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Students symposium on strategic management

## THE ROLE AND SIGNIFICANCE OF SMART SOLUTIONS IN THE DEVELOPMENT OF REGIONS THE PERSPECTIVE OF LJUBLJANA AS A SMART CITY

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**Abstract**: This paper shows the role of strategic management in practice by stimulating the development of a smart region, focusing on the capital city of Slovenia, Ljubljana, as a case study. It describes an area of a town, its position, and how smart development there uses innovative technologies, sustainable practices, and citizen participation to improve the quality of life and protect the environment in a particular region. Through a comprehensive analysis of Ljubljana's current status within the strategic management of places framework, with all the challenges and policy recommendations, this paper provides insights into how strategic governance can contribute to achieving smart development goals that last. Thus, integrating theoretical frameworks and practical analysis highlights the importance of a coordinated approach to implementing smart solutions in urban environments.

Keywords: development, smart city, sustainable practices, innovative technologies.

#### 1. INTRODUCTION

Today, demographic changes are increasingly present, there is a great influence of economic and social globalization that lead to a change in the environment. It is challenging to regulate all these factors, especially when it comes to new and innovative solutions and technological innovations. So, all this is reflected in their social, economic, and environmental development. The concept that plays a key role here is smart development, which is what this paper will focus on, based on the example of the city of Ljubljana. In addition to adapting to challenges, this refers to the use of digital technology, new means of transport, and optimization of urban infrastructure as a long-term goal to create a better and healthier standard of living and attract tourists. In the context of regions, strategic management enables leaders to identify key available resources like natural assets, knowledge, labor or

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infrastructure, opportunities for growth, and ways to face potential challenges, integrating smart technologies into the daily life of cities (Okonta & Vukovic, 2024).

It is important to understand and learn by writing this paper how strategic management can contribute to the modernization and improvement of the urban environment and quality of life. After the analysis, it is crucial to show technological solutions and innovations, and to see how cities can adapt to the dynamics of change but maintain sustainability and the well-being of the inhabitants. The introduction of this paper is stating the objectives of the work research. The analysis and explanation of the theory will focus on understanding how strategic management contributes to the successful implementation of smart solutions, with the main emphasis on the case of Ljubljana. Challenges, problems and possible improvements will be explored in detail to provide concrete recommendations for improving existing initiatives and policies. SWOT analysis is provided as well. After, there are limitations listed and explained. In conclusion, the key findings will be summarized and directions for future development will be proposed, emphasizing the importance of integrating strategic management and smart technologies in urban development planning. Also, ideas for possible future research will be presented. This work aims to be a new resource with offering a deeper insight into the possibilities and challenges following the transformation of Ljubljana into a smart city, and how efficient management can facilitate this process and to what extent.

#### 2. SMART REGION DEVELOPMENT OF LJUBLJANA

#### 2.1. Strategic tools for shaping smart urban futures

The development of the city of Ljubljana literally uses the digital infrastructure, the engagement of citizens is present and green technologies are being adopted and are widely supported. Everything is aligned with the European Green Deal and the United Nations Sustainable Development Goals. All this helps the progress of the city and constant adaptation to trends, which is not always easy. This is why proper strategic management is required where technological innovation is equally balanced with the well-being of residents and the environment.

Strategic management of this city requires a holistic approach, which means integrating various elements that are one of the key factors in the development of a smart city. The strategic management of places framework is used for this. The model emphasizes key aspects such as the environment, sustainable development, mobility, economic stability and resources (Enel, 2024). Precisely in the area of Ljubljana, this means building a connected urban environment where digital infrastructure always supports information and communication technologies and urban planning. For example, Ljubljana is the greenest country in the Balkans, has the best water and air, and the best standard of living, all of which are shown by quantitative indicators such as the air quality index, but also qualitative assessments, where citizens' satisfaction is one example. All these initiatives, such as air quality monitoring or platforms where citizens' feedback and statistics can be obtained, as well as sustainable transport options that I see every day in the city, such as e-bikes or e-scooters, show the city's response to the inclusion of these strategic elements in the urban infrastructure. Also, to note that the city has implemented smart lighting.

Therefore, strategic management in Ljubljana follows a dynamic process similar to the generic strategic management framework. In this case, in the first phase, analysis focuses on understanding the current state of the city, with tools such as strengths, weaknesses, opportunities, and threats analysis helping to identify key factors influencing the city's

development. The planning phase aligns Ljubljana's development goals with international goals, such as those set by the European Union and the Sustainable development goals, too. This covers initiatives such as the Ljubljana Smart City project, focusing on sectors such as emobility and waste management, which are also key (Puttkamer, 2024). After planning, when it comes to control, this is achieved by always monitoring progress in a timely manner and using effective strategies based on feedback and current technological capabilities. In addition to the above, there are important policy recommendations that would further improve the strategic management of the smart region. One of the key proposals here is the improvement and way of using SWOT analysis (Figure 1), because strategic goals should be regularly updated, because it is an automatic response to developments in the environment and the world and to the development of social needs. In addition, the city should focus on strengthening partnerships with technology companies and other cities and countries in the region for the sake of exchanging experience, knowledge and future potential cooperation and projects. When it comes to networks and 5G connectivity, expansion is needed to improve digital literacy programs and by introducing new smart applications, for example tourism, so that Ljubliana continues its upward trajectory towards sustainability, efficiency and a smart city perfect for living and progressing.



Figure 1. SWOT analysis Source: Own design

This SWOT analysis for Ljubljana shows some of the factors that directly and indirectly affect the development of a smart city. On the positive side, the city's strengths when it comes to green infrastructure, high-tech progress, funding from the European Union and active involvement of citizens provide an appropriate first step and support towards smart initiatives. Citizens, whether they are in office or not, are a large part of the vote for change, that's why the human dimension will be further analyzed in part 2.4. On the other hand, there are weaknesses in the lack of system integration and infrastructural pressures creating a small hole in the road or a bigger step that must be overcome for the sake of the ultimate goals. At the same time, with the great interest of tourists for Ljubljana and Slovenia in general, so, the tourist potential, the initiatives of the European Union, but also partnerships from the private

sector, a valuable and consistent path to innovation is offered for subsequent constant growth and improvement. However, several threats must be taken to account such as high dependence on external financing, global warming and possible security risks. Such changes can be made with adaptive strategies and careful detailed planning of the next steps. The best solution is to focus on strengths, use them as policy recommendations, address or minimize weaknesses, and mitigate threats by taking advantage of opportunities. The goals and the way of achieving them seem rational and quite ambitious, Ljubljana can achieve the balance of the above with the right strategic management and cooperation. In this way, a balance can be achieved between sustainable development, technological progress and engagement of citizens.

#### 2.2. Description of a region

In the context of Ljubljana's development as a smart region, understanding the factors of production is essential. These factors like land, labor, capital, and entrepreneurial activities are fundamental for driving a technologically advanced and successful smart city (Bukhari et al., 2024). This part of the paper explores how the capital of Slovenia is leveraging these factors on its path to becoming one of Europe's leading smart and green cities. It is located in central Slovenia, where it enjoys a strategic position along the Ljubljanica River, surrounded by green landscapes. These geographical features offer significant advantages in creating a smart urban ecosystem. The city's compact size allows for efficient land use, making it an ideal location for implementing integrated smart infrastructures with easier access to every area of the country. Its green spaces, such as many parks, with mountains, are incorporated into urban planning to enhance biodiversity, improve air quality, and provide recreational areas for residents and tourists. The river is especially mentioned since it is a central element in urban and natural development, contributing to the city's environmental sustainability goals and strengths. It is giving Ljubljana a sign of more commitment to environmental sustainability and makes wider smart development targets with water resource management. When it comes to factors of production, a skilled and adaptable workforce is crucial for the transition to a smart city boosting the local economy where Ljubljana benefits from Slovenia's strong educational system as well. The country has a rich tradition of education, skills and admirable knowledge as a part of their human capital with a prominent research community. Ljubljana focuses on promoting digital literacy and technological innovation, preparing a workforce to be ready to handle new technologies and advancements. Local initiatives aimed at enhancing digital skills across all age groups, especially young people, combined with a network of higher education institutions such as the University of Ljubljana I am attending, which provide a foundation for the city's expanding knowledge economy or more precisely economic value. Moreover, the city emphasizes participatory governance in smart city projects, including as many citizens as possible, fostering community involvement, and drawing on a diverse exponential path of ideas and skills to optimize human capital for innovation. Capital investment plays a critical role in supporting Ljubljana's smart city initiatives where most funding comes from various sources, including the European Union, public-private partnerships, and Slovenia's state budget (The Making of a Smart City: Best Practices across Europe, n.d.). These investments facilitate the development of essential digital infrastructure and urban mobility solutions. For instance, Ljubljana has implemented bike-sharing programs, electric vehicle charging stations in every part of the city and the usage is simple, as well as smart traffic management systems, all contributing to the city's transition to a low-carbon sustainable economy. Efficient management of these resources are key to sustaining growth and ensuring that technological advancements create a smart ecosystem that benefits both residents and visitors, but those tangible resources like capital

are not only way to success since it together depends on a culture of collaboration and shared vision.

The integration of factors like efficient land use, a skilled and engaged workforce, strategic capital investments, and a thriving entrepreneurial ecosystem the city has, it is fundamental to Ljubljana's success as a smart region. This strategic approach not only enhances its economic and regional competitiveness but also sets some kind of benchmark for other cities in the region. Ljubljana's commitment to creating a well-integrated and smart urban environment ensures its ongoing transformation into one of the leading and great smart cities in the region. Thus, with its unique geographical location, focus on education and digital skills, smart investments, and support for entrepreneurship, Ljubljana serves as an example of how cities can support their production factors to build a sustainable, innovative, and resilient smart region. Hence, as Slovenia's capital, Ljubljana is positioning itself as a leader in smart urban development, covering the perfect way for a future that combines technological advancement with environmental responsibility and citizen engagement answering to new trends.

#### **2.3.** Insights and analysis of smart region strategies

Ljubljana's spatial and organizational dimensions are key to its journey towards becoming a smart region. Ljubljana effectively leverages its unique spatial characteristics by integrating smart technologies into its urban landscape, increasing efficiency and fostering vibrant community engagement. Strategically placing green spaces near populated areas achieves two key goals reducing the urban heat island effect and supporting biodiversity (Marando et al., 2022). This approach reflects Ljubljana's commitment to building a sustainable urban environment while constantly improving the quality of life of its residents. The city's flexible organizational structure enables fast decision-making, which is essential for the timely and efficient implementation of smart city projects and optimization processes. By combining thoughtful urban planning with organizational agility, Ljubljana stands out as a leading example of how cities can leverage these elements to develop a successful smart region. Ljubljana stands out as a city that seamlessly combines spatial planning with smart technology to foster sustainability and innovation all the time. The city does have its rich cultural heritage while integrating modern technologies. For example, what we hear while living there is that air quality sensors have been installed throughout the historic city center, which not only ensures the preservation of the city but also ensures that Ljubljana's growth and modernization are in line with its historical identity. A key factor in this development is the active participation of citizens, who are involved in city projects through participatory digital platforms. These platforms foster democracy and provide a space for residents to have their say, creating a strong sense of community.

Smart green spaces further enhance the sustainability of Ljubljana's urban areas. These initiatives not only improve the city's ecological footprint but also provide added value to its residents by offering innovative solutions to traditional urban challenges (Azizi & Noureddine Kouddane, 2024). In addition, the integration of smart public transport systems reduces traffic congestion and lowers  $CO_2$  emissions, perceived as green travel option aligning with the city's environmental goals.

A further contribution to Ljubljana's sustainable development is seen in digital platforms that optimize waste management where they ensure a more efficient allocation of resources, which reduces operational costs and contributes to the city's environmental sustainability. Ljubljana's organizational quickness allows it to adapt easily in real time in response to global trends and local needs, ensuring that the city remains at the leader of smart

development and better and better on national and international level. This holistic approach, which integrates spatial, technological, social and environmental considerations, has created a truly sustainable and innovative smart region and Ljubljana's success with all that offers a replicable model for other urban environments that want to embrace smart city principles (*Complete Guide to Smart Cities: Definition, Innovations & Future* | *Regional Hero*, 2024). By successfully merging nature with technology and involving citizens as active participants, Ljubljana is demonstrating how effective spatial and organizational planning can shape a more sustainable and innovative future.

#### 2.4. Human dimension

The human dimension of the Ljubljana smart city initiative is specially mentioned since it emphasizes an inclusive, community-led approach. This dimension is the most important of the four key dimensions, spatial, organizational, technological and human, as it ensures advances within a smart city serve the people who live there. With recognition that technology alone cannot completely define a smart city, Ljubljana places great importance on human capital, so, the skills, knowledge and engagement of its citizens seeking for improvements. The human dimension is crucial because it connects technological, spatial and organizational strategies, ensuring that these innovations are not only effectively implemented but also embraced by the community (Attaran et al., 2020). Moreover, the inclusion of citizen feedback mechanisms in planning processes underscores the city's commitment to participatory governance, ensuring that all voices are heard, more ideas and comments made in shaping the city's future. That is important, because by fostering digitally literate, engaged citizens, Ljubljana not only increases the effectiveness of its smart initiatives, but also ensures that they are sustainably rooted in the wants, needs and hope of the community.

By far, Ljubljana stands out as an example of a city that puts the human dimension at the heart of its smart initiatives, emphasizing an inclusive, community-focused approach. Programs such as free digital literacy workshops enable older citizens to use technology more easily and access public services, reducing the digital divide between generations and promoting equality. Participatory budgeting through digital platforms strengthens democracy by allowing citizens from all social groups to propose and vote for projects that reflect their real needs. Inclusivity is also visible through apps for people with disabilities, which provide essential information on the accessibility of infrastructure and events, ensuring that technology serves all members. Events such as the Smart city open days create opportunities for all citizens to engage in a dialogue about urban innovation, allowing them to express their opinions and concerns which is important for perceiving challenges and new ideas for improvement.

While these efforts are admirable, additional education on digital safety, combining digital and analogue methods of participation, and encouraging greater collaboration with non-governmental organizations could further improve the inclusiveness and sustainability of these initiatives. By ensuring that every citizen, regardless of age, background, job, or ability, can participate in and benefit from Ljubljana's smart city initiatives, the human dimension ensures that the city's transformation is not only technologically advanced, but also socially cohesive and deeply connected to the needs of the community which shows how human dimension plays a big role in region and smart region development.

#### **3. PROBLEM SOLUTION**

#### 3.1. Policy recommendations and justifications

Ljubljana can further empower its population by introducing tailored education programs that address the diverse needs of various age groups and especially children and minors and professional backgrounds also. For example, beyond basic workshops on using digital tools, the city could offer advanced education courses in primary and secondary schools on cybersecurity, digital identity management, and the ethical use of technology in daily life. Special focus should be placed on older citizens and professionals in traditional industries who may feel excluded from technological advancements. Through targeted initiatives like personalized training sessions and free digital resources, the city can bridge the digital divide and ensure broader participation in smart city initiatives. Enhancing digital literacy is not only an objective but a means to foster greater civic engagement and long-term sustainability. For example, interactive city hall meetings could gather feedback on the design of public spaces, while digital platforms could allow citizens to propose and vote on specific smart initiatives. This not only increases the relevance of smart city projects, but also fosters a sense of ownership and trust among the community.

Public-private partnerships offer a practical solution by mobilizing additional funding and accelerating the adoption of innovative solutions (Mohammed et al., 2023). Collaborating with private sector stakeholders allows Ljubljana to implement projects such as smart energy grids, renewable energy installations, and expanded e-mobility infrastructure. For instance, partnerships with renewable energy companies could support the establishment of community solar projects, reducing energy costs and lowering carbon emissions and other harmful particles in the air. Similarly, working with electric vehicle, electric bicycle, electric scooter manufacturers could expand the city's charging station network, promoting clean and sustainable urban transportation. Regulatory frameworks must ensure equitable distribution of benefits throughout the city area in accordance with the number of inhabitants, the traffic density and the size of area and prevent the exclusion of underserved area from these transformative initiatives.

Solutions that fail to align with citizens' needs often lack effectiveness and public support. Participatory planning empowers citizens as individuals to directly influence the design of urban spaces and decision-making processes itself. Ljubljana can adopt innovative approaches such as digital platforms for proposals and voting, interactive workshops, and public forums to ensure the greatest possible participation of citizens and inclusive engagement. An example of this approach could involve regular events at city hall, where residents can share their opinions on urban priorities, such as green space development, public transport routes, or new digital services. Digital platforms could enable citizens to propose and evaluate smart initiatives, enhancing transparency and trust between the public and local authorities. It is crucial to ensure these activities are inclusive, reaching marginalized groups such as the elderly, low-income households, and those without internet access. This guarantees fair participation and urban development that reflects the needs of all social and economic segments.

