeno najmanju kupovnu cenu proizvoda iz odabranog asortimana. Primenom ovih metoda mogu se unaprediti performanse preduzeća u smislu fokusiranja na određenu vrstu traženog proizvoda.

Keywords: *teorija igara, mešovite matrične igre, analitički metod, grafički metod, Lindo*

1. UVOD

Teorija igara počinje sa radom Johna von Neumanna tokom 1920-ih, što je kulminiralo njegovom knjigom sa Oskarom Morgensternom. Proučavali su "nula-sum" igre u kojima su interesi dva igrača strogo suprotstavljeni. John Nash je obradio opštiji i realističniji slučaj mešavine zajedničkih interesa i rivalstva i bilo kog broja igrača. Drugi teoretičari, kao npr. Reinhard Selten i John Harsanyi koji su sa Nashom delili Nobelovu nagradu za ekonomiju 1994. godine, proučavali su još kompleksnije igre u kojima jedan igrač ima više informacija od drugih iz prakse iz domena mešovitih igara (Dixit, 2024).

Brojni su primeri u Teoriji igara, kako teoretski, tako i u praksi, od najbanalnijih do velikih problema i dilema. Postavlja se pitanje kako ih rešiti. Najopštiji primer jesu prodavci i kupci. Prodavcima je u interesu da što više prodaju i po što višoj ceni, a kupcima da plate što manje, po mogućstvu i sa odloženim rokom plaćanja. Ono što se upravo želi postići je najbolje moguće rešenje za sve aktere što nekada nije ni malo lako.

Teorija igara je matematička teorija procesa donošenja odluka igrača (učesnika, protivnika) koji su u sukobu (konfliktu) ili su uključeni u konfliktne uslove (Jovanović**,** 2016). Pomoću teorije igara neophodno je analiziranje i rešavanje konfliktne situacije. Pri rešavanju mešovitih matričnih igara potrebno je odrediti optimalne strategije za svakog igrača (Jovanović**,** 2016). Ukoliko se odmah može pronaći jedna optimalna strategija za oba igrača, onda se radi o prostim matričnim igrama. Međutim, ukoliko svaki od igrača ima

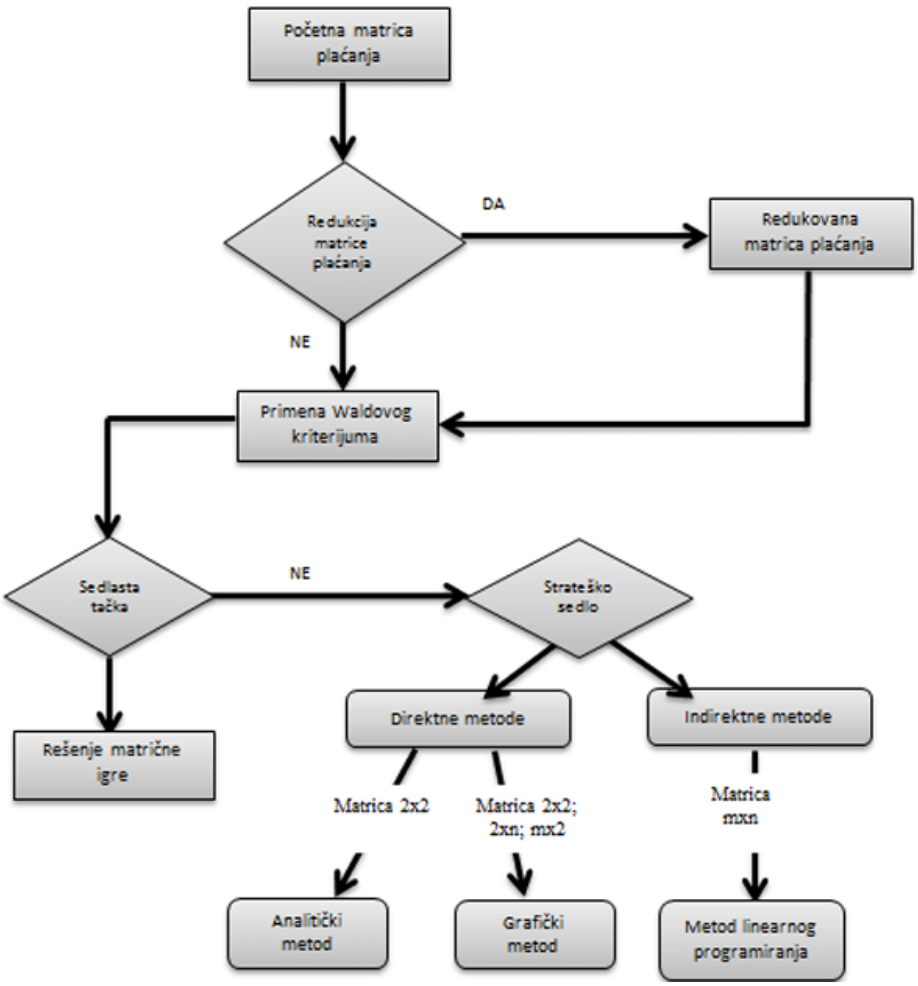
drugačiju optimalnu strategiju, reč je o mešovitim matričnim igrama. Rešenje mešovitih matričnih igara se dobija nakon uvođenja elemenata slučajnosti prilikom izbora pojedinačnih strategija, a svakoj strategiji se dodeljuje određena verovatnoća (Jovanović**,** 2016). Suština je u tome da ne postoji jedinstvena strategija koja će omogućiti igraču „A“ maksimalni mogući dobitak odnosno jedinstvena strategija igrača „B“, već se radi o kombinaciji strategija.