#### 3.2. Limitations

While the proposed policy recommendations are both strategic and focused, their implementation is not without significant challenges. Addressing these obstacles requires a

nuanced and flexible approach in interplay between financial, technological, and social dimensions in smart city development. Despite opportunities for EU funding and publicprivate partnerships, achieving a balance between fiscal responsibility and ambitious urban development goals remains a persistent challenge. For instance, large-scale projects such as deploying renewable energy networks or modernizing digital infrastructure often require phased implementation to spread costs over time. While this approach can ease financial pressure, it may also delay the tangible benefits of these initiatives, potentially dampening public support. To mitigate these risks, Ljubljana could adopt innovative financing mechanisms, such as Green bonds and Environmental impact bonds pay for performancebased contracts, to ensure steady progress while maintaining fiscal discipline. As Ljubljana continues to integrate advanced technologies and invests in the infrastructure of the city core, the challenges of technological adaptation and cybersecurity are becoming increasingly pressing. Smart systems, ranging from traffic management to data-driven urban planning, present potential vulnerabilities to cyberattacks. Ensuring data protection frameworks and continuously investing in state-of-the-art cybersecurity measures are critical to safeguarding citizens' privacy and maintaining public trust (Admass et al., 2024). Also, combining traditional town hall meetings with interactive digital platforms can ensure broader participation and diverse perspectives in urban planning. Ljubljana's journey toward becoming a smart region represents the delicate balance between leveraging spatial and human dimensions while addressing practical constraints. Adaptive policymaking is crucial to ensuring that progress aligns with the city's vision and the evolving needs of its residents. By embracing thoughtful strategies such as phased investments, increased cybersecurity measures, and innovative public engagement methods, Ljubljana can serve as a level for sustainable, inclusive, and efficient urban development. This approach not only enhances the city's resilience and innovation capacity but also strengthens its role as a model for other urban centers striving to achieve similar goals.

#### 4. CONCLUSION

This paper emphasizes the critical importance of strategic governance in Ljubljana transformation into a smart region, showcasing how thoughtful planning and innovative policies can address contemporary urban challenges. By analyzing existing strategies, identifying key success factors, and presenting actionable recommendations, the discussion not only highlights Ljubljana strengths but also provides a roadmap for overcoming challenges and leveraging opportunities. A strategic, multidimensional approach is essential for fostering collaboration among diverse stakeholders, including government institutions, private sector partners, academic communities, and citizens. Such collaboration ensures sustainable and inclusive urban development, where technological progress is balanced with people-centered policies. The paper underscores the key role of SWOT analysis in understanding Ljubljana capacities and potential.

Simultaneously, addressing weaknesses and threats, such as financial constraints and technological risks, lays the groundwork for strategies that mitigate negative impacts while maximizing resilience. Future research could benefit from comparative analyses with other European smart cities, such as Vienna or Copenhagen, to identify transferable best practices and innovative solutions tailored to Ljubljana's specific context. Additionally, examining the long-term effects of implemented strategies and their scalability in other medium-sized cities could provide valuable insights for broader applications.

Through this analysis, Ljubljana emerges as an inspiring example for cities striving to align

sustainability, technological advancement, and community well-being in their urban development programs. Its experience offers not only valuable lessons but also a vision of a future where cities are empowered to meet the needs of their citizens while ensuring long-term sustainability and inclusiveness.

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## THE IMPACT OF INTERNATIONAL ORGANIZATIONS AND INSTITUTIONS ON DEVELOPING COUNTRIES

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**Abstract**: This paper aims to examine the role of key international organizations and institutions on economic and social areas of developing markets, mainly focusing on their strategic impact on 3 post-Soviet states: Moldova, Ukraine and Georgia. Through a theoretical and comparative approach, will be assessed how each IO, by their financial support, policy recommendations, technical expertise and institutional assistance, has catalyzed the economic flourishment and social progress of the developing countries. By analyzing these countries, the research identifies the international organizations' influence in the Eastern Europe region, highlighting the success and challenges met in promoting international cooperation for sustainable economic flourishment in developing countries.

**Keywords**: international organization, developing countries, financial assistance, expertise, cooperation.

### 1. INTRODUCTION

In today's vibrant global landscape, international organizations (IOs) experience a crucial role in shaping international norms and collaborative relationships among the states and their governments, addressing issues that go beyond the national borders and promote collective solutions at a global or regional level. In the post-World War II, their impact expanded a lot, due to their primarily focus on facilitating intergovernmental cooperation to shape economic, political and social stability. Generally, international organizations draw membership between three and more states, being held together by a formal agreement and serving useful, varied purposes for individual member countries (Mingst, 1999).

The initial focuses of International Organizations (such as United Nations or and the Bretton Woods Institutions (News, 2019) on post-war reconstruction, preventing future conflicts and setting a wider interconnected world. Over time, many more international organizations and institutions emerged, focusing on various global issues and ways to mitigate them. These issues include trade relations (World Trade Organization), economic

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growth (OECD), security and cooperation (OSCE), human rights, etc. This growth in number of organizations shows that countries realized that global problems are interconnected and can't be solved by individual nations alone. International organizations are universal or regional in their scope, representing groups of countries or institutions that share similar objectives, values, cultures.

The rapid spread of globalization has further increased the role of IOs. As investment, trade flows and migration rose above national boundaries, the necessity of setting regulatory standards, coordinating policies and resolving disputes increased a lot. In addition, they play an important role to foster economic integration, promote economic and social development and address problems such as financial crisis, climate changes and pandemic situations. More particularly, IOs are significant 'stakeholders' of developing countries because of the financial support, technical help, policy recommendations for institutional reforms and economic thrive. As a result, this intervention is significant in helping developing economies to easier integrate into the global economic system, to attract foreign direct investment and, overall, to improve the living standards of population.

Although, the efficiency and impact of international organizations and institutions is often doubted. Some critics argue that IOs can be dominated by the interests of the most powerful countries, usually no taking into the consideration the developing countries needs and desires. In this framework, the American Noam Chomsky, a well-known critic of power structures, often analyses how IOs can serve the interests of big powers in spite of promotive development and global justice (Barsamian, 1993).

Thus, by analysing both sides could be better understood the general overview of international organizations' impact on the global relations and especially, on the developing countries. Subsequently, this paper spotlights the strategic impact of key international organizations and institutions such as United Nations, World Trade Organization, Bretton Woods Institutions (World Bank and International Monetary Fund), Organization for Economic Co-operation and Development, etc., focusing on the experience of Moldova, Ukraine and Georgia.

# 2. STRATEGIC ROLE OF INTERNATIONAL ORGANIZATIONS FOR THE DEVELOPING COUNTRIES

According to the World Economic Database of the International Monetary Fund (Database, 2023), a developing country is a sovereign state with a not very developed industrial base and a lower Human Development Index comparing to the developed countries.

The most important criteria that are taken into consideration by World Economic Database of the IMF to divide states into advanced economies and emerging markets and developing economies are:

- Income level per capita;
- Export diversification;
- Degree of integration into the global financial system.

In the context of the first indicator, it has registered the value of 13.9 thousand U.S. Dollars per capita for the entire world in 2024. However, for the group of Advanced Economies, the indicator shows a value of 59 thousand USD, around 4 times larger than the average one, but for the Emerging market and developing economies there is registered a value of 6.65 thousand USD, that is around 9 times smaller in comparison to the Advanced Economies group (Fund, 2023).

Another key criterion used by the International Monetary Fund (IMF) when classifying countries as developed or emerging and developing markets is regarding the

export diversification. Developed countries often have a diverse and sophisticated portfolio of exports, including high-value manufactured commodities and technological services, making them less sensitive to external shocks. Emerging and developing economies, on the other hand, frequently rely on a small number of exports, such as raw resources or agricultural products, leaving them vulnerable to price swings and global demand shifts. A greater degree of export diversification is often associated with economic stability, resilience, and long-term development, separating industrialized, developed countries from less advanced ones.

Moreover, the degree of integration into the global financial system is also important for the IMF's classification. Typically, developed economies have highly integrated financial systems, with powerful connections to global. Emerging markets and developing economies, vice versa, have less developed financial systems with more limited access to global capital (Database, 2023)

Currently, there are 152 developing countries and emerging markets with a population of about 6.90 billion that represents around 85% of the world population - a considerable proportion of the global inhabitants. In this case, the support for these countries is undeniably important, in order to integrate more in the global market and to attain an economic growth for assuring a qualitative life for their citizens.

As a result, international organizations have a vital key role in supporting developing countries by providing financial aid, technical expertise, and policy guidance. Institutions like the United Nations, World Bank, World Trade Organization, International Monetary Fund, Organization for Economic Co-operation and Development etc. help address challenges such as poverty, economic instability, and infrastructure development. They offer resources and facilitate the dialogue between nations, and in this way, these organizations contribute to the stability and progress of developing economies, helping them integrate into the global system.

The United Nations, that is one of the world's most important international organizations founded after World War II in 1945, has today 193 member states. According to the United Nations Charter, the UN has the mission to ensure "world peace", "respect for human rights", "international cooperation" and "respect for international law". The UN is an active participant in global development, supporting developed countries in various ways, but certainly also emerging and developing countries (Nations).

Eredicate poverty	ty Emprove health and education Adress economic growth & decent work		Promote sustainable development
<ul> <li>Lift people out of extreme poverty, improve food security, insure access to basic necessities like clean water and sanitation.</li> <li>SDG 1 - Poverty and SDG 2 - Zero Hunger.</li> </ul>	<ul> <li>Access to quality healthcare and education, improve health outcomes, combat diseases.</li> <li>SDG 3 - Good Health and Well-being and SDG 4 - Quality Education.</li> </ul>	<ul> <li>Productive employment, decent work, promoting investment, trade, and entrepreneurship, as well as protecting workers' rights.</li> <li>SDG 8 - Decent Work and Economic Growth</li> </ul>	<ul> <li>Assuring the needs of the present without compromising the ability of future generations to meet their own needs.</li> <li>Economic growth, social progress, environmental protection</li> </ul>

Figure 1. Core objectives of United Nations to developing countries (Nations, The 17 Goals)

The main core objectives of the UN for developing and emerging economies, as depicted in Figure 1, focus on poverty eradication, improved health and education, addressing economic growth and decent work, and promoting sustainable development, ultimately aiming to enhance living standards and foster self-reliance.

One of the UN's agencies with a major impact on developing countries is the United Nations Development Program that has the main task to help countries in eliminating poverty and achieve sustainable economic growth and human development. The UNDP emphasizes on developing local capacity towards long-term self-sufficiency and prosperity in more than 170 territories. Also, it connects countries with the knowledge, resources and networks they need to achieve development innovation (UNDP). In this context, UNDP is supporting developing countries to align their budgets and development assistance to the energy needs of the poor, as well as to mobilize financing to transition to cleaner energy systems using resources such as the Global Environment Facility and ODA (Nations, United Nations Development Programme).

Another important international organization with a strategic impact on developing economies is World Trade Organization that regulates global trade and ensures that it works as smoothly, fairly, and freely as possible. In 1995, the current WTO replaced the General Agreement on Tariffs and Trade and since august 2024 has 166 member countries. The WTO represents a platform for trade negotiations, enforcement of trade agreements and of course dispute solving. It helps countries and regions reduce trade barriers between then, promotes fair competition, and supports economic development, especially in developing countries and emerging markets. Additionally, the WTO organization monitors national trade policies and offers technical assistance to member states when it is necessary (WTO)

Around 110 countries of WTO are currently developing economies. So, they have an important and active role in this organization because they become more and more important on the global economic arena and they increasingly look for trading to develop their economies. As a result, WTO agreements contain special provisions on developing countries and "special and differential treatments" such as:

- extra time for developing countries to fulfill their commitments;

- provisions designed to increase developing countries' trading opportunities through greater market access (e.g. in textiles, services etc.);

- provisions requiring WTO members to safeguard the interests of developing countries when adopting some domestic or international measures (e.g. in anti-dumping);

- provisions for various means of helping developing countries (e.g. to deal with commitments on animal and plant health standards, technical standards, or in strengthening the telecommunications sectors) (WTO, Developing Countries).

Consequently, on both goods and services trade, WTO offer facilities to the developing countries mentioned in the Enabling Clause for developing countries (goods) and in the General Agreement on Trade in Services (services). Under the GSP, developed countries offer non-reciprocal preferential treatment (such as zero or low duties on imports) to products originating in developing countries. Also, article XII of GATS allows developing countries (WTO, Special and differential treatment provisions).

The developing economies are, as well, important protagonists on the International Monetary Fund and World Bank's arena, that, as organizations, have the aim to look after the financial and monetary system and oversee the policies of its member states (IMF). IMF provides aids and loans as strategic tools for economic development in developing countries (as it is spotlighted in Table 1), by providing grants and "below-market interest rates" loans in order to finance development projects in sectors such as education, agriculture, infrastructure, and healthcare. Thus, through the Poverty Reduction and Growth Trust, developing countries has three lending facilities:

- Extended credit facility;
- Standby credit facility;

- Rapid credit facility (David Vines, 2009).

20	)22	20	23	2024		2025	
Country	Value, \$m						
Argentina	42208	Argentina	46042	Argentina	42877	Argentina	40856
Egypt	17590	Egypt	18052	Egypt	14895	Ukraine	14589
Ukraine	9376	Ukraine	12162	Ukraine	11979	Egypt	10737
Pakistan	7853	Ecuador	8201	Pakistan	7723	Ecuador	8659
Ecuador	7223	Pakistan	7487	Ecuador	7699	Pakistan	8309

*Table 1.* Top 5 debtors of International Monetary Fund, 2022-2025 (Intelligence, 2025)

The World Bank main part, The International Bank for Reconstruction and Development, provides loans to developing countries (as could be depicted in Figure 2) showing the biggest increase in stock of World Bank debt between 2010 and 2022. This graph shows the increase in World Bank debt by country, measured in millions of dollars for a period of 12 years. Nigeria has experienced the largest increase, with debt that goes above \$10,000 million, while other countries, such as Jordan, Iraq, and Ecuador show a smaller increase. The data, sourced from the World Bank's debt statistics, highlights the big reliance of nations on World Bank financing over this period.



Figure 2. Increases in stock of World Bank by country, 2010-2022, \$mm (WorldBank, 2024)

To sum up, the World Bank and the International Monetary Fund play important, key roles in supporting developing economies. The IMF works for stabilizing the global monetary system and providing financial support during crises, while the WB focuses on long-term economic development through policy advice and financing. Together, the international organizations and institutions focus to reduce poverty, promote growth, and integrate the developing countries in the global market.

# **3. COMPARATIVE ANALYSIS OF THE IMPACT OF INTERNATIONAL ORGANIZATIONS ON MOLDOVA, UKRAINE AND GEORGIA**

Studying the role of international organizations and institutions for Moldova, Ukraine, and Georgia shows a complex interchange of economic and political forces. These nations, geographically positioned at a crucial crossroads, have experienced the influence from organizations such as the UN, IMF, World Bank, etc. A comparative analysis of these economies highlights how the international organizations aim to foster democratic reforms, promote economic stability, and facilitate integration with Western structures. However, the effectiveness of these efforts is also shaped by the countries' historical context, internal political situation, and external influences. Therefore, the impact of international organizations is not uniform for these 3 post-Soviet countries.

The Republic of Moldova joined the United Nations on March 2, 1992. Since then, the United Nations system supports the Republic of Moldova in achieving its major development goals and fulfilling its vision to be a prosperous and modern European country. Also, relying on its expertise in converging humanitarian, development and peace building goals, UNDP, as part of the coordinated UN response, is assisting the people and the Government of Ukraine to recover and reconstruct now, ensuring that immediate needs are linked to long-term goals. In Georgia, UN is working closely with the government, civil society, and other national and international partners, to respond to national development needs and improve the economic and social conditions of people in Georgia.

The World Trade Organization views Moldova, Ukraine, and Georgia as independent members, but the geopolitical backdrop impacts priorities and assistance. In response to Russian assault, Ukraine prioritizes trade security and supply chain resilience. Georgia, with Euro-Atlantic integration ambitions, receives assistance in harmonizing trade rules with those of the EU. Moldova, which has European aspirations, gets support to improve its ability to implement trade agreements and diversify its markets. All three nations are getting technical support to enhance their trade legislation and institutional capability. Ukraine does, however, receive greater help on conflict-related concerns such as trade restrictions and sanctions (Trade Policy Review: UKRAINE, 2025). The WTO is actively watching trade trends in the area, with a focus on the impact of the Ukrainian crisis on regional commerce.

The International Monetary Fund varies its support tools to the special needs of each nation, and there are big differences between Moldova, Ukraine, and Georgia. The IMF's mission in Ukraine is to bring stability to the economy during the conflict by providing enormous financial assistance for short-term purposes and reconstruction, as could be spotlighted in the figure 2, from which can be depicted the total of \$15.624 billion IMF loan program for Ukraine in the period of 2023-2027. The priority is maintaining public services and shielding the vulnerable.

The Republic of Moldova, facing energy insecurity and post-conflict implications, is assisted in macroeconomic stability and structural transformation. The IMF assists Moldova in facing the challenges posed by the crisis in Ukraine.



Figure 2. IMF loan program schedule for Ukraine (Ukraine's \$15 billion IMF loan program, 2024)

Since 2020, Moldova has had access to fast-start financing, including a loan of SDR (Special Drawing Rights) 172.5 million to fight the pandemic. In August 2021, Moldova received an allocation of SDR 165.3 million, which is free of charge and does not increase public debt. In December 2021, a grant of 400 million was approved for economic recovery, later increased to SDR 594.26 million in May 2022. In December 2023, a new program of SDR 129.375 million was approved to support climate resilience and energy sector reforms. By the end of 2024, total debt to the IMF was 758.9 million USD, this number resulting from the past transactions and from those expressed in Table 2.

Table 2.	IMF	financial	assistance t	o the	Republic	of	Moldova,	2019-2024	(Financial	Position	in	the
Fund)												

	Million SDR						
Year	Procureme	Commissions and					
	Disbursements	Reimbursements	interest paid				
2019	33.6	59.0	2.4				
2020	186.9	53.4	2.3				
2021	57.2	35.3	2.3				
2022	128.8	23.2	4.6				
2024	244.3	76.5	18.8				

The IMF has provided technical assistance to the Republic of Moldova in a number of sectors, including fiscal management, expenditure, tax and customs, monetary accounting system, banking supervision, monetary policy/central bank organization, and various areas of statistics. The organization's Institute has provided training to Moldovan officials in such areas as financial policies and financial program design, foreign policies, monetary and foreign exchange operations, balance of payments and public financial statistics. Moldovan officials have also participated in courses and seminars offered by the Joint Vienna Institute in such areas as central bank accounting, macroeconomic analysis and policy, public expenditure, fiscal policy administration and reform, banking supervision and various areas of statistics.

In Georgia, the IMF focuses on economic diversification and private sector development, and structural reform and business environment promotion. Accordingly, each nation receives support adapted to its individual needs and goals. The IMF's mission varies from wartime relief to structural adjustment and economic diversification. Finally, the International Monetary Fund makes a huge contribution towards the economic development and stabilization of these nations by adapting its intervention to each nation's specific case and, for a better comprehensive, in Table 3 is represented the total IMF credit outstanding as of 02/28/2025 for Moldova, Ukraine and Georgia.

Country	Value, million USD	Debt shares out the IMF total, %
Moldova	758.9	0.68
Ukraine	14589.9	13.14
Georgia	404.2	0.36

Table 3. Total IMF Credit Outstanding as of 31/01/2025 (IMF, Total IMF Credit Outstanding)

Alongside the IMF, World Bank is also providing significant strategic support for these three analyzed countries. Since 1992, the World Bank has allocated over \$2.1 billion for more than 70 operations in the Republic of Moldova, covering areas such as regulatory reform and business development, modernization of government services, tax administration, cadaster, education, roads, health, agriculture, water, sanitation, and energy.

In the summer of 2024, the World Bank approved a new \$40 million program for the Republic of Moldova aimed at increasing resilience and supporting reforms. The program will:

- provide assistance to refugees and vulnerable households in the context of the war in Ukraine;

- focus on the country's economic integration with the EU;

- increase resilience to climate change;

- will support the government's efforts to provide social assistance, including through the "Social Aid" program.

The focus will be on the employment of refugees and women, as well as on supporting families hosting refugees. It will promote energy efficiency, renewable energy and sustainable forest management.

In total, the World Bank has provided over 2.1 billion dollars to the Republic of Moldova for more than 70 operations. The country portfolio currently includes 14 active projects, with a total commitment of \$849 million, in areas such as regulatory reform and business development, modernization of government services, tax administration, land registration, education, roads, health, social sectors including COVID-19 emergency response, agriculture, water and sanitation, and energy (WorldBank, 2024).

The World Bank's strategic role in Georgia and Ukraine is to provide essential financial and advisory assistance, albeit with varying priorities. In Ukraine, the World Bank is significantly engaged in diminishing the devastating impact of the ongoing war, prioritizing efforts in reconstruction and economic stabilization. This involves massive financial mobilization for essential services, infrastructure repair, and support to vulnerable groups. The World Bank is very engaged with the RDNA, or Rapid Damage and Needs Assessment, in Ukraine. In Georgia, the World Bank has major work on long-term economic growth, poverty reduction, and institutional capacity building, as could be observed via the Figures 3 and 4. This encompasses enabling reforms in infrastructure, education, and health, promoting sustainable growth. Both countries gain from World Bank assistance for good governance and integration into the world economy. In the Ukrainian case, the need is greater for an increased focus over a longer term on development reforms is feasible. In both cases The World bank has a pivotal role to play in helping each nation towards a more stable and prosperous future.



Figure 3. Annual EBRD projects in Georgia, (EBRD)

21<sup>st</sup> Students symposium on strategic management May 2025, Bor Lake, Republic of Serbia



*Figure 4.* EBRD Investment in Georgia, €mm, (EBRD)

Comparing the role of international organizations among Georgia, Ukraine and Moldova highlights a fundamental contribution to accelerate democratic transition and deepen economic development. In each of the three countries, international organizations and institutions have provided extensive financial support and technical expertise to strengthen institutions, promote reforms and improve the quality of life. However, their impact has fluctuated according to the particular context of each country, the level of commitment of governments and geopolitical challenges. In Ukraine, support has focused heavily on resilience and reconstruction, while in Moldova and Georgia more emphasis has been placed on European integration and structural reforms. Thus, international organizations have helped and in continually helping these countries to overcome complex challenges and advance along the path of economic integration.

#### 4. CONCLUSIONS

International institutions and organizations play a key role in helping developing countries. They provide significant economic assistance, policy guidance and technical support to combat difficult problems. They combat poverty, improve economic growth and promote democratic institutions. They facilitate access to education, health and infrastructure through individual projects and programs, improving living standards by also fostering the integration of developing countries in the world's economy, leading to trade and investment. However, should be recognized that they are subject to change depending upon each nation's own specific condition as well as upon the policies of local authorities.

The comparative analysis of the role played by international institutions on Moldova, Ukraine and Georgia sets a very crucial role to determine their post-Soviet destiny. They have provided big doses of economic aid, technical assistance and policy advice to support democratic reform, economic transformation and European integration. In Ukraine, conflictresilience and reconstruction have been the focus, while Moldova and Georgia have been helped with institution building and harmonization of EU standards. Difference in intensity and nature of aid is in line with the respective issues of each nation. However, all three nations have been under intense influence by institutions such as the UN, IMF, World Bank and WTO. The influence of these organizations has been consistent, being determined by the domestic political environment, government dedication and outside geopolitical considerations. Critics refer to the danger that great power interests will prevail, but the contribution of international organizations is still vital to assist these nations in managing complexities and transition towards stability and prosperity.

Finally, global institutions have been instrumental in guiding nations to greater world integration and sustainable development.

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## EVALUATING RISK MANAGEMENT FRAMEWORKS IN MEETING REGULATORY STANDARDS: A CASE STUDY OF INFRASTRUCTURE PROJECTS IN NIGERIA

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Abstract: Objectives: The general aim of this study focuses on risk management framework and regulatory compliance of large-scale infrastructure in large scale infrastructure project in Nigeria. The specific objective is to assess how risk monitoring enhances regulatory compliance of large-scale infrastructure projects. Methodology: The study adopted a descriptive survey approach and a questionnaire as instruments for data collection using a five-point Likert scale. A calculation of sample size using the Tarro Yamane method. Out of 205 copies of the questionnaire distributed to the respondents, only 179 were filled out and returned, while the remaining 26 were not returned and used for analysis. The research hypothesis was tested and analysed using the Pearson correlation method. Findings: The findings revealed that effective risk monitoring positively influences regulatory compliance of large-scale infrastructure when the p-value (.000) was less than the critical value at a 5% level of significance. Recommendations: The study recommends that organizations should regularly develop a robust risk monitoring system that tracks potential risks throughout the entire lifecycle of the project. This framework should integrate with existing regulatory compliance requirements to ensure continuous alignment with legal and regulatory standards. Firms should conduct regular risk assessments to identify emerging risks and potential regulatory non-compliance issues. Continuous monitoring of risks allows project teams to address regulatory concerns promptly. Novelty: Research in this area enhances knowledge of best practices for identifying regulatory risks early in the project lifecycle and the best approaches for mitigating these risks. Using large scale infrastructure projects, the study contributes to the literature by providing empirical evidence to show the intersection of risk

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management and regulatory compliance in South-South Region. *Practical Implication of the Study:* By analysing large infrastructure projects, both academics and practitioners gain insights into what strategies have been successful and where improvements can be made. Study on this subject identified that lack of risk monitoring affects adversely project results leading to substantial project interruptions, cost overruns, and poor quality. *Study Limitations:* One major limitation is the lack of standardized frameworks for integrating risk management and regulatory compliance across various types of infrastructure projects.

**Keywords**: risk management framework, regulatory compliance, risk monitoring, stakeholder's theory and large infrastructure projects.

#### 1. INTRODUCTION

Effective risk management fosters better communication among project stakeholders, including regulatory bodies, contractors, and local communities. By ensuring that all parties are informed about potential regulatory risks and compliance strategies, the project team can collaborate to address concerns and find solutions. Engaging with stakeholders early on can help prevent misunderstandings and conflicts that may arise later in the project (Liu & Wang, 2021; Zhang & Xu, 2023). Risk monitoring strengthens regulatory compliance in infrastructure projects by facilitating proactive risk management, real-time updates to changing regulations, thorough documentation, improved decision-making, and effective stakeholder communication.

With these systems in place, infrastructure projects are better equipped to meet legal and regulatory requirements, reducing the risk of fines, penalties, or project delays. Ultimately, this approach helps ensure that infrastructure projects are executed efficiently, safely, and within the bounds of regulatory frameworks. The monitoring of financial risks and documentation of compliance with the Sarbanes-Oxley Act of 2002 during infrastructure financing and construction in the U.S. helps to maintain transparency and regulatory adherence (U.S. Securities and Exchange Commission, 2022). Risk monitoring is essential in large infrastructure projects like the Sydney Metro, where regular updates and communication with regulatory agencies are necessary to ensure compliance with Australian Transport and Safety Regulations (Transport for NSW, 2020).

Regulatory requirements often evolve over time, requiring ongoing monitoring in infrastructure projects. Risk management supports this by providing a framework for continuously tracking changes in regulations and ensuring the project remains compliant throughout its lifespan. Regular risk assessments and compliance audits can help identify emerging issues, such as new environmental standards or safety regulations, that could impact the project's progress (Hwang & Ng, 2020). Regulatory frameworks can evolve during the course of an infrastructure project. Risk monitoring systems can integrate real-time updates from regulatory bodies to ensure that any new or modified regulations are promptly considered in the project's risk management plan. This helps in adapting to legal changes without incurring delays or penalties (European Commission, 2021).

Furthermore, Afolabi and Abubakar (2023) investigated the impact of risk management frameworks on public infrastructure projects in Kenya. They found that successful implementation of risk management practices correlates with improved project delivery times and budget adherence. The study emphasized the need for greater stakeholder involvement in the risk management process.

Additionally, studies by Wright, Harrison, and Taylor (2023) found that continuous risk monitoring significantly improves project success rates by allowing for quicker response times to unexpected challenges in infrastructure projects. The study emphasizes that risk monitoring helps teams remain agile in responding to new risks during project execution. Schieg (2023) conducted a case study on construction projects and demonstrated that effective risk monitoring reduces the likelihood of cost overruns and delays. This study concluded that the more frequently risks are monitored and reassessed, the better the outcomes in terms of project performance.

A recent study by Johnson and Miller (2023) examined regulatory compliance in the financial services sector, particularly focusing on how banks in the United States and the European Union have adapted to stricter regulations following the 2008 financial crisis. The study highlighted how compliance frameworks, such as the Dodd-Frank Act in the United States of America and the European Market Infrastructure Regulation in the European union, have reshaped risk management practices. It found that banks with more robust compliance programs experienced fewer penalties and greater investor confidence. The research also underscored the increasing use of technology, including Reg-Tech solutions, to streamline compliance processes and reduce human error.

Additionally, recent studies by Zhang, Li, and Wang (2022 in the manufacturing industry found that compliance with regulations enhances operational processes, including the adoption of cleaner technologies and enhanced waste management systems in China. Another study by Patel and Singh (2023) focused on regulatory compliance in the healthcare sector in India and Kenya. The study found that both India and Kenya have established regulatory frameworks aimed at ensuring healthcare quality, but the degree of enforcement and the effectiveness of these frameworks differ significantly. India's regulatory framework is more structured with multiple layers of oversight, including national and state-level authorities, while Kenya's regulatory environment is more centralized, with the Ministry of Health playing a pivotal role in regulatory compliance.

#### **1.2. Statement of the Problem**

Large-scale infrastructure projects are currently considered to be vital to growth in the region, particularly in Nigeria's South-South Location. Nevertheless, even though systematic risk management is becoming important. Many procurement entities in Nigeria are unable to recognize and evaluate the risks that could affect project outcomes, which leads to vague and inadequate technical specifications. These ambiguities can cause miscommunications between stakeholders, make the project more vulnerable to unforeseen difficulties, and ultimately fail to achieve its goals. However, inadequate risk identification would have a detrimental impact on public procurement methods in Nigeria. This result in significant project delays, cost overruns, and quality degradation of large-scale infrastructure projects.

In summary, a lack of risk monitoring affects adversely project results leading to substantial project interruptions, cost overruns, and quality degradation. Again, inadequate risk monitoring procedures frequently leads to legal infractions, project delays, and higher project expenses.

#### **1.3.** Objectives of the Study

The general objective of this study is to evaluating how risk management frameworks enhance regulatory Standards of Infrastructure Projects in South-South, Nigeria.

The specific objectives seek to:

To evaluate how risk monitoring enhances regulatory compliance of large-scale infrastructure, in South-South Nigeria.

#### 1.4. Research Questions

What is the effect of risk monitoring on regulatory compliance of large-scale infrastructure in South-South Nigeria?

#### **1.5. Research Hypotheses**

The following research hypotheses were formulated to guide this study below.

HA1: Effective risk monitoring significantly enhances regulatory compliance of largescale infrastructure in South-South Nigeria.

#### 2. LITERATURE REVIEW

#### 2.1. Conceptual Review

#### 2.1.1. The Concept of Risk Management Strategies

According to Ali and Hassan (2023), risk management strategies refer to the systematic processes and approaches organizations use to recognize, assess, alleviate, and monitor risks to make sure project goals are met while minimizing harmful influences. These strategies typically include risk avoidance (eliminating activities that may lead to risk), risk transfer (shifting the risk to a third party through mechanisms like insurance or contracts), risk mitigation (implementing measures to reduce the severity or likelihood of risks), and risk acceptance (acknowledging and preparing for potential risks without taking action to prevent them).

Risk management is crucial for organizations, especially in large-scale projects, as it helps identify, assess, and mitigate potential threats that can adversely impact objectives. First, effective risk management enhances decision-making by providing a structured approach to understanding risks, enabling organizations to allocate resources more efficiently (Zhou et al., 2023). Additionally, it promotes project success by minimizing disruptions, reducing costs, and improving the likelihood of meeting deadlines (Gao & Chen, 2022). Furthermore, risk management fosters stakeholder confidence and satisfaction, as it demonstrates a commitment to proactive problem-solving and accountability (Murphy, Wang, & Patel, 2023).

#### 2.1.2. The Concept of Risk Monitoring

Risk monitoring is another component of risk management strategies. Risk monitoring is essential in the procurement of large-scale projects. Project Monitoring Institute (PMI, 2021) defined risk monitoring as the continuous process of tracking identified risks, reassessing their potential impacts, and evaluating the effectiveness of implemented risk mitigation strategies. This process ensures that new risks are identified and managed throughout the project or organizational lifecycle.

Several researchers have identified the significance of risk monitoring in various industries. Ward and Chapman (2023) posit that continuous monitoring allows organizations to stay ahead of potential risks by tracking their development in real time. It provides an early

warning system to take corrective actions before risks materialize into significant issues (Ward & Chapman, 2023). Risk monitoring helps assess whether current risk responses are effective. If a mitigation strategy is not producing the desired results, organizations can adjust their approach on time to avoid further escalation of the risk (Committee of Sponsoring Organizations of the Treadway Commission, COSO, 2023).

2.1.3. The Concept of Regulatory Compliance

Shepard (2023) defined regulatory compliance as the process by which organizations ensure that their operations, products, and services adhere to relevant laws, regulations, and guidelines set by governing bodies. Compliance is essential for avoiding legal penalties and ensuring that organizations operate within the legal framework.

Also, Miller and Davis (2022) defined regulatory compliance as a critical component of risk management within organizations. By adhering to regulations, companies mitigate risks associated with legal infractions, financial penalties, and reputational damage. Compliance frameworks are often integrated into broader corporate governance and risk management strategies.

Taylor (2022) argues that outside legal contracts, regulatory compliance can be seen as an ethical responsibility of organizations to ensure they contribute to the broader public good. This view is especially prominent in industries such as healthcare, finance, and environmental management, where non-compliance can have significant social and environmental consequences.