Obzirom da u današnje vreme postoji mnogo primera teorije mešovitih matričnih igara, ovde je razmatran primer jedne samostalne zanatsko trgovinske radnje kroz potencijalne kupce i deo prodajnog asortimana.

2. TEORIJSKO-METODOLOŠKE POSTAVKE RADA

2.1. Mešovite matrične igre

Kod matričnih igara, igra može biti u domenu prostih ili mešovitih matričnih igara. Sam put rešavanja matrične igre može se objasniti i preko algoritma koji je prikazan na Slici 1. Prema ovom algoritmu, matrica plaćanja može biti redukovana na matricu manjih dimenzija, nakon čega se primenjuje Waldov kriterijum, ili ukoliko to nije moguće, odmah se pristupa primeni ovog istog kriterijuma.



Slika 1. Algoritam rešavanja matričnih igara (Radić, 2020)

Kada matrica plaćanja nema sedlastu tačku, rešavanje problema se komplikuje pa se moraju primeniti i druge metode. U ovom radu obradiće se direktne metode i to analitičke i grafičke. Analitički metod može biti primenjen putem direktnih formula ili parcijalnih izvoda.

Posmatramo dva igrača A i B. Igrač A ima *m* alternativa - strategija, dok igrač B ima *n* alternativa. Shodno tome, igrači A i P te strategije biraju sa verovatnoćama $p_1,\ldots,p_m$ odnosno $q_1,\ldots,q_n$ i pri tome važi:

$$\sum_{i=1}^{m} p_i = 1 \tag{1}$$

$$\sum_{j=1}^{n} q_j = 1 \tag{2}$$

Vektor P = (p_1, …, p_m) nazivamo mešovitom strategijom igrača A, dok vektor Q = ($q_1,\ldots,q_n$) nazivamo mešovitom strategijom igrača B. kod čiste strategije jedna verovatnoća jednaka je 1, a sve ostale su 0. Kod mešovite strategije najmanje dve verovatnoće moraju biti pozitivne (Dixit, 2024).

2.1.1. Direktna priimena formula

Najjednostavniji slučaj je matrica tipa 2x2, pa je na njenom primeru podesno objasniti formule koje se koriste u direktnoj primeni.

Neka je matrica plaćanja označena kao:

$$\begin{matrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{matrix}$$

I neka je P*(p_1, p_2) optimalna strategija igrača A, Q*(q_1, q_2) optimalna strategija igrača B, a V vrednost igre. Tada važi:

$$p1 = \frac{a_{22}-a_{21}}{a_{11}+a_{22}-a_{12}-a_{21}} \tag{3}$$

$$p2 = 1 - p1 \tag{4}$$

$$q1 = \frac{a_{22}-a_{12}}{a_{11}+a_{22}-a_{12}-a_{21}} \tag{5}$$

$$q2 = 1 - q1 \tag{6}$$

$$V = \frac{a_{22}\cdot a_{11}-a_{12}\cdot a_{21}}{a_{11}+a_{22}-a_{12}-a_{21}} \tag{7}$$