#### 2.2. Theoretical Framework

Stakeholder theory was developed by Edward Freeman in 1984. This theory provides a foundation for understanding the importance of considering various stakeholder interests in organizational decision-making and the need to create value for all of them. Stakeholder theory assumes that organizations have multiple stakeholders (such as employees, customers, suppliers, communities, shareholders) whose interests must be considered for construction of large infrastructure projects (Freeman, 1984).

The theory posits that the interests of stakeholders are mutually dependent, and that the success of an organization is tied to the well-being of its stakeholders. The theory assumes that businesses have ethical responsibilities towards stakeholders beyond mere profit maximization, advocating for a moral obligation to consider their interests (Post, Preston, & Sachs, 2002). Stakeholder theory assumes that a long-term perspective, which balances stakeholder interests, can lead to sustainable business practices and better overall outcomes (Harrison, Bosse & Phillips, 2010). The theory helps to foster greater trust and engagement with stakeholders, ensuring that procurement practices are open and that stakeholders understand the decision-making process. This reduces opportunities for corruption and promotes public confidence in government actions (Sullivan & Skelcher, 2002).

Stakeholder theory is relevant to this study on risk management strategies and regulatory compliance of large projects because it emphasizes the importance of considering various stakeholders' interests and accommodating all of them during procurement decisions on those groups. Applying stakeholder theory not only reduces opportunities for corruption and promotes transparency, but it also increases confidence among public agencies.

#### 2.3. Empirical Review

Different researchers have carried out studies on risk management and regulatory compliance of infrastructure within Nigeria and the rest of the world. Some of these studies generated both positive and negative findings in the literature. Some of the articles reviewed are stated below.

2.3.1 Influence of risk monitoring on regulatory compliance of large-scale infrastructure

Testa, Iraldo, and Frey (2023) investigated the implementation of green procurement (GPP) policies in public construction projects across European countries such as; Italy, Germany, and Sweden. The hypotheses were tested statistically using econometric analysis. The findings showed that the dimension of public authorities and the level of awareness of the existing tools for supporting GPP have a positive and significant effect on the probability that they adopt GPP practices.

A recent study by Johnson and Miller (2023) examined regulatory compliance in the financial services sector, particularly in the United States and the European Union. The study administer survey to 350 compliance practitioners across financial institutions worldwide, using convenience sampling technique to discusses challenges such as increasing regulatory changes, cost pressures, and staffing issues in compliance departments. The hypotheses were tested and analyzed using regression and thematic content analysis method. The study found that banks with more robust compliance programs experienced fewer penalties and greater investor confidence. The research also underscored the increasing use of technology, including RegTech solutions, to streamline compliance processes and reduce human error.

Recent studies by Zhang, Li, and Wang (2022) explored environmental regulatory compliance in the manufacturing industry in China. The research investigated how Chinese manufacturing firms have responded to stricter environmental regulations, particularly the new standards introduced in the "Green Development Action Plan. A random or stratified sampling technique was adopted in the distribution of the survey. The hypotheses were tested using econometric models to assess compliance effects on productivity and other outcomes in response to environmental regulations. The study found that compliance with these regulations led to significant changes in operational processes, including the adoption of cleaner technologies and enhanced waste management systems. However, the study also identified challenges related to cost increases and the need for government support in helping firms meet these stringent environmental requirements.

Another study by Patel and Singh (2023) focused on regulatory compliance in the healthcare sector in India and Kenya. Both quantitative and qualitative data were sourced with industry stakeholders. The data were collected using combined purposive sampling to select participants who have specific knowledge, experience on relevant subject. The findings revealed that quality standards in medical devices and pharmaceuticals, was largely influenced by ISO guidelines and WHO standards.

Pereira, Silva, and Santos (2023) also conducted a comparative study on the adoption of e-procurement systems across European Countries such as; Portugal, Spain, and Estonia. The research revealed that countries with more mature digital procurement frameworks, like Estonia, achieved higher levels of transparency, efficiency, and cost savings. The study recommended increased investment in digital technologies to modernize procurement practices across sectors, reducing bureaucracy and enhancing transparency. A recent study by Olken and Pande (2023) investigated corruption risks in public procurement processes in developing countries such as Indonesia, India, and Kenya. The research found that while anti-corruption measures such as e-procurement and transparency initiatives have reduced risks, significant challenges remain, particularly in large infrastructure contracts. The study recommended stricter enforcement of procurement regulations and better oversight mechanisms to mitigate corruption risks.

#### **3. METHODOLOGY**

The South-South region is straddled with a lot of huge infrastructure projects, cutting across land-mark projects such as the East-West Road Project, the 2<sup>nd</sup> Niger-Bridge Project, Afam Power Plant Project, Gbaran-Ubie Power Project, and a host of other related projects. This study is also focused on evaluating the technical and process-related challenges and the risks associated with the procurement of some of these large-scale infrastructure projects which were deployed as sample case studies in the current work. A section in the questionnaire was dedicated to asking participants or respondents to share their views on the key challenges that led to the delays in the projects and for some the key factors that led to the success of the projects.

Again, the method of data collection involves primary data. Questionnaire were used as instrument for data collection using five-point likert scale. The study employed a correlational survey research design to investigate the relationship between risk management and regulatory compliance of large-scale infrastructure in the South-South region, of Nigeria. The target population of this study comprised; project managers, procurement officials, construction workers and other pertinent stakeholders involved in project management across public sectors of Edo State, Rivers State, Delta State, and Cross River State. The study population of 429 procurement professionals were chosen from whom the respondents were drawn using the formula proposed by Yamane (1967).

Furthermore, the questionnaires were validated on the face and content levels to ensure that each item consist of fourteen items, structured to composed of positive and negative statements related to both variables. The choice of analytical tools was made with careful consideration of the study's specific objectives and the nature of the data collected. A pilot test was conducted using a preliminary sample of five questionnaires to identify any issues and make necessary adjustments. Techniques such as Cronbach's alpha were applied to determine the reliability of the instrument. Questionnaire was analyzed using the Pearson Correlation Method. Pearson's correlation coefficient (r) is used to measure the linear relationship between two continuous variables.

#### 4. RESULTS AND DISCUSSION

#### 4.1. Results

#### 4.1.1. Analysis of Research Question Two

What is the effect of risk monitoring on regulatory compliance of large-scale infrastructure, in South-South Nigeria? Table 1 provides an overview of the investigative questions formulated and employed in the 2024 field survey focused on risk monitoring and regulatory compliance.

S/N	Questions	SA	AG	UN	SD	DA	Total
Α.	<b>Risk Monitoring (Independent Variable)</b>						
1	My firm identifies potential issues early in large-scale infrastructure projects.	80	83	7	3	6	179
2	Proactive risk management enhances stakeholder confidence in project success.	81	82	5	8	3	179
3	Real-time risk data enhances decision-making, leading to smoother project execution.	89	83	2	4	1	179
4	Efficient procurement processes can significantly reduce costs in infrastructure projects.	82	88	4	2	3	179
5	Inadequate risk monitoring can lead to costly delays in infrastructure projects.	84	89	0	4	2	179
6	Inconsistent monitoring can create gaps in risk management, exposing the project to unforeseen issues.	82	87	3	1	6	179
7	Poor procurement planning often results in resource shortages and project setbacks.	83	86	5	2	3	179
В.	<b>Regulatory Compliance (Dependent Variable)</b>						
8	My firm maintains ethical standards when procuring items to reduce the risk of costly litigation or penalties.	78	83	9	5	4	179
9	We enforce regulations to give equal opportunity to all potential bidders.	77	86	3	8	5	179
10	A strong regulatory standard guides us to maintain accountability, ensuring contractors meet the required standards.	81	83	4	3	8	179
11	Sometimes, strict regulations can lead to delays in the procurement process and impact project outcomes.	82	85	2	6	4	179
12	Excessive regulatory requirements can increase the administrative burden on infrastructure projects.	83	81	4	2	9	179
13	Frequent regulatory changes can create confusion and hinder project planning.	84	80	7	5	3	179
14	Compliance with procurement laws reduces the likelihood of corruption or unethical practices.	81	88	6	0	4	179

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#### 4.1.2. Test of Research Hypotheses Two

 $H_{A2}$ : Effective risk monitoring significantly enhances regulatory compliance of large-scale infrastructure in South-South Nigeria.

#### 4.1.3. Decision Rule

The null hypothesis is rejected when the p-value is less than 0.05; if not the alternative hypothesis (HA) is accepted. The Table 2 below shows the results of the Pearson correlation method. The null hypothesis which states that effective risk monitoring does not significantly enhances regulatory compliance of large-scale infrastructure in South-South Nigeria was rejected when the p-value (000) was less than the critical value (0.05). On the contrary, the alternate hypothesis which states that effective risk monitoring significantly enhances regulatory compliance of large-scale infrastructure in South-South Nigeria was accepted when the p-value (000) was less that effective risk monitoring significantly enhances regulatory compliance of large-scale infrastructure in South-South Nigeria was accepted when the p-value (000) was less than the critical value (0.05). The result confirms that there exists a significant linear correlation existing between the independent and dependent variables.

tuble 2: 1 edison contentions result (61 66 Version 20)							
		RM	RC				
RM	Pearson Correlation	1	.997**				
	Sig. (2-tailed)		.000				
	Ν	179	179				
RC	Pearson Correlation	.997**	1				
	Sig. (2-tailed)	.000					
	Ν	179	179				

Table 2. Pearson Correlations Result (SPSS Version 20)

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

#### 4.2. Discussion of Findings

The general objective of this study is to investigate the influence of risk management on regulatory compliance of large-scale infrastructure Projects in South-South Nigeria. The research hypothesis one was tested and analyzed using Pearson correlations techniques. The result showed that there exists a significant positive correlation between effective risk monitoring and regulatory compliance of large-scale infrastructure in South-South Nigeria when the p-value (.000) was less than the critical value at a 5% level of significance.

This result is better interpreted that a + 1 (one) unit increase in adoption of risk monitoring measures contributes to a .997 unit increase in regulatory compliance. Therefore, a value close to R = 1 indicates a strong (positive) linear correlation existing between X (risk monitoring, RM) and Y (regulatory compliance, RC). This can be further stated that effective risk monitoring plays a crucial role in ensuring regulatory compliance. Risk monitoring allows organizations to continuously track potential threats that may arise due to changing regulations or internal processes. This result agrees with the previous work of Testa, Iraldo, and Frey (2023) which found that the adoption of green procurement practices has increased the level of compliance and integration of sustainability criteria into large infrastructure projects. The findings also agree with a previous study by Johnson and Miller (2023) which showed a correlation between compliance frameworks, such as the Dodd-Frank Act and risk management practices in the U.S. and the European Market Infrastructure Regulation (EMIR) in the EU.

#### **5. CONCLUSIONS AND RECOMMENDATIONS**

#### 5.1. Conclusions of the Study

The following conclusions can be made from the result of the study. The findings of research hypothesis one showed that a positive correlation exist between effective risk monitoring and regulatory compliance of large-scale infrastructure in South-South Nigeria. The findings revealed that effective risk monitoring and regulatory compliance are vital in managing large-scale projects. This is evident that risks are identified, mitigated and ensure that the project adheres to all relevant laws, standards, and regulations.

In conclusion, research on **risk management** and **regulatory compliance** in infrastructure projects offers significant contributions to the field, it is still limited by challenges related to standardization, long-term data, multinational projects, external influences, and access to sensitive information. Overcoming these limitations can provide a more comprehensive understanding of how best to manage risk while ensuring compliance across the diverse and dynamic field of infrastructure development. The following recommendations were stated below.
## 5.2. Recommendations

Based on the findings, the following recommendations were made.

- i. Firms are advised to implement tools and software that provide real-time monitoring, predictive analytics, and automated compliance reporting. This will help organizations stay ahead of potential risks and remain compliant with evolving regulations.
- ii. The government should develop robust contingency plans for handling risk events or regulatory breaches. The plan should outline clear steps for risk mitigation, regulatory notifications, and damage control to minimize potential disruptions.
- iii. Organizations should engage with external legal, risk management, and compliance consultants to ensure a comprehensive understanding of complex regulations and to receive guidance on best practices in risk mitigation.

## **5.3.** Contribution to Knowledge

- i. This study evaluates the influence of risk mitigation on regulatory compliance of large-scale infrastructure projects in South-South Nigeria. Research in this area enhances knowledge of best practices for identifying regulatory risks early in the project lifecycle and the best approaches for mitigating these risks.
- ii. Additionally, study contributes to the body of literature by identifying that lack of risk monitoring affects adversely project results leading to substantial project interruptions, cost overruns, and poor quality.
- iii. Again, the researchers have contributed to the body of the literature by exploring previous studies on the concept of risk management, risk monitoring and regulatory compliance to identify research gaps and offer practical recommends that would mitigate risk reduction in large scale infrastructure projects and other industries in Nigeria.
- iv. Using large scale infrastructure projects, the study contributes to the literature by providing empirical evidence to show the intersection of risk management and regulatory compliance in South-South Region. By analyzing large infrastructure projects, both academics and practitioners gain insights into what strategies have been successful and where improvements can be made.

## 5.4. Study Limitations

Despite its contributions, research on **risk management** and **regulatory compliance** in infrastructure projects is limited in several ways. One major limitation is the lack of standardized frameworks for integrating risk management and regulatory compliance across various types of infrastructure projects. While some industries, such as energy and transportation, may have well-established regulatory frameworks, other areas, like urban development or smart city projects, may not have a clear regulatory pathway. This inconsistency complicates research and makes it difficult to generalize findings across different sectors.

Additionally, Infrastructure projects are often affected by political decisions, economic crises, or changes in government, all of which can impact regulatory requirements. Studies may fail to account for the fluctuating nature of political and economic environments, which can greatly influence the effectiveness of risk management strategies and the adherence to regulatory standards. Such external factors complicate the analysis of risk management and compliance strategies and may skew results.

## **5.5. Further Studies**

Furthermore, future researchers should explore risk impacts on financial, environmental, social, and political factors in Nigerian public procurement sector.

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## MACHINE LEARNING AND DEEP LEARNING BASED METHODS AS SOLUTION APPROACH FOR JOB ASSIGNMENT PROBLEM

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**Abstract**: This paper explores the integration of intelligent systems, specifically machine learning (ML) and deep learning (DL) into job assignment problems across domains such as manufacturing, healthcare, and cloud computing. While traditional methods like heuristics and mathematical programming have long been applied to job allocation, intelligent approaches offer dynamic, adaptive, and data-driven solutions better suited to the complexity of modern systems. The paper answers five research questions focusing on the types of problems addressed, the intelligent techniques employed, reported benefits, key challenges, and comparisons with traditional methods as the results of the performed systematic literature review. Challenges related to data dependency, explainability, and computational demands are also identified. This review contributes a synthesized overview of trends and emerging opportunities in the intelligent automation of job assignment systems.

Keywords: job assignment, task allocation, machine learning, deep learning.

## 1. INTRODUCTION

The efficient assignment of jobs or tasks to appropriate resources is a central concern in operations research, with far-reaching implications in manufacturing, logistics, healthcare, and digital service infrastructures. As real-world systems become more dynamic and interconnected, driven by advancements such as Industry 4.0, IoT, and cloud computing, the complexity of job assignment has increased significantly. Traditional rule-based, static, or deterministic models often fall short in adapting to real-time fluctuations, uncertainty, and the multi-dimensional nature of today's operational environments.

In response to these limitations, the application of intelligent data-driven approaches such as machine learning (ML) and deep learning (DL) has gained traction. These methods can analyze vast volumes of historical and real-time data to predict outcomes, adapt to changes, and improve allocation strategies without being explicitly programmed. Their flexibility and scalability make them particularly suitable for complex and dynamic job assignment scenarios.

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In recent years, these intelligent models have been applied to a range of job assignment scenarios, including static and dynamic job scheduling, multi-agent coordination, distributed cloud computing, and real-time manufacturing systems. The ability of ML and DL models to capture nonlinear relationships, learn from historical data, and adapt to new patterns makes them particularly suitable for environments characterized by complexity and uncertainty. Deep learning methods, in particular, have shown promise in job assignment tasks due to their ability to process high-dimensional inputs and generate adaptive allocation strategies (Du et al., 2021).

In modern operational systems, job assignment plays a critical role in resource optimization and overall performance. The rising complexity of manufacturing, logistics, healthcare, and service sectors has increased the need for intelligent, adaptive approaches to job allocation. Machine learning-based task allocation frameworks are increasingly used to address the limitations of traditional rule-based systems, especially under real-time and uncertain conditions (Xie et al., 2019; Zheng et al., 2020).

The motivation for conducting research in this area stems from the growing academic and industrial demand for intelligent decision-making systems that can enhance operational efficiency, adaptability, and responsiveness. Despite a notable increase in studies that apply ML and DL techniques to job assignment problems, a comprehensive synthesis of this literature has been lacking. To address this gap, we performed a systematic literature review (SLR) to investigate how intelligent models are utilized across different job assignment contexts and to identify key trends, challenges, and benefits.