2.1.2. Grafički metod

Grafički metod (metoda) zasniva se na geometrijskoj interpretaciji, pri čemu se mora prvo krenuti od jednog igrača. Mi sami biramo od kog igrača ćemo krenuti. Za igrača za kog smo se odlučili, sastavljamo nejednačine na osnovu matrice plaćanja. Ukoliko smo počeli od igrača A, onda moramo pronaći parametre p_1 i p_2 koji određuju njegovu optimalnu strategiju P* (Milovanović, 2019). Daljim matematičkim proračunom, tj. rešavanjem jednačina i primenom analitičke geometrije, dolazimo do jednačina pravih za igrača A.

Dobijaju se dve prave koje se seku i u njihovom preseku nalazi se tačka P* koja u stvari predstavlja optimalnu strategiju igrača A.

Na sličan način sastavljamo nejednačine za igrača B, s tim što je odnos prema vrednosti igre V u prvom slučaju ≥, a u drugom ≤.

2.1.2. Lindo program

Lindo (*engl.* Linear Interactive and Discrete Optimizer) predstavlja interaktivni softverski paket koji je razvijen od strane kompanije Lindo System Inc., USA (LINDO) i može koristiti u svim aplikacijama gde je potrebno izvršiti optimizaciju. Softverski paket Lindo v.6.1. funkcioniše tako što se u njega unose funkcija cilja i ograničenja i brzo se dobijaju gotova rešenja (Milovanović, 2019; LINDO, 2024).

Da bi se definisao problem u Lindo v.6.1. programu koriste se oznake y_i i z_0, za igrača A, xj i g_0 za igrača B (Milovanović, 2019), kao i sledeće formule:

$$V = \frac{1}{z_0} = \frac{1}{g_0} \tag{8}$$

$$p_i = y_i \cdot V \tag{9}$$

$$q_j = x_j \cdot V \tag{10}$$

3. REZULTATI PRAKTIČNOG PRIMERA

Primena direktnih metoda za rešavanje problema mešovitih matričnih igara će u ovom radu biti prikazana na primeru SZTR za proizvodnju nameštaja pod imenom "XXX" u cilju zaštite podataka. SZTR "XXX" proizvodi i prodaje različite komade nameštaja namenjene kako fizičkim, tako i pravnim licima. U Tabeli 1 su prikazane cene po različitim vrstama nameštaja u odnosu na dve vrste kupaca, fizička i pravna lica.

Tabela 1. Prodajne cene dela asortimana SZTR "XXX"

Cene u hiljadama RSD	Fizičko lice	Pravno lice
Sto	11	9
Stolica	5	4
Orman	20	14
Vitrine	15	16
Polica	10	8

U cilju pojednostavljenja daljeg postupka obrade podataka pristupa se redukciji. Nakon izvršene redukcije izgled početne matrice plaćanja prikazan je u Tabeli 2.

Tabela 2. Matrica plaćanja nakon redukcije

		Potencijalni kupac	
		Fizičko lice	Pravno lice
SZTR "XXX"	Orman	20	14
	Vitrine	15	16

Kako bi se proverilo da li je reč o prostim ili mešovitim matričnim igrama, mora se potražiti "sedlasta tačka", što se postiže primenom Waldovog kriterijuma (Tabela 3).

Tabela 3. Primena Waldovog kriterijuma

		Potencijalni kupac		Min *j*	Max *i*
		Fizičko lice	Pravno lice		
SZTR "XXX"	Orman	20	14	14	15
	Vitrine	15	16	15	
	Max *i*	20	16	$15 \leq V \leq 16$	
	Min *j*	16			

Na osnovu rezultata prikazanih u Tabeli 3, može se zaključiti da ova igra pripada mešovitim matričnim igrama, obzirom da ne postohi sedlasta tačka. Vrednost igre V nalazi se između 15 i 16., tj. $15 \leq V \leq 16$.

3.1. Rešavanje definisanog problema pomoću analitičkog metoda direktnom primenom formula

Radi bolje preglednosti prikaz elemenata koji će biti korišćeni u formulama dat je u Tabeli 4.

Tabela 4. Potrebni elementi matrice za primenu formula

		Potencijalni kupac	
		Fizičko lice (q1)	Pravno lice (q2)
SZTR "XXX"	Orman (p_1)	20	14
	Vitrine (p_2)	15	16

Direktnom primenom formula dobija se sledeće:

$$p1 = \frac{a_{22} - a_{21}}{a_{11} + a_{22} - a_{12} - a_{21}} = \frac{16 - 15}{20 + 16 - 14 - 15} = \frac{1}{7}$$

$$p2 = 1 - p1 = \frac{6}{7}$$

$$q1 = \frac{a_{22} - a_{12}}{a_{11} + a_{22} - a_{12} - a_{21}} = \frac{16 - 14}{20 + 16 - 14 - 15} = \frac{2}{7}$$

$$q2 = 1 - q1 = \frac{5}{7}$$

$$V = \frac{a_{22} \cdot a_{11} - a_{12} \cdot a_{21}}{a_{11} + a_{22} - a_{12} - a_{21}} = \frac{16 \cdot 20 - 14 \cdot 15}{20 + 16 - 14 - 15} = 15{,}71\ n.j.$$

Odnosno:

p_1=14,29 %; p_2=85,71%; q_1=28,57%; q_2=71,43%

3.2. Rešavanje definisanog problema pomoću grafičke metode

Kao polazni podaci koristiće se podaci iz Tabele 4, pri čemu se formira sistem nejednačina za SZTR "XXX":

$20\ p_1 + 15\ p_2 \geq V$

$14 p_1 + 16\ p_2 \geq V$

Optimalna mešovita strategija SZTR"XXX" dobija se uz uslov $p_1+p_2 = 1$, odnosno, $p_2 = 1-p_1$, pa se dobija sledeće:

l1: $20\ p_1+15\ p_2 \geq V$
$20\ p_1+15\ (1-p_1) = V$
$20\ p_1+15-15p_1 = V$
$5p_1+15 = V$
$p_1 = 0 \rightarrow V = 15$
$p_1 = 1 \rightarrow V = 20$

l2: $14\ p_1+16\ p_2 \geq V$
$14\ p_1+16\ (1-p_1) = V$
$14\ p_1+16-16p_1 = V$
$-2p_1+16 = V$
$p_1 = 0 \rightarrow V = 16$
$p_1 = 1 \rightarrow V = 14$

Grafičko rešenje nalazi se u preseku prava l_1 i l_2, što se dobija izjednačavanjem njihovih jednačina:

$5p_1+15 = -2p_1+16$

$5p_1+2p_1 = 16-15$

$7p_1 = 1$

$p_1 = 1/7 = 0{,}1429$

$p_2 = 1-p_1 = 6/7 = 0{,}8571$

Na taj način se dobija optimalna mešovita strategija SZTR "XXX" P*(1/7; 6/7). Ukoliko se p_1 i p_2 zameni u bilo kojoj jednačini prave l_1 ili l_2, dobiće se vrednost igre V:

$5p_1+15 = V$

$5/7+15= V$

$V= 15{,}71$

Kako bi se dobila i optimalna strategija potencijalnih kupaca formira se sistem nejednačina:

$20\ q_1+14\ q_2 \leq V$

$15q_1 + 16\ q_2 \leq V$

Uz uslov $q_1+q_2 = 1$, odakle sledi, $q_2 = 1- q_1$:

l1: $20\ q_1+14\ q_2 \leq V$
$20\ q_1+14\ (1-q_1) = V$
$20\ q_1+14-14q_1 = V$
$6q_1+14 = V$
$q_1 = 0 \rightarrow V = 14$
$p_1 = 1 \rightarrow V = 20$

l2: $15\ q_1+16\ q_2 \leq V$
$15\ q_1+16\ (1-q_1) = V$
$15\ q_1+16-16q_1 = V$
$-q_1+16 = V$
$q_1 = 0 \rightarrow V = 16$
$q_1 = 1 \rightarrow V = 15$

Grafičko rešenje u preseku prava l_1 i l_2:

$6q_1+14 = -q_1+16$

$6q_1+q_1 = 16-14$

$7q_1 = 2$

$q_1 = 2/7 = 0{,}2857$

$q_2 = 1-q_1 = 5/7 = 0{,}7143$

Na taj način se dobija optimalna mešovita strategija kupaca Q*(2/7; 5/7).