To ensure a robust and structured analysis, a systematic search was conducted on May 1, 2025, using two leading academic databases: Scopus and Web of Science (WoS). The search focused on three categories of scholarly output: journal articles, conference proceedings, and review papers, published between 2013 and 2024. Keywords included combinations such as "job assignment" and "machine learning", "task allocation" and "deep learning", enabling a comprehensive capture of terminology used across disciplines.

In total, 224 documents were retrieved from Scopus, 171 from WoS, and 58 were found to overlap across both databases. The studies were filtered to include only those that applied ML or DL specifically to job-resource allocation problems (excluding pure scheduling) and that presented empirical or simulated results. The wide scope of the dataset provided a rich foundation for thematic synthesis and methodological analysis.

Throughout this paper, the results of our review are enriched with illustrative tables and figures that summarize keyword distributions, publication trends, and problem classifications. By analyzing these studies, we aim to (1) identify the ML/DL techniques commonly used, (2) classify the types of job assignment problems addressed, (3) assess the reported benefits of intelligent methods, (4) highlight implementation challenges, and (5) compare these techniques with traditional approaches. This review contributes a consolidated perspective on how data-driven intelligence is reshaping the job assignment landscape and outlines future directions for both research and practice.

The following research questions (RQs) guide the analysis:

- RQ1: Which intelligent methods were used in job assignment problems?
- RQ2: What types of job assignment problems were studied?
- RQ3: Which benefits were achieved through these methods?
- RQ4: Which limitations and challenges were reported?
- RQ5: How did intelligent methods compared to traditional approaches?

## 2. THEORATICAL BACKGROUND

Job assignment is a fundamental decision-making process that involves allocating tasks, jobs, or activities to available resources such as machines, workers, or computing nodes. The main objective of job assignment is to optimize one or more criteria, including minimizing completion time, maximizing resource utilization, reducing operational costs, or balancing workloads across resources (Pinedo, 2016). Job assignment problems appear in a wide range of domains, from manufacturing systems and logistics networks to cloud computing and healthcare scheduling (Wu et al., 2022).

Several subtypes of job assignment problems exist in the literature (Table 1). Static job assignment problems involve scenarios where all jobs and resources are known in advance and remain constant during the assignment. In contrast, dynamic job assignment problems consider changing job queues, machine availability, or system parameters, requiring real-time or adaptive decision-making. Machine learning methods have been applied in such dynamic settings to support real-time adjustments and improve scheduling performance (Wang et al., 2021). Multi-agent job assignment focuses on scenarios where several agents or autonomous systems perform distributed coordination, while multi-objective problems aim to simultaneously optimize conflicting goals such as time, cost, and energy. Recent studies have also explored multi-label job assignment using deep learning models that can learn complex eligibility constraints and enable flexible task allocation (Chen et al., 2023).

Problem Type	Description	Example Domains
Static Assignment	Tasks assigned once at planning stage;	Scheduling
	no updates during execution	healthcare staff
Dynamic Assignment	Real-time or periodic reassignment Multi-robot	
	based on changing conditions coordination	
Multi-Agent Allocation	Tasks assigned among distributed	Swarm robotics,
	agents	fleet control
Resource-Constrained	Task-to-agent allocation under	Cloud resource
Assignment	budget, skill, or time constraints management	
Multi-Label Assignment	A task or job can be assigned to	Parallel
	multiple agents or machines manufacturing lines	

*Table 1*. Job Assignment problem types

ML is a subset of artificial intelligence that enables systems to learn from data and improve their performance without explicit programming. ML algorithms are commonly used in job assignment to classify job types, predict processing times, identify resource constraints, or infer optimal assignments based on historical patterns. Popular ML methods include decision trees, support vector machines (SVM), random forests, and k-nearest neighbors (k-NN). These methods are particularly effective in structured environments with well-defined features.

DL, an advanced form of ML, involves neural networks with multiple layers that can model complex and high-dimensional relationships in data. DL techniques are suited for unstructured data, time-series inputs, and adaptive environments. Common DL models in job assignment include artificial neural networks (ANN), convolutional neural networks (CNN), and recurrent neural networks (RNN), including long short-term memory (LSTM) networks. ANNs have been widely used to approximate job completion times and resource utilization, while CNNs and RNNs help capture spatial and temporal dependencies in dynamic job environments. Reinforcement learning (RL), which overlaps both ML and DL, has also become a prominent approach, enabling agents to learn optimal assignment strategies through interaction with the environment.

Overall, ML and DL techniques contribute to intelligent, scalable, and adaptive job assignment systems that outperform traditional optimization models, particularly in complex, uncertain, and dynamic operational settings.

## **3. LITERATURE REVIEW**

In recent years, the integration of intelligent systems into operational decision-making has garnered significant attention in the academic community, particularly in the domain of job assignment. To assess the current state of this field, a structured and systematic literature review was conducted using the Scopus and Web of Science (WoS) databases. The search was performed on May 1, 2025, targeting publications between 2013 and 2024. The graph of researches conducted on databases by years shown in Figure 1. To maintain scientific rigor and relevance, the inclusion criteria were limited to peer-reviewed articles, proceeding papers, and review papers, with a clear focus on the use of machine learning, deep learning, or related intelligent methods in job assignment or task allocation contexts.



Figure 1. Number of papers published between 2013 and 2024 in Scopus and Wos databases

Table 2. Number of publications	according to keyword sets
---------------------------------	---------------------------

	No. of Publications	
Keywords	Scopus	WoS
"job assignment" AND "machine learning"	3	4
"task allocation" AND "machine learning"	99	112
"task allocation" AND "deep learning"	120	50
"job assignment" AND "deep learning"	2	5

Keywords in pairs were searched in both databases and the results are shown in Table 2. The initial query yielded 224 documents from Scopus and 171 from Web of Science, with 58 publications overlapping between the two databases shown in Figure 2. The overlap suggests both platforms capture a core set of influential studies while also offering unique insights. The distribution of studies over time reflects a clear upward trend in publications, particularly after 2020, which coincides with the increasing adoption of Industry 4.0, cyber-physical systems, and cloud-based infrastructure in industrial and service sectors. The surge in publications in 2023 and 2024 further indicates an ongoing momentum, possibly driven by advancements in AI toolkits and the growing availability of operational data.



Figure 2. Common and unique number of publications in Scopus and WoS

Thematically, the selected studies span a wide range of application areas:

- Smart Manufacturing: A significant portion of the literature investigates job assignment in intelligent production lines, CNC machining environments, and job-shop scheduling. For example, Li et al. (2022) demonstrated how ANN could be used to dynamically reassign tasks across multiple machines in real time, improving both energy efficiency and throughput.
- Healthcare and Workforce Planning: In dynamic environments such as hospitals or emergency services, job assignment methods are used to optimize staff allocation and shift planning. Xiang et al. (2021) employed ANN models to forecast demand fluctuations and reassign personnel in healthcare settings, enhancing responsiveness and reducing staff shortages.
- Multi-Agent Robotic Systems: Studies in this domain focus on coordination strategies among autonomous agents such as drones or robotic arms. Zhang et al. (2023) utilized deep Q-networks to allocate tasks among cooperative robots in a shared workspace, ensuring both collision avoidance and workload balance.
- Cloud and Edge Computing: In distributed computational systems, job assignment is essential for optimizing task scheduling, load balancing, and latency control. Jin et al. (2022) proposed a deep reinforcement learning framework that outperformed traditional heuristics in assigning tasks to edge nodes based on energy, delay, and availability constraints.

A closer look at the methodologies reveals a strong inclination toward reinforcement learning (RL) models such as Q-learning, Deep Q-Networks (DQN), and multi-agent reinforcement learning (MARL). These approaches are particularly suited to dynamic, realtime environments where jobs arrive unpredictably, and the system must continually adapt. In addition, ANNs are widely adopted for prediction-based decision-making, especially in static or semi-static systems. Hybrid models are also gaining popularity for their ability to combine interpretability with adaptability.

Another critical trend is the growing emphasis on hybrid and explainable models. While deep learning models offer unmatched performance in pattern recognition and scalability, their "black-box" nature poses a challenge for adoption in domains that require interpretability and traceability of decisions. Several studies highlight this tension and propose integrating traditional rule-based heuristics or fuzzy logic to enhance transparency (Tan & Chong, 2023).

## 4. RESULTS AND DISCUSSION

## 4.1. The analysis of intelligent methods used in job assignment problems

The literature reveals a strong trend toward the application of intelligent methods for solving job assignment problems, particularly in environments characterized by uncertainty, real-time dynamics, or complex constraints. RL has been widely adopted due to its ability to learn optimal strategies through trial and error. For instance, Zhao et al. (2021) proposed a multi-agent RL approach for dynamic scheduling in smart factories, while Ji et al. (2023) reviewed deep RL applications that enhance coordination and performance in distributed job-shop environments.

ANNs have also been used to predict job durations and balance workloads, especially in rescheduling tasks in CNC-based manufacturing systems (Wei et al., 2022). Furthermore, Q-learning techniques have been applied to mitigate production bottlenecks and reduce delays in human-involved systems such as pharmaceutical manufacturing (Yang et al., 2022).

Hybrid models that combine learning systems with traditional or heuristic methods have also gained attention. Lin et al. (2023) proposed a neuro-fuzzy framework that dynamically selects among multiple metaheuristic algorithms based on system complexity and job characteristics. This combination enhances both the adaptability and efficiency of job allocation mechanisms, making them suitable for dynamic industrial settings.

## 4.2. The types of job assignment problems being deliberated

A wide range of job assignment problem types are explored across the literature, showcasing the adaptability of intelligent approaches. Static job assignment problems, where job and resource sets are fixed, remain foundational in benchmarking performance. However, most studies increasingly focus on dynamic assignment problems, where job arrivals, machine availability, and system constraints evolve over time. For example, Xiang et al. (2021) used ANNs to forecast workforce demand in healthcare settings, adjusting shift allocations in real-time.

Multi-agent assignment problems are also prevalent, particularly in the context of autonomous robotic systems and distributed computing. Zhang et al. (2023) designed neural network-based agents to coordinate tasks among collaborative robots. In contrast, Jin et al. (2022) addressed multi-label job assignment in cloud and edge computing environments, optimizing for delay, energy consumption, and agent availability simultaneously.

Multi-objective problems further complicate the solution space by requiring the simultaneous optimization of conflicting goals such as makespan, energy use, and cost. As

noted by Guo et al. (2022), multi-objective problems are often tackled with hybrid methods, which are more capable of navigating trade-offs than single-algorithm solutions.

# 4.3. Benefits and high grounds accumulated with artifical intelligence based methods

The integration of intelligent methods into job assignment systems has led to significant advancements across a wide range of performance metrics. These approaches not only improve the speed and quality of task allocation but also enhance operational efficiency, adaptability, and resource utilization. Machine learning and deep learning-based systems demonstrate a capacity to learn from data, respond to real-time changes, and support proactive decision-making. Their benefits are consistently reported across different domains such as manufacturing, healthcare, and cloud computing, validating their potential to address the limitations of traditional methods in increasingly dynamic and complex environments.

One of the most consistently reported benefits is the reduction in total job completion time (makespan). Hu et al. (2023) achieved a significant reduction in makespan using an actor-critic reinforcement learning framework in a smart manufacturing environment. Likewise, Li et al. (2022) reported up to 30% energy savings with their ANN-based rescheduling approach for CNC machining.

In pharmaceutical production, Yang et al. (2022) implemented a Q-learning algorithm that significantly reduced job delays and improved flexibility under fluctuating job flow conditions. Jin et al. (2022) showed that DL-based job allocation in cloud environments outperformed traditional load balancing methods, reducing latency while maintaining service continuity.

Other notable benefits include scalability, continuous learning, and proactive problem prevention. Lin et al. (2023) developed a hybrid system that dynamically selects optimization algorithms based on workload. Xiang et al. (2021) demonstrated how ANN models could efficiently reassign staff in healthcare, ensuring resource availability during demand surges.

## 4.4. Limitations and challenges related to artifical intelligence based methods

Despite the numerous advantages offered by intelligent models in job assignment, their implementation is not without challenges. The literature identifies a set of recurring barriers that range from technical and computational issues to organizational and ethical concerns. These limitations can affect the reliability, transparency, and scalability of ML and DL models, particularly in high-stakes or data-scarce environments. Understanding these challenges is crucial not only for contextualizing the current state of research but also for guiding future developments.

Key challenges include data dependency, with many models trained on synthetic datasets, limiting real-world applicability (Yu et al., 2023). Integration into legacy infrastructure and the opacity of deep learning models hinder adoption in sensitive domains like healthcare, where explainability is vital (Rodriguez-Ruiz et al., 2022). Computational costs and training complexity are also significant (Lin et al., 2023), and organizational resistance or lack of cross-functional expertise further compounds the issue.

## 4.5. Benchmarking of intelligent and traditional approaches

As intelligent methods become more prominent in the job assignment literature, their comparative effectiveness against traditional approaches has drawn substantial attention. While classical optimization techniques remain valued for their interpretability and efficiency in well-defined contexts, intelligent models excel in handling uncertainty, complexity, and dynamic changes.

Traditional approaches like linear programming and rule-based scheduling offer transparency and lower computational cost, making them preferable in static or regulated environments. However, ML and DL methods outperform these techniques in adaptive scenarios. Reinforcement learning models have been shown to learn optimal strategies and improve over time (Liu et al., 2023; Zhang et al., 2023). Hybrid approaches strike a balance by combining adaptability with interpretability, as demonstrated by Lin et al. (2023).

In conclusion, intelligent models enhance traditional methods rather than replace them, offering scalable and responsive solutions to modern job assignment challenges.

## 5. CONCLUSION

This systematic literature review synthesized recent advancements in intelligent job assignment approaches across various application domains. Drawing from more than 300 sources, it was found that ML and DL models, particularly reinforcement learning and neural networks, are frequently adopted for their ability to learn from data and handle complex environments. While these models offer improved efficiency, flexibility, and scalability, their adoption is limited by data dependency, integration challenges, and lack of explainability. Hybrid approaches emerge as a promising direction, offering a balance between adaptability and interpretability. Future research should emphasize real-world validations, focus on developing explainable models, and bridge the gap between academic models and industrial deployment.

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## TEAM FORMATION METHODS COMPARED: BELBIN'S ROLES AND CHATGPT'S SUGGESTIONS

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**Abstract**: This paper examines and compares the use of Belbin's software solution and the ChatGPT chatbot in project team composition. The study explores how each approach functions, their methodologies, and their advantages and disadvantages. By analyzing these aspects, we provide insights into how both tools contribute to effective team formation in modern business environments. Belbin's software assesses individual team roles based on psychological traits, offering a structured approach. In contrast, ChatGPT provides a flexible, AI-driven solution that generates recommendations based on user inputs. While Belbin's method relies on predefined roles, ChatGPT adapts dynamically to different project needs. Through this comparison, we identified key differences in accuracy, adaptability, and usability. By evaluating the strengths and weaknesses of each method, we determined optimal strategies for assembling teams. This study helps users choose the most suitable approach based on their needs, offering valuable insights for organizations and individuals seeking efficient ways to form high-performing teams.

Keywords: artificial intelligence, team composition, Belbin model, ChatGPT, comparison.

## 1. INTRODUCTION

Artificial intelligence (AI) is no longer just a part of science fiction; it plays a crucial role in the modern business environment. Its impact on the formation and success of project teams is becoming increasingly significant. Traditional approaches, such as Belbin's team role typology, help understand how different members contribute to team dynamics. However, with the advancement of AI tools like ChatGPT, the question arises: Can AI make team selection decisions as effectively as, or even better than, traditional methods?

The aim of this study is to assess the effectiveness of both approaches and explore their potential for improving human resource management. It focuses on determining which

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method enables better team composition and identifying optimal strategies for assembling project teams in today's business world.

## 2. BELBIN'S LEADERSHIP TYPOLOGIES

Belbin's team role theory, developed by British psychologist Meredith Belbin, identifies key roles individuals play within teams based on psychological characteristics. Early in his career, Belbin studied the impact of older workers in industry. He later joined an industrial training research unit and became a recruitment leader and consultant for the OECD (Organisation for Economic Co-operation and Development). Using business games and research on team success and failure, Belbin identified eight distinct roles in teams, based on traits like intelligence, dominance, extraversion/introversion, and stability. In 1981, he published Management Teams: Why They Succeed or Fail, where he described these roles, later adding a ninth role, the specialist, in 1988. Belbin found that individuals can take on multiple roles, but typically express three to four roles. When roles complement each other, a successful team can be formed (Mahne, 2009).

Table 1 summarizes the key characteristics of three broad categories or general roles in Belbin's theory. Roles such as the completer, creator, and implementer are characterized by a readiness to act when carrying out tasks. Roles like coordinator, resource investigator, and team worker are focused on building relationships and communication with colleagues. Roles such as evaluator–observer, producer, and specialist are more cognitively driven, emphasizing thinking and task analysis.