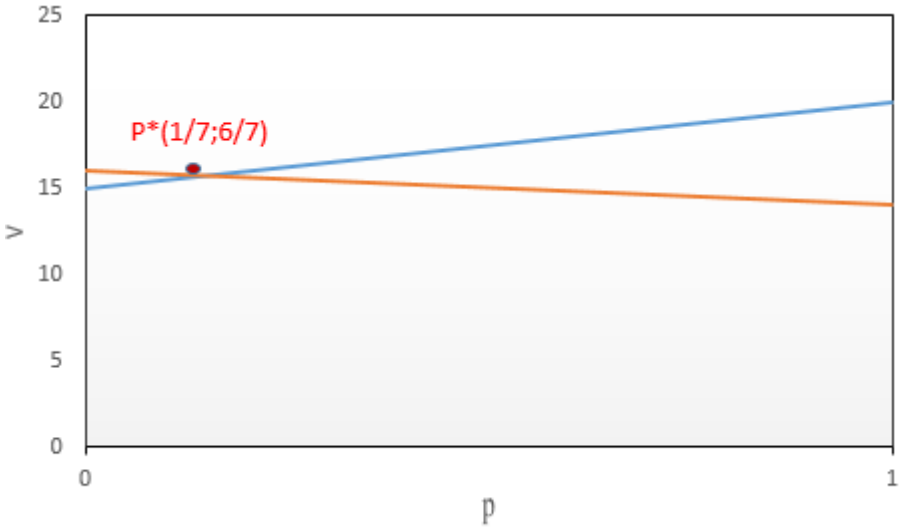
Ukoliko se q_1 i q_2 zameni u bilo kojoj jednačini prave l_1 ili l_2, dobiće se vrednost igre V:

$6q_1+14 = V$

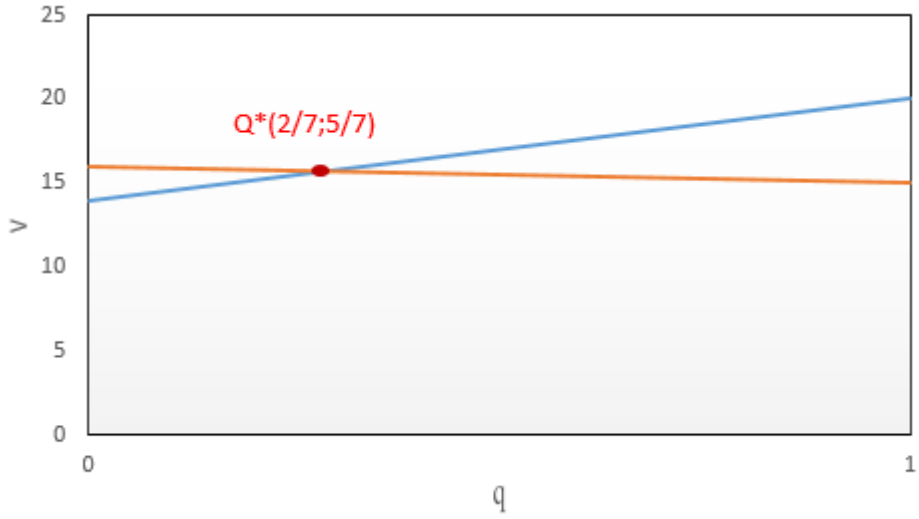
$12/7+14= V$

$V= 15{,}71$

Grafički prikaz rešenja zadatog problema prikazan je na Slikama 2 i 3.



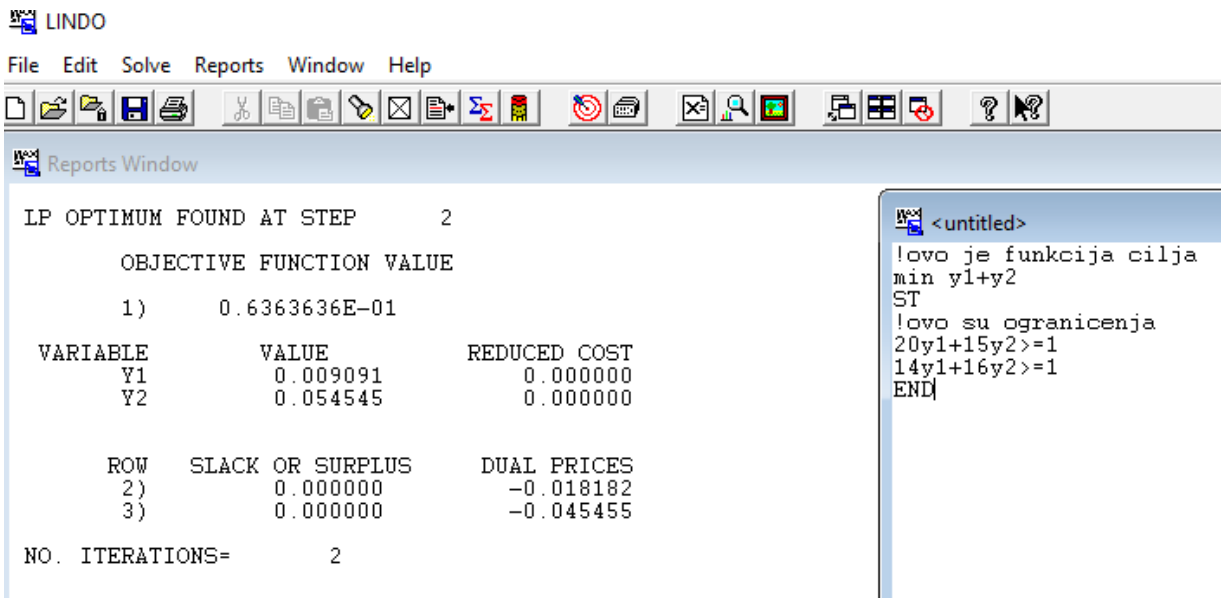
Slika 2. Grafički prikaz opimalne strategije SZTR "XXX"



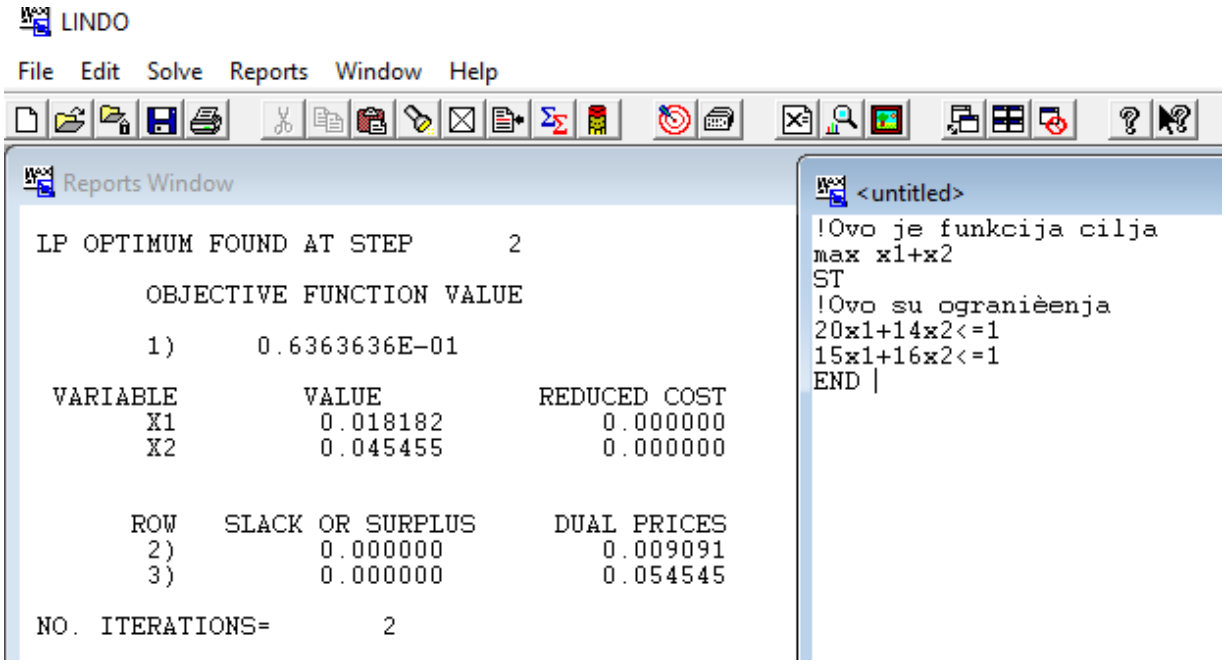
Slika 3. Grafički prikaz optimalne strategije potencijalnih kupaca SZTR "XXX"

3.2. Rešavanje definisanog problema primenom programskog paketa LINDO

Provera tačnosti prethodnih rezultata izvršena je primenom softvera LINDO 6.1, što je prikazano na Slikama 4 i 5.