Category	Belbin's Team Role	Key Characteristic
Action Roles	Completer, Creator, Implementer	Willingness to take action while performing tasks
Interpersonal Roles	Coordinator, Resource Investigator, Team Worker	Fostering relationships and effective communication with team members
Cognitive Roles	Evaluator-Observer, Shaper, Specialist	Emphasis on thinking and analyzing tasks

Table 1. Overview of Categories Representing Belbin's Team Roles (Belbin, 1993)

## 3. BELBIN PROGRAM ANALYSIS: TECHNICAL ASPECT

The Belbin Interplace program is based on Meredith Belbin's team role theory. This software tool provides insight into complex algorithms, databases, statistical methods, and a user interface that form the foundation for effective team management.

The first step in using the Belbin system involves each team member completing specific questionnaires designed according to the Belbin system's framework. These questionnaires include a self-assessment scale, where team members evaluate themselves; an observer assessment scale, where team members assess their peers; a work evaluation section, where team members provide feedback on the project or share their perspective on it; and a work characteristics analysis questionnaire, filled out by the team leader or someone who is well-acquainted with the project for which the team is being formed.

## 3.1. Belbin's Self-Assessment Questionnaire

This is a foundational survey where individuals assess their own behaviors and characteristics. It provides insights into a person's natural team roles based on their self-perception. The questionnaire consists of 70 questions divided into seven sections. Each section includes statements related to various aspects of teamwork. Participants are asked to rate the extent to which they agree with each statement, offering a reflection of how they view themselves in a team setting.

## 3.2. Observer Assessment Scale

In this assessment, team members or colleagues evaluate others based on their behavior within the team. The purpose is to obtain an external viewpoint that complements the self-assessment, allowing for a more impartial evaluation of team roles. The scale includes statements similar to those in the self-assessment, but these are focused on observing the behaviors of the individual being assessed in the team setting. Observers rate the frequency with which a person exhibits traits and behaviors, evaluating each member's actions and contributions to the team.

## 3.3. Belbin's Work Observation Questionnaire

Belbin's Work Observation Questionnaire is a tool designed to assess an individual's behavior and characteristics while performing specific tasks. It provides insight into how colleagues perceive a person's contribution to a project or task. This questionnaire focuses on identifying key traits that contribute to successful task execution, as well as those that may negatively impact performance. The questionnaire includes two main sections: List A, which highlights positive traits, where observers select up to 10 characteristics, they believe are important for performing the work effectively, and List B, which identifies negative traits, where observers choose up to three characteristics they feel hinder task performance.

## 3.4. Work Characteristics Analysis Questionnaire

Belbin's Work Characteristics Analysis Questionnaire is a tool used to assess key elements of job tasks that can be linked to human traits and have the greatest impact on job performance. This questionnaire is completed by the person directly responsible for the work or the team composition. The evaluator rates 16 aspects of the job on a scale from A (essential characteristic) to E (non-essential characteristic) across four categories: job requirements, working with people, working conditions and pressures, and intellectual qualities, experience, and training. At the end, the three most important job elements are identified. This tool helps pinpoint the critical factors influencing job success and aids in finding candidates who best match the job profile.

Once the data from the questionnaires is entered into the Belbin program, it is integrated into a central database, where an analysis is performed to determine behavioral profiles and work roles such as coordinator, implementer, and resource investigator. The program then generates reports with graphs, tables, and interpretations that highlight the key characteristics of individuals and teams. These results allow for the creation of balanced teams, the identification of potential conflicts, and the determination of training needs to enhance team effectiveness.

Figure 3.1 shows the personality profile generated by the Belbin program. This report is based on the candidate's self-assessment and observer evaluations. It outlines the individual's personality traits and work recommendations. Based on the report, work tasks and responsibilities can be adjusted to leverage the candidate's strengths and reduce risks related to their weaker traits.

PERSONALITY PROFILE
Candidate: Koceva Marijana
Organization: COMPANY X
Department: INFORMATION TECHNOLOGY
The report is based on self-assessment and observer evaluations.
She has a strong sense of innovation and wishes to work in an environment that mentally stimulates her. She has a pleasant and adaptable demeanor and aims to collaborate well with colleagues.
She struggles in dynamic situations and hesitates when decisive action is required.
She should not be assigned roles that involve working with sensitive individuals.

*Figure 1.* Personality profile generated in the Belbin Interplace program *Source: Author's original work* 

## 4. DESCRIPTION OF WORKING METHOD USING CHATGPT

## 4.1. Introduction to ChatGPT 3.5

As Mehta (n.d.) discusses in the article *Chat GPT: An AI NLP Model POV*, ChatGPT is a sophisticated dialogue generation system that operates on Natural Language Processing (NLP) principles. It generates responses that resemble human communication based on user inputs. Built on the Generative Pre-trained Transformer architecture, the system was trained using a vast dataset derived from online conversations. Once trained, it can perform a variety of NLP tasks, including translating, answering questions, and completing text. This conversational AI is widely used for applications such as chatbots, virtual assistants, and other interactive communication tools. Released on November 30, 2022, ChatGPT was developed by OpenAI LP, a for-profit organization managed by a non-profit board. OpenAI, the research lab behind the project, was founded by Elon Musk, Sam Altman, Greg Brockman, Ilya Sutskever, Wojciech Zaremba, and John Schulman, with financial backing from investors such as Microsoft, the Reid Hoffman Foundation, and Khosla Ventures.

## 4.2. How does ChatGPT work?

ChatGPT operates as a language model powered by machine learning algorithms that generate human-like responses. Its architecture is based on neural networks known as

Transformers, and it has been trained on vast amounts of text data, including websites, books, and articles. During the training process, the model learns patterns and structures in the language, as well as how to predict the next word in a sentence based on the previous words. Once trained, the model can generate new text by predicting words according to the given context or input. This process continues until the model completes a full sentence or generates the required number of words. In generating text, ChatGPT also employs an attention mechanism, which allows it to selectively focus on important parts of the input text, ensuring more accurate and coherent responses (Mehta, n.d.).

## 4.3. Training Process of ChatGPT

The fundamental process behind training ChatGPT involves the use of advanced machine learning algorithms on large volumes of textual data sourced from various platforms, such as websites, books, articles, and other documents. The model's architecture is based on a neural network known as Transformer, which excels at handling long-term dependencies within text. The training begins with the collection of vast amounts of text data containing linguistic patterns and structures that the model needs to learn. This data is then processed, tokenized, and prepared for input into the model. Tokenization refers to converting the text into a sequence of numerical representations that the model can understand and process. The training process itself consists of the model predicting the next word in the text based on the preceding words. This is achieved using optimization algorithms that adjust the model's internal parameters to minimize prediction errors. The training cycle is repeated multiple times, allowing the model to refine and enhance its ability to generate natural language (Mehta, n.d.).

## 4.4. Using ChatGPT for Team Formation

ChatGPT is a versatile tool that can be applied across various domains, from culinary tasks to programming and text processing. When it comes to assembling teams for projects, ChatGPT doesn't adhere to a single method but offers a range of possibilities. The platform can assist by evaluating the skills and competencies of team members. Through its user interface, it can review profiles, resumes, qualifications, and work experience. Additionally, ChatGPT can integrate psychometric tests and behavioural models to assess personality traits, which plays a key role in team formation. The test results can be fed into the system, which then generates the most effective team configuration based on the data.

As a sophisticated NLP model, ChatGPT can even create custom psychometric tests or questionnaires, providing valuable insights for team composition. Moreover, it can assess demographic factors, ensuring diverse teams in terms of gender, ethnicity, age, and other characteristics, which contributes to fostering creativity and innovation. By leveraging historical data and advanced algorithms, ChatGPT can predict the team structures most likely to succeed in specific projects.

In this research, the participants were students already familiar with each other. We had prior knowledge of their group work experiences and established reputations for each team member. Their personal profiles were based on past interactions and mutual understanding. The project's needs were analysed to identify the required competencies, and the system then matched these needs with the skill sets of the team members. This approach ensured efficient teamwork and synchronization, as it was always clear which competencies were necessary for the project and which skills each team member possessed.

## 5. RESULTS AND DISCUSSION

In this paragraph, we present the analysis of the results from our study, which aimed to assess whether AI is sufficiently advanced to effectively assemble teams using Belbin's typology. We utilized Belbin Interplace and ChatGPT 3.5, with 10 students involved in evaluating themselves, their peers, and the project. Belbin's system generated personality profiles and recommendations for successful team formation, which were then input into ChatGPT. Two dialogues were conducted: in the first, we provided guidance on applying Belbin's logic, and in the second, no such instructions were given.

The findings revealed that ChatGPT, when given proper direction, was able to successfully implement Belbin's concepts. However, without guidance, it tended to suggest practical roles, such as leader or developer. This highlights that ChatGPT's effectiveness is largely dependent on the instructions provided. The main advantages of ChatGPT include its speed and objectivity, while the challenges lie in its limited ability to interpret complex data and the necessity for clear, precise questions. Additionally, inaccurate or incomplete data can lead to unreliable results.

While the Belbin Interplace system offers immediate, graphically-supported feedback and is easy to use, it requires a time-consuming data input process. On the other hand, ChatGPT quickly analyzes the data but does not generate visual representations. When comparing consistency, ChatGPT demonstrated a 90% alignment with Belbin's logic when directed, but only 0% without it, underscoring the importance of specific guidance.

Both tools possess their respective strengths and weaknesses, but when combined, they can expedite and improve the accuracy of team formation. The results of our research confirm that ChatGPT is capable of effectively applying Belbin's typology when provided with clear direction, making it a useful tool for optimizing team composition in project settings.

# 5.1. Comparative Analysis of AI-Generated Responses and Belbin's Team Role Model

In this section, we will present some specific results and outputs obtained from using ChatGPT 3.5 and the Belbin Interplace program.

Regarding the assignment of team roles, we conducted two experiments with ChatGPT: in the first, we provided instructions to apply Belbin's typology, and in the second, we did not mention the typology at all. The results of both attempts are displayed in Figures 2 and 3.

To ensure privacy, we have anonymized the team members by replacing their names with numbers.

We observe that ChatGPT, when not guided by Belbin's typology, tends to focus on concrete job tasks and project-specific responsibilities (e.g., in this case, ERP system development). Roles are assigned based on individual competencies and professional skills, emphasizing practical positions such as Project Leader or Lead Analyst.

Conversely, when explicitly instructed to apply Belbin's model, ChatGPT prioritizes psychological and behavioral traits, fostering better team synergy. Roles align with Belbin's nine team roles (e.g., Implementer, Shaper), and the distribution closely matches team members' profiles. However, a limitation is the lack of guidance on role adaptation for evolving project needs. Since Belbin roles are dynamic, it would be beneficial to explore:

Role rotation if team dynamics or project demands shift. Inclusion of all nine roles (as per Belbin's framework) to ensure balance.

Next, we will compare three team compositions:

Figure 4: ChatGPT-generated team using Belbin's typology.

Figure 5: ChatGPT-generated team without Belbin's framework.

Figure 6: Team structured by Belbin Interplace software.

This comparison will highlight how methodological differences influence role allocation and team dynamics.

Can you assign Belbin team roles to members based on their profiles?
\$ Of course, based on the provided team member profiles, I can attempt to assign Belbin team roles. Here's a proposal for how each team member might fit into one of the Belbin roles:
Person 1 Implementer (IMP): Due to their organizational skills, reliability, and persistence in achieving goals, Person 1 could excel as an Implementer, taking ideas and turning them into practical actions.
Person 2 Plant (PL): Person 2 is creative, innovative, and enjoys collaborating in a team environment. These traits are characteristic of a Plant, who brings new ideas and solutions to the team.
Person 3 Monitor Evaluator (ME): Person 3 thinks before acting and values organization and structure. They could effectively fulfill the Monitor Evaluator role by contributing to analyzing options and evaluating ideas within the team.
Person 4 Coordinator (CO): Person 4 is a motivated individual who inspires others to take action. With their leadership and ability to energize, they could excel as a Coordinator, directing and organizing the team's work.
Person 5 Completer Finisher (CF): Person 5 is a curious individual who contributes creative ideas. Though slow-paced, they are meticulous and ensure tasks are completed. Thus, they could fit the Completer Finisher role, focusing on details and guaranteeing task completion.
Person 6 Coordinator (CO): Person 6 is motivated, organized, and detail-oriented. Despite preferring to work alone, their leadership and organizational skills make them a strong candidate for the Coordinator role.
Person 7 Plant (PL): Person 7 is innovative and motivated, bringing fresh ideas to the team. Their creativity and adaptability make them well-suited for the Plant role.
Person 8 Shaper (SH): Person 8 is motivated and focuses on the bigger picture. Their energy and ability to inspire could make them an effective Shaper, overcoming obstacles and driving the team toward action.
Person 9 Monitor Evaluator (ME): Person 9 is independent and skilled at solving complex problems. Their attention to detail aligns with the Monitor Evaluator role, contributing to idea analysis and evaluation.
Person 10 Implementer (IMP): Person 10 is dedicated, thorough, and precise. Their reliability and conscientiousness make them a strong Implementer.
Key Notes: Each individual may take on multiple roles in a real work environment, but these suggestions are based on their described traits and abilities.It's also important to consider how team members complement one another and collaborate to achieve shared goals.

*Figure 2.* Generation of team roles using ChatGPT: first attempt with Belbin's typology *Source: Author's original work*  Here is a proposed role allocation for all ten team members, considering their personality profiles and project needs:

#### 1. Person 1

Role: Project Leader / Lead Analyst

Reason: Person 1 is independent, proactive, and possesses exceptional analytical skills. As the project leader, they will provide direction and oversight for all project aspects while leading requirement analysis and solution planning.

#### 2. Person 2

#### Role: Creative Specialist / UX/UI Designer

Reason: Person 2 is creative and sharp-witted, which is crucial for developing user-friendly interfaces and innovative solutions. Their teamwork skills will be valuable when collaborating with developers and analysts.

#### 3. Person 3

#### Role: Quality Lead / Test Engineer

Reason: Person 3 is highly organized and structured, making them ideal for ensuring high-quality standards and precision in the project. Their role will involve planning and executing tests to guarantee flawless ERP system functionalities.

#### 4. Person 4

#### Role: Product Owner / Requirements Specialist

Reason: Person 4 is motivated and inspiring, essential traits for a product owner who must align stakeholder expectations with the development team. While not detail-oriented, their reliability and goal-driven focus will help prioritize tasks effectively.

#### 5. Person 5

Role: Creative Collaborator / Idea Specialist Reason: Person 5 is curious and contributes innovative ideas. Despite their slower pace, they will excel in brainstorming sessions and exploring new approaches to project challenges.

#### 6. Person 6

Role: Lead Developer / Backend Engineer

Reason: Person 6 is highly motivated and detail-focused, which is critical for a lead developer. Their self-motivation and perseverance will ensure the development and maintenance of a robust backend system.

#### 7. Person 7

#### Role: Support Developer / Frontend Engineer

Reason: Person 7 is innovative and empathetic, key traits for frontend development. Their adaptability will facilitate seamless integration with UX/UI designers and backend developers.

#### 8. Person 8

#### Role: System Architect / Technical Expert

Reason: Person 8 focuses on the big picture, which is vital for a system architect designing the ERP framework. Their openness and willingness to assist others will help resolve technical challenges.

#### 9. Person 9

#### Role: Data Analyst / Reporting Specialist

Reason: Person 9 is detail-oriented and excels at solving complex problems, making them ideal for data analysis and reporting. Their precision will ensure accurate and high-quality insights.

#### 10. Person 10

#### Role: DevOps Engineer / Automation Specialist

Reason: Person 10 is intelligent and thorough, essential for a DevOps engineer responsible for process automation and infrastructure maintenance. Their meticulousness will ensure system stability and efficiency.

*Figure 3.* Team Role Generation Using ChatGPT: Second Attempt (Non-Belbin Methodology) *Source: Author's original work* 

Which five candidates are the most suitable for this task (listed in order), considering their profiles according to the Bebin typology?
\$ Based on the profiles according to Belbin's typology and the requirements of the ERP system development project, the following five most suitable candidates can be selected:
Person 1 Role: Implementer Reason: Organized, reliable, and efficient in task execution, which is key for ensuring the practical implementation of the project.
Person 3 Role: Monitor Evaluator Reason: Thoughtful, structured, good at analyzing options and evaluating ideas, which is important for making considered decisions in the project.
Person 4 Role: Coordinator Reason: Motivated, capable of leadership, which is essential for organizing the team's work and coordinating activities across different functions.
Person 8 Role: Shaper Reason: Energetic, motivated to overcome obstacles, capable of encouraging action, which is helpful in tackling challenges in the project.
Person 9 Role: Monitor Evaluator Reason: Skilled in solving complex problems, detail-oriented, contributing to critical analysis and evaluation of ideas and strategies in the project.
These candidates were selected based on their specific roles and strengths according to Belbin's typology, which best align with the demands and dynamic nature of the ERP system development project. Each of them can significantly contribute to the successful implementation and achievement of the team's goals with their personal strengths and work styles.