Slika 4. Rezultati primene Lindo programa za SZTR ”XXX”



Slika 5. Rezultati primene Lindo programa za potencijalne kupce SZTR ”XXX”

Tumačenje rezultata Lindo programa za SZTR “XXX”:

$z_0 = 0{,}06363636$

$V = 1/z_0 = 1/0{,}06363636 = 15{,}71$

$Y_1 = 0{,}009091$; pa je $p_1 = Y_1 \cdot V = 0{,}009091 \cdot 15{,}71 = 0{,}2857 = 14{,}29\ \%$

$Y_2 = 0{,}045455$; pa je $p_2 = Y_2 \cdot V = 0{,}045455 \cdot 15{,}71 = 85{,}71\ \%$

Na sličan način se tumače rezultati za potencijalne kupce SZTR “XXX”:

$g_0 = 0{,}06363636$

$V = 1/g_0 = 1/0{,}06363636 = 15{,}71$

$X_1 = 0{,}018182$; pa je $q_1 = X_1 \cdot V = 0{,}018182 \cdot 15{,}71 = 0{,}1429 = 28{,}57\ \%$

$X_2 = 0{,}054545$; pa je $q_2 = X_2 \cdot V = 0{,}054545 \cdot 15{,}71 = 0{,}7143 = 71{,}43\ \%$

4. DISKUSIJA REZULTATA

Imajući u vidu sve prethodne rezultate, odnosno rezultate dobijene direktnom primenom formula, grafičkom metodom i primenom LINDO softvera, zaključujemo da su svi rezultati identični. To potvrđuje sledeće:

P* je optimalna mešovita strategija SZTR "XXX" i to: P*(1/7;6/7), što znači da postoji 14,29 % verovatnoće da će SZTR "XXX" proizvoditi orman i 85,71 % verovatnoće da će proizvoditi vitrine

Q* je optimalna mešovita strategija potencijalnih kupaca i to: Q*(2/7;5/7), što znači da postoji 28,57 % verovatnoće da će fizičko lice kupiti nameštaj SZTR "XXX" i 71,43 % verovatnoće da će pravno lice obaviti kupovinu kod istog SZTR

Takođe, proračunata vrednost V = 15,71 n.j.koja je dobijena svim metodama, nalazi se u opsegu $15 \leq V \leq 16$, čime je još jednom potvrđena ispravnost dobijenih rezultata.

5. ZAKLJUČAK

Teorija igara, kao i mešovite matrične igre imaju primenu u svakodnevnom životu. U ovom radu kao primer primene prikazan je deo prodajnog asortimana jedne radnje u zavisnosti od vrste potencijalnih kupaca. Dobijene vrednosti optimalnih strategija putem analitičkog i grafičkog metoda identične su, kao i putem Lindo programa. Identičnost rezultata govori u prilog tačnosti modela.

Dobijena vrednost igre predstavlja prodajnu cenu proizvoda iz odabranog asortimana radnje, ali istovremeno i kupovnu cenu. Na taj način, korišćenjem mešovitih matričnih igara može se pomoći kako u odabiru određenog proizvoda sa stanovišta kupaca, tako i ukazivanjem na možda ciljanu proizvodnju samog proizvođača.

APPLICATION DIRECT METHODS FOR SOLVING MIXED MATRIX GAMES ON THE EXAMPLE OF AN SZTR

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Abstract

This paper demonstrates the application of direct methods for solving mixed matrix games through the example of an independent trading shop. The optimal strategies of players in the game and the value of the game were obtained using analytical and graphical methods, with validation of results using the Lindo v.6.1 software package. By solving the problem, it was concluded that the optimal strategies of players are P* = (14.29%, 85.71%) and Q* = (28.57%, 71.43%), with the value of the game being V=15.71 (expressed in thousands of RSD). The value of the game represents the highest selling price and simultaneously the lowest purchase price of products from the selected range. By applying these methods, the performance of companies can be improved by focusing on specific types of sought-after products.

Ključne reči: *game theory, mixed matrix games, analytical method, graphical method, Lindo*

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