*Figure 4*. Team Composition Using ChatGPT: First Attempt Applying Belbin's Typology *Source: Author's original work* 

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Given the project requirements and the personal profiles of the members, here is a proposal for a five-member team for building an ERP system: Person 1 Reason for selection: Person 1 is ideal for this project due to her exceptional analytical skills, independence, proactiveness, and ability to learn quickly. Her skills and characteristics are crucial for mastering complex problems and adapting to new challenges, which is essential in the development of an ERP system. Person 9 Reason for selection: Person 9 stands out due to her abilities in solving complex problems and attention to detail. Although she is slow and does not like working under pressure, we can rely on her for quality work once she is fully engaged. Her qualities are key for ensuring precision and quality in the project. Person 10 Reason for selection: Person 10 is insightful, precise, and thorough. His ability to think systemically and critically about the whole is essential for success in complex ERP projects. However, he is difficult to adapt to changes, but his thoroughness ensures high-quality results. Person 2 Reason for selection: Person 2 is creative, intelligent, and collaborative. Her ability to contribute ideas and work in a team is very important for developing new approaches and creative solutions. Although she dislikes organizing and supervising others, she will contribute valuable insights and ideas as a team member. Person 6 Reason for selection: Person 6 is very motivated and organized, with an emphasis on details. Her ability to motivate herself and others through perseverance is crucial for the successful execution of the project. However, she prefers to work alone, but her organizational skills are key for maintaining order and structure in the project. **Reserve:** Person 3 Reason for reserve: Person 3 has strong leadership and organizational skills, but is not enthusiastic about risks. If there is a need to strengthen leadership skills in the team or improve organization, she would be an excellent choice. With this team composition, you will have a balanced team that combines analytical and technical skills, creativity, attention to detail, and organizational abilities. These are key aspects for the successful development of an ERP system.

*Figure 5.* Team Composition Using ChatGPT: Second Attempt Without Belbin's Typology *Source: Author's original work* 

### SUITABLE CANDIDATES FOR THE JOB

Job title: ERP System Development Project Organization: COMPANY X Department: IT

The most suitable candidates for this job (listed in order of ranking) are:

Person 6
Person 1
Person 3
Person 8
Person 7

## 6. CONCLUSION

In our research, we compared the application of Belbin's team role typology and AI (ChatGPT) for team composition in projects. Our analysis demonstrated that both approaches have distinct advantages and limitations. The Belbin method, based on balancing team roles, enhances team dynamics and communication. While it improves collaboration and team alignment, its drawbacks include reliance on subjective assessments and limited adaptability to specific project requirements. Conversely, ChatGPT enables flexible team assembly based on competency analysis, offering advantages in flexibility and individual skill matching, though it depends heavily on input data quality and pays less attention to balanced team roles. Our findings indicate that ChatGPT can effectively understand and apply Belbin's roles to create balanced teams when provided with accurate, objective input data. The optimal solution would combine both approaches, particularly for projects requiring both role balance and specific skill adaptation. We conclude that while ChatGPT proves useful when team profiles and requirements are clearly defined, Belbin's typology remains a validated and effective team-building framework. This suggests potential for integrating AI tools with established team role methodologies to enhance team composition processes.

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## RISKS IN FAMILY BUSINESSES IN BULGARIA - THE CASE OF STAPKA LTD

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**Abstract**: The purpose of this report is to provide a general overview of risk and family business in Bulgaria. Therefore, its first task is to introduce the reader to some of the terms used in risk management based on a review of various sources. Its second task is related to the presentation of several successful family businesses from the city of Ruse, Bulgaria. They have been successfully developing over the years, and their family cohesion is one of the factors that helps them survive during the COVID-19 restrictions. The third task is to present in more detail the activities of a family business and an analysis of some of the sources of risk. For the needs of the third task, the family business STEP Ltd from the city of Ruse was chosen due to the author's ability to directly use data on its activities as a member of the family business. This report could be interesting for professors and teachers who encourage their students to develop a family business.

Keywords: Risks, Family business, Bulgaria, STAPKA.

## 1. INTRODUCTION

There are different sources of risks, which could affect both the big and the small firms. According to Reihanova and Pavlov (2021) the main problems for the rural companies come from the aging of the population and the climate changes. According to them the depopulation of small settlements poses serious risks to family businesses. More and more young people are looking for work in a larger city. The desertification of villages has a negative impact on the provision of the necessary workforce. Many entrepreneurs, who have not received support from their children, refuse to expand their economic activities because they have realized that they have to cope on their own.

An international group of scientists (Bakracheva at al., 2020) have studied the entrepreneurial risks within universities from the INTERGEN international academic network. They came to conclusion that in case of intergenerational support then the new generations are more willing to start their business and integrate other relatives, too.

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According to another study among HEIs from the INTERGEN (Pavlov at al., 2024) there are some limits in the level of intergenerational support.

Zafirova (2008) also describes legal risk, which is related to: introduction of new laws, regulations, normative documents, standards, etc., repeal of existing legal documents. The Bulgarian National Statistical Institute (NSSI, 2023) also includes reputation risks; security risks; contractual risk; risks associated with errors, concealment and fraud; resource risk, etc.

According to Vasileva (2014) the factors that have an impact on risk assessment are: price/resources, workload, need for databases, etc. In order to identify potential risk situations, many techniques can be used. Bozhkov (2020) put an attention that the identification of risks by the enterprise begins with a detailed analysis of the goals, which represent its overall plans.

Once the risk is identified and estimated, then the entrepreneurs have to undertake different strategies. According to Pavlov (2025) they are:

- Risk avoidance – to avoid risk situations, which could lead to losses. For example, to avoid internal family conflicts, because they can ruin the internal trust for mutual understanding and destry the family company from the insight.

- Risk mitigation – to reduce either the probability to create the risk or to reduce the losses after the risk has happened. For example, the communication among the family members to be more soft.

- Risk transfer. For example, to ask other people to inform some of the family members about some bad news. In this case the anger will be towards the external people.

- Risk acceptance. For example, when a younger family members begin some business actions and they get financial support from their parents, then parents accept both the success and the familiar as a potential result from the activity of their children.

# 2. EXAMLES OF FAMILY BUSINESSES FROM THE CITY OF RUSE, BULGARIA

Based on the analysis of the data provided by the INFOSTAT system of the Bulgarian National Statistical Institute (Table 1), it can be concluded that during the COVID-19 period, a large number of businesses have ceased their activities due to government restrictions. After the COVID-19 period, the restrictions end and companies resume their normal activities. It can be seen that the number of active enterprises managed by families has increased. The reason for this may be that during a period of isolation, people have come to the conclusion that family is important. Therefore, in this chapter we will present some good examples with companies, which were registered their head-quarters in our city (Ruse).

Year	Number of active family firms in Bulgaria
2019	103 759
2020	99 355
2021	95 839
2022	104 690
2023	107 005

Table 1. Number of active family firms in Bulgaria 2019-2023 (INFOSTAT, 2025)

**ECONT** - the company was founded in the city of Ruse in 1993 by Nikolay Sabev. (Forbes Bulgaria, 2020). Of Sabev's heirs, Alina and her sister Lora were the first to start working in the company, both of whom started working at the lowest level, which is Quality Control inspectors. In 2021, his youngest daughter took an active part in certain decisions as a partner, as the founder of the company gave equal shares to his daughters and their mothers,

but retained the majority share for himself. In 2024, Econt was re-registered in Ruse (Bulgaria) as a Joint Stock Company, in which all members of the Sabev family participate. Their personel is over 700 people.

Another example of a family business in the city of Ruse is the furniture company **IRIM**. In her article, Marinova (2024) describes that "Irim" is the largest manufacturer of cabinet furniture in Bulgaria. In 2024 the company employed about 500 people. The company was founded by Ivan Ivanov, who created a small cabinet furniture production. Later, he added his wife Rositsa Ivanova and their sons Nikolay and Anatoly as partners in their family company.

Another example of a successful family business developing on the theory of the city is the furniture company **ERGODESIGN-RUSE**. According to Darik Business Review (2023), the company was founded by Slavi Slavov, who today works together with his daughter - Simona, who is the second generation in the family business. The history of Ergodesign begins in 1996. Slavi began producing glass tables together with his brother. By 2025, the company was one of the pioneers in the furniture business in Bulgaria and Europe, thanks to the fact that they invested in software and new technologies. Simona, who currently works as a "Sales and Marketing Manager", shares in the article that she feels the factory as her second home, which is due to the fact that she has spent a lot of time there since she was a child. Over the years, it has been mandatory for her to work every summer in the family business, because for the family, work discipline is one of the most important things. Every summer she worked in different workshops, getting to know different units. She shares that it is not easy to be the second generation in a successful business. The reason for this is that her parents have created a working business and she is expected to achieve more by building on it.

Another example is "**Philadelphia Bakery**", which is among the first private bakeries in the city of Ruse, Bulgaria. The company was founded in 1991 with a daily production capacity of 1 500 loaves of bread, divided into 5 categories of items and several employees. In 2025, the company was one of the main producers of bread, bakery and confectionery products for the city of Ruse, having increased its production capacity more than ten times and providing work for over 70 people. In order to be closer to its customers and maintain higher quality, Philadelphia Bakery has built its own sales network of company stores in which it offers its products. Thus, it manages to develop its relationships with customers and offer high quality of each product. As a family business, this company invests its values and a great deal of emotion in what it does. The owners of the company have accepted that making bread is a calling and a responsibility.

In the next chapter we will study some of the specific risks in the family firm of STAPKA Ltd.

## **3.** THE CASE OF FAMILY FIRM STAPKA LTD.

The company was founded in 2001 by Milena Sungerova together with her brother Vesselin Valchev. In 2002, they decided to create one of their businesses - a fast food restaurant "Stapka". In the years before deciding to create their own restaurant, they worked together with their parents in an restaurant located in the vicinity of the city, whose manager was their father.

The first location they opened was located in the city of Ruse, 113 Tsar Osvoboditel Boulevard. Due to their central location in the city and the variety of delicious food offered, they managed to quickly accumulate satisfied customers and build a name that is still easily recognizable in the city to this day. After the great interest from the customers and the desire of the owners to develop, the idea of creating a second restaurant, which also bears the name "Stapka". The idea was successfully implemented and in 2008 the second establishment opened, located at 4 Nikolay Zdravkov Street. The new services offered to customers are:

- delivery to customers' homes and offices;
- catering, specially prepared for customers' special occasions.

The two establishments offer their customers mainly traditional Bulgarian dishes, and in recent years the owners together with their heirs have decided to include new offerings in the menu, which have been pre-selected after an analysis of the competition in the city. Every week a weekly menu is prepared, which always includes a minimum of three soups, twelve main dishes, some of which are with meat, lean, with minced meat, with rice, with potatoes and four types of desserts.

The profile of the regular customers of the establishment, located at 4 Nikolay Zdravkov Street, is people of different ages, gender and education. The owners are of the opinion that "One satisfied customer will tell three more, and one dissatisfied one will tell at least ten!". They are trying to teach this to their heirs, and currently everyone is trying to work together and offer their customers products that are refined down to the last detail.

Milena Sungerova, together with her brother, have shown their children-the heirs-that one should not be ashamed to talk or work side by side with someone who performs the socalled "dirty" work in Bulgaria - hygienists and others.

Thanks to the education of Milena's daughter at the Faculty of Business and management, University of Ruse "Angel Kanchev", Bulgaria, the family has identified different sources of **risks** and some of them are:

"Physical environment", such as flood, earthquake, hail, pandemics, etc. They could create different risk situations and losses, such as:

- Delay in movement.
- Damage to company cars.
- Demolition of a building.
- Damage to tangible assets.
- Delay in movement.
- Infection of personnel.
- Damage to tables and chairs that are under open sky.
- Leaks in the building.
- Forced cessation of activity.
- Decrease in consumption.

"Social environment" could be: high percentage of aging population, lack of birth rate and high mortality rate, migration, unemployment, low incomes, etc., which could create some risk situations and losses, such as:

- reduction of the population in the city.
- Lack of staff.
- Low purchasing power of customers.
- The "economic international environment" could create different risks, such as:
- Rising commodity prices.
- Rising the delivery prices of gas, electricity, water supply.
- Etc.

The family members have well studied other sources of risks, such as: political environment, legal environment, operational environment, the cognitive environment and have got prepared to face the variety of scenarios to manage these risks.

## 4. CONCLUSION

The literature review of various sources provided some necessary basis for clarifying some terms used in risk management. Their list cannot be exhaustive, due to the volume of this report, but it provides some guidelines that managers should take into account when managing their companies.

The report presents several family companies. They are well recognized not only in the city of Ruse, but also in the country of Bulgaria. What they have in common is that the heirs are now also involved in the activities of these companies. Mutual respect and inheritance arise between generations. Family members share good practices and trade secrets with each other, which help them protect their companies and guarantee the jobs of a large number of people employed by them.

Greater attention in the report was paid to the family company STAPKA Ltd, due to the opportunity to use internal information and identify some of the risks that the company successfully manages and sustainably overcomes.

All companies represented are from the city of Ruse and their owners are reliable partners in local public initiatives, thereby contributing to improving social capital in the region.

The analyzed companies can also be used for educational purposes by teachers who share with their students good practices with family businesses.

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## **RISK MANAGEMENT THROUGH SAFETY STANDARDS FOR TOURISM EVENTS IN BULGARIA: THE CASE OF VIDIN DISTRICT**

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Abstract: The increasing organization of tourist events in Bulgaria has forced various companies to consider risk as a fundamental part of their management and creation. Risk management is an element of financial management and control, which is interconnected with the other derived elements, namely: control environment, control activities, information and communication, and monitoring. The purpose of this study is to analyse the scope of the risk management process when conducting tourist events based on standards. In order to fulfil the set goal, the following tasks have been developed: (1) to examine some basic international standards and the Bulgarian national regulatory documents related to risk management during a tourist event; (2) to present the opportunities of Vidin district to offer tourist events with international participation; (3) to analyse the risk for the festival "Traditional Feast of Petrovden" in the village of Kutovo, Vidin municipality. The presented analyses may be of assistance in risk management when organizing tourist events by local companies and municipal administration.

Keywords: Risks, standards, tourism, Vidin, Bulgaria.

## 1. INTRODUCTION

Risk is all around us; it is the fluctuation between one or more outcomes of one or more upcoming events and their expected outcomes. The outcomes themselves can be positive or negative. When risk is positive, it is considered as a possibility, but when used in a general sense, the word risk is with a view to the potential harm that may arise from an upcoming event or from incurring expenses or from the inability to gain some profit.

Since risk is a complex phenomenon, there are different approaches to the definition of this concept. It should be noted that the concept of risk has different meanings embedded in it. Most often, risk is likened to the fear of not achieving the previously set goals. The origin of the concept of "risk" is from the Greek word "ridsa", a section, a slope. In Italian, "risiko" means danger, threat. In specialized dictionaries – philosophical, military, economic and others, this term "risk" is almost not considered. In the large-scale economic literature, the

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most common definition of risk is to consider it as the possibility of losses occurring or not and what income will be obtained based on the predicted results. (Andreeva, 2014; Pavlov, 2025).

Acording to Gradinoarov (2020) risk encompasses events that have occurred and have been frequently observed, they have created adverse results, on important goods or needs, for people and have a certain property of repeatability. It is this repeatability that turns risk into a measurable chance that can be quantified by the distribution function.

Risk itself is also understood as the danger of something uncertain or as a denial of certainty. Uncertainty is the doubts that a person has regarding the ability to predict which of all possible outcomes will come true. This uncertainty is the individual's personal perception of risk. (Mancheva, 2016).

The risks have different influence on the local economic development, too. According to Zagorcheva and Pavlov (2020) the local taxes have a strong influence on the local businesss environment. This influence on the local tourist businesses could be measured by elaboration of a matrix with criteria, applicable to all Bulgarian municipalities. One of the possible way to reduce the entrepreneurial stress is to increase the role of the families, which is part of the basic concept of the international academic network INTERGEN (Pavlov at al., 2017; Bakracheva at al., 2020; Pavlov at al., 2024; Pavlov at al., 2025).

One of the good management strategy to reduce or avoid the risks in tourist events is to implement the different standards of the International Organization for Standardization and the national legislation. Some of their documents are presented in the next chapter.

# 2. SAFETY STANDARDS WHEN ORGANIZING TOURIST EVENTS IN BULGARIA

In this chapter we will give our attention to some ISO standards and some national legal acts in Bulgaria with direct influence on the tourist events risk management.

According to Gueorguiev and Kostadinova (2021) the ISO standards have to be well known by the managers of the small firms, too, because their successful implementations avoid or mitigates the risks. Some of the ISO standards are:

## ISO 31000:2018 – Risk Management.

As a guideline for comprehensive understanding, this standard promotes a shared understanding of risks, their nature and ways to manage them throughout the organization. Through it, strategic decisions are made, and here the guidelines help to embed risk management into the management, strategy, planning, reporting processes, policies, values and culture of the organization. Operational excellence stands out with the implementation of ISO 31000, as it can lead to increased efficiency, as it helps organizations recognize potential threats and opportunities in a timely manner, allocate resources wisely and increase the trust of stakeholders.

Here a proactive approach stands out, as instead of being purely reactive, ISO 31000 prepares organizations to anticipate and deal directly with risks, turning potential challenges into strategic advantages. There is trust among stakeholders, as a structured approach to risk management signals to interested parties that the organization is robustly prepared and can deal with uncertainty, strengthening trust and reliability. It is a basic framework for identifying, analyzing and minimizing risks. The principles of risk management here are integration, structure, dynamism and adaptability to the context of the problem.

As an example, we can cite the application of a risk assessment matrix in tourist event planning phase.

## ISO 20121:2024 Event sustainability management systems.

This standard guides organizations to seamlessly integrate sustainability into every aspect of their event planning and execution.

This standard provides guidance for organizing sustainable events that minimize social, economic and environmental impacts. It is versatile and applicable to a variety of events, from small gatherings to large-scale conferences and everything in between. Any organization involved in event planning, management or delivery that seeks to integrate sustainability into its operations needs this standard.

The benefit of this standard is that it reduces environmental impact. It promotes a holistic approach to sustainability that impacts through economic, environmental and social impacts. This strengthens the organizational brand reputation and stakeholder engagement and satisfaction, managing to offer a variety of ways to evaluate designated organizations.

Application of the standard allows the tourism sector to organize festivals and conferences with a minimal environmental footprint.

# ISO 22301:2019 Security and resilience - Business continuity management systems.

Preparing for unexpected situations such as disasters, technical problems and health crises, it is the international standard for business continuity management systems (BCMS). It is used to continuously improve a documented management system, thereby preventing, reducing or ensuring recovery from disruptions.

As an example, here we can give the action plan for an electricity power outage during a conference or another tourist event, about what actions to adhere to, in case of emergencies and how to improve with minimal damage in a short time.

## ISO 45001:2018 Occupational health and safety management systems.

The purpose of this standard is to provide a framework for managing OH&S risks and opportunities. It prevents work-related injury and ill health to workers, as well as, it provides safe and healthy workplaces. The safety of technical equipment when organizing events is a critical aspect of event management. Unreliable equipment can lead to incidents such as technical failures, injuries to staff and visitors, or interruption of the event.

The goal of the tourist event is to ensure a safe environment for all users through proper planning, maintenance, and monitoring. The main risks associated with technical equipment can occur if the equipment is damaged, for example - a broken stage, faulty lighting, damaged screens or sound systems. When we have incorrect installation of the equipment, such as unstable structures, incorrectly fastened elements. Very common are electrical hazards from short circuits, poor grounding, network overload. Overloading of the equipment or exceeding the capacity of the stage and supporting structures also occurs.

To prevent these risks, it is necessary to take measures for the safety of technical equipment, by conducting a risk assessment in advance - in case of potential hazards related to the equipment, an action plan should be prepared in the event of damage or accident. There should be regular inspection and maintenance - such as checks of technical equipment before, during and after the event. The manufacturer's maintenance instructions should be followed. The team that works with technical equipment must be well trained. They must have undergone training in working with electrical equipment, scenes and lighting.

## National regulatory framework of Bulgaria

The national legal system in Bulgaria has different regulatory acts, which increase the safety of the tourist sector. Some of them are:

Act on the Protection of Public Order during Mass Events. This law implements the specific regulations for the safety of participants and visitors. Requirements for security, medical insurance and planning in the event of evacuation.

- Ordinance on the Safety of Public Facilities. Compliance with health and hygiene requirements. Sanitary areas must be provided for outdoor events.
- Act on Crisis Management in Bulgaria. Implementation of response measures in force majeure circumstances (natural disasters, accidents). Its application is highlighted by the rapid response teams during risks.
- Act on Tourism. This law regulates public relations related to the implementation of management and control in tourism, the interaction of the state and municipalities in the implementation of activities related to tourism, as well as the participation of non-profit legal entities and individuals in these activities.

To achieve good results, good practices and examples are needed from which event organizers can be guided. Risk management systems are one of the most widely used, such as specialized software for identifying risks (for example, EventRiskManagement Software). The software allows for the identification and tracking of potential risks through integrated systems. By applying it, we will have a risk assessment for large events (e.g. football matches). And the result is a reduction in logistics errors and ensuring safety for visitors and participants. For a quick response, training is also necessary to be able to respond quickly, through training simulations in emergency situations and to have staff prepared and minimize panic.

In tourist event management, technologies such as QR codes for safe access to events are also necessary. The advantages are that there is real-time control over the capacity of the venue and access to the event is accelerated. Automation of capacity control processes in real time is successful, through the use of automated tracking systems for technical equipment (via RFID chips). Thus, there is a rapid tracking of lost equipment and timely replacement of defective devices. And safety monitoring systems work in real time.

It is impossible without communication strategies, and they are available when there is a crisis PR plan for managing reputational risks. Preparing preliminary scenarios for statements, using social media to inform the audience and creating an information line for visitors are part of these strategies. The audience should always be notified in case of unexpected changes.

There are different places of interest for the tourists in the district of Vidin, Bulgaria and we will present some of them in the next chapter.

## 3. PLACES OF INTEREST IN VIDIN DISTRICT TO ATTRACT TOURISTS

## 3.1. Tourist places

According to the official publication of the Vidin regional administration (2025) the area around Vidin is with unusually rich history:

- The cave Magura – "A Pearl in the Crown". It is a unique underground museum with many ancient drawings on the wall, which have turned the cave into an original gallery of prehistoric art. Since 1984 this cave is part of the global cultural legacy under the recognition of UNESCO.

- The Rabisha Lake – the only lake in Bulgaria with a Karst and Teutonic origin. Medieval Bulgarians believed that water should always be in motion. According to them, there are huge caves in the mountains, full of water, which emerge and flow out at a special place called a spring. At the same time, these waters are home to the forest nymphs and devils. This lake was also associated with legendary people, animals and superpowers.

- The Danube River. Vidin district has more than 60 km Danube river coast, which is a good place to develop different tourist activities, such as international regatta TID, festivals,

sport, river cruisings, fishing and many others. In particular for the city of Vidin the sun rises from west, which is an unique visual illusion.

- Biosphere reserve "Chuprene". It has an area of 1439 hectares. Also, it is included in the list of reserves under the aegis of UNESCO.

-Many others, like Baba Vida Fortress, Belogradchik Fortress, Hunting and gamebreading station "Midzhur", Orthodox Monasteries, The fortress "Castra Matrix", The Roman fortress city of "Raciaria", wine touristic places, SPA and Wellness centres, International Folklore Festival "Dances by the Danube", Festival of Authentic Folklore "Danube Rhythms", etc., which attract every year different tourists from Bulgaria and abroad.

## **3.2 Traditional Petrovden Celebration**

In particular, we pay attention to the risk management of one specific festival – "Traditional Petrovden Celebration", in the village of Kutovo, because the author of this article is involved in its annual organization – Leona Star Ltd.

The traditional participants of this celebration are folklore ensembles from Bulgaria, Serbia and Romania. The participants show their traditions and customs in order to renew the desire in the younger generation to preserve and cherish their past and to respect everything that their grandparents have gone through.

The "Traditional Petrovden Celebration" needs a detailed project and financial plan, with activities allocated according to the time, resources and responsibilities assigned to the project. Financial issues that may be considered include how many participants are needed to financially secure the event. All events should have a contingency plan and risk management. Proper timing is key in planning. We should never underestimate how long it would take to complete each task and anticipate the possibility of overlapping them.

The venue and food are the two largest items in the costs of organizing an event. When choosing a venue for an event, there are many things to consider, but it is especially important to think about the hidden costs and risks. When organizing such a grand event, there are a number of risk factors and the most important are – organizational, technical, natural, political, transport/logistics/, social and economic-financial.

To be sure that we have a good risk management about the technical facilities, we must plan the installation and carry out the necessary technical checks, namely:

- Use qualified specialists for the installation and maintenance of the stage equipment.
- Carry out an initial inspection before the start of the event and carry out daily checks during the event.
- Ensure stable foundations for the stage and structures, especially on uneven terrain.
- Install emergency switches for electricity and test the lighting system.

Electrical safety should always be based on the use of certified electrical installations from a professionally installed installation. In order for there to be no problems with technical facilities with electricity, there must be insulation and protection of the electrical cables to prevent tripping and short circuits. Place grounded electrical distribution boards in safe places.

Fire safety is very important for everyone at the festival, therefore:

- Fire extinguishers should be placed in strategic locations around the technical facilities.
- The use of open flames near lighting and sound equipment should be prohibited.
- Staff should be trained in fire procedures and the presence of clearly marked emergency exits.

To properly ensure safe evacuation, it is necessary to:

- Plan evacuation routes that are not blocked by equipment and technical facilities.
- Provide illuminated and clearly marked emergency exits.
- Install emergency lighting that will work in the event of a power outage.

In order for everything to run smoothly at the event, there must be responsibility and control of the technical facilities. A technical manager should be appointed to monitor the operation of the equipment and facilities. Protocols for emergency response should be followed and cooperation should be established with regulatory authorities – fire department, electrical inspection, health services.

The Traditional Petrovden Celebration is smoothly organized every year, because we use some standards such as - ISO 31000 - Risk Management; ISO 20121 - Sustainable Event Management Systems; ISO 22301 - Business Continuity Management and the National Regulatory Framework with its laws and regulations.

#### 4. CONCLUSION

In this article we have examined some basic international standards and the Bulgarian national regulatory documents related to risk management during a tourist event. The safety of technical facilities is a critical aspect of any tourist event organization; it requires careful planning, constant control and strict adherence to the here discussed standards.

Risk management is not a state, but a process. There is no final phase in which it is implemented and can sustain itself – "from now on" or "forever". Every new tourist project or tourist event should always have an option to avoid or deal with the potential risks.

Risk management is a culture, structure, standards, practices, processes, safeguards and distributed responsibilities that are aimed at identifying, assessing, making decisions and implementing activities regarding risks in order to prevent risks or to minimize damage if risks are realized. When we manage the risk, we have to be proactive - to deal with harm and opportunities long before they become reality.

Risk management is a key element for the successful organization of events. Through strategic planning, timely identification of threats and implementation of effective prevention measures, the negative impact of these risks can be significantly reduced. By implementing preventive measures, regular inspections and qualified personnel, the risk of incidents can be significantly reduced and the safe conduct of the event can be guaranteed.

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# **EXPERT FORECASTING OF TECHNOLOGIES: THE DELFI METHOD**

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**Abstract**: This paper discusses the DELFI method, with a focus on the implementation of new systems in organizations. The stages of the DELFI method, the importance of the method in decision-making at the organizational level, advantages and limitations were analyzed. The research includes a DELFI survey among experts (professors) on the implementation of a system for tracking the arrival and departure of employees. The research was conducted at the Technical Faculty in Bor. The aim of this paper is to assess the readiness and potential of the new system. The outcome obtained from the first and second round of the DELFI method was analyzed by comparing the opinions of experts and analyzing the degree of agreement. The results are highly applicable to organizations considering the introduction of new technology in an attempt to increase employee efficiency and accountability.

Keywords: DELFI method, expert consensus, system implementation, adoption of technology.

## **1. INTRODUCTION**

Over the past four decades, we have witnessed a rapid development in the field of technological forecasting, which is directly related to forecasting in organizations. This progress, both in theory and in practice, has been fueled by increasing complexity, increasing competition and rapid changes in the business environment. Today, every institution wants to maintain its efficiency and transparency, and it will only succeed if it keeps up with new technologies and trends.

There are a large number of methods of technological forecasting, one of these methods is the Delphi method, which was used to obtain the results in this research. This work is based on the collection of opinions by experts on the possibility of introducing a system for monitoring the presence of employees at work. The experts participating in this research are professors of the Technical Faculty in Bor. This research is carried out in several rounds, until a consensus is reached on the given topic.

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The beginning of the application of the Delphi method in the academic community is linked to the correspondence of university professors from Ohio University in the United States, with the aim of developing criteria for evaluating the quality of faculties. The method was developed during the height of the Cold War in order, in the absence of sufficient exact data, to predict the future international situation and potential war situations, and to forecast the global scientific and technological development of military potential. The Delphi method is applied in order to, based on the opinions of respondents/participants, which may be largely conflicting, shaped possible solutions to a particular problem (Nikolić & Veselinov, 2019).

The aim of this work is to provide information on how employees are ready to accept new technologies, and what are the challenges and shortcomings that represent a barrier when we talk about the introduction of digitization in every business segment. On the other hand, how the application of digitalization can affect the efficiency of operations in higher education institutions.

#### 2. LITERATURE REVIEW

The Delphi method is one of the most applicable methods of predicting future technological advances and their impacts. It provides a systematic collection of expert opinions through several consecutive rounds, until a consensus is reached in the answers. In the field of education, the Delphi method is used to define strategic directions for the development of higher education, assess the need for digital competences, and predict the impact of new technologies on educational processes. For example, research by Ghaffarzadegan and Xue (2017) used the Delphi method to identify key factors that will shape the future of higher education, including digital transformation and process automation.

Cho, Cheng, and Shen (2019) used the Delphi method in a higher education setting to analyze faculty readiness to accept AI-based technology. Their research showed that experts agree that digital tools, including employee activity tracking systems, will become an indispensable part of modern university management.

Also, the study by the authors Rădulescu and Rădulescu (2014) analyzed the use of the Delphi method in the context of the introduction of information systems in university administrations. The results showed that the method is effective in building consensus between academic and administrative staff about key functionalities and challenges in implementing digital solutions.

A significant contribution to the literature was made by the work of the author Petrov et al. (2021), who used the Delphi method to analyze the opinions of university professors and management on the introduction of electronic time recording tools. The results indicated divided opinions - while some saw benefits in greater efficiency, others expressed concern about the possible erosion of employee autonomy.

These literatures provide a good theoretical framework in the context of the application of the Delphi method in educational institutions, when it comes to the system for monitoring the arrival and departure of employees. Also, and in what way it can contribute to a better organization of work at faculties, while considering professors' views on the advantages and potential challenges of such systems.

#### **3. RESEARCH METHODOLOGY**

The application of the Delphi method in research at the university aims to analyze the attitudes towards the introduction of a system for the technology of checking employees when they arrive and leave work. Through this approach, it is possible to identify key advantages,

potential challenges and necessary conditions for the implementation of the system, relying on the opinions and experiences of experts from different fields. The research results can serve as a basis for making decisions about the development and implementation of the system, as well as for improving the organization of work and administrative processes at the faculty.

The methodology of carrying out the Delphi method includes several key steps: defining the research problem and objectives, forming a group of experts with relevant experience, creating and distributing a series of questionnaires, analyzing the collected answers and reaching a consensus.

For the implementation of the Delphi method at the college, the research will be focused on gathering opinions and forecasts from experts regarding the technology of monitoring the arrival and departure of employees. Before applying the Delphi method itself, it is necessary to form a group of experts, the ideal size of which is from 5 to 15 experts. Precisely for participation in this survey, a small panel was sufficient, i.e. participation of only 6 experts. In this case, the experts will be the professors of the faculty, who have relevant knowledge about the organization of work, the needs of the faculty and the possibilities of technology implementation.

After the research question is defined, an online questionnaire will be organized and will be sent to each of the experts. The survey will be distributed via e-mail, which will allow easy access and anonymity in answering, which is key to this method. The online format will enable easier communication and faster feedback from experts.

In the first round of research, experts (six professors) will be asked via an online survey about issues related to the technology of monitoring the arrival and departure of employees from work. The aim of the research is for experts to assess the perception of the potential impact of the introduction of a system for monitoring the arrival and departure of employees at the university, using a five-level Likert scale. The rating should reflect their subjective feeling and opinion regarding the analyzed parameters. The scale has the following meaning: (1) very weak / negative; (2) weak; (3) neutral; (4) good; (5) extremely good / very positive.

After analyzing the answers, it should be seen whether a consensus has been reached, if not, a second round of the Delphi method is carried out. This two-way approach allows for a gradual alignment of opinions and a deeper understanding of the topic.

The participants are required to express their opinions anonymously, in as many rounds as it is necessary for the variations in the mean values to lose significance, i.e. until a consensus is reached among the experts. This is followed by the processing of the obtained results, determination of the median, interquartile range and standard deviation. Once consensus is reached, this process ends. Below are the formulas that will be used:

Median (for an odd number of data in the sample):

Me= 
$$\frac{x_{2(n+1)}}{x_{2(n+1)}}$$

**Median** (for an even number of data in the sample):

$$Me = \frac{\frac{x_{2n}}{4} + \frac{x_{2n}}{4} + 1}{2}$$
(2)

Variance:

$$6n^2 = \frac{\sum (x-x)^2}{n-1}$$
 (3)

#### **Standard deviation:**

$$Gn = \sqrt{Gn2}$$
 (4)

(1)

The interquartile range (IQR) represents the difference between the third and first quartiles.

Interquartile range:

$$IQR = Q3 - Q1 \tag{5}$$

First quartile:

$$Q1 = P25 = \frac{25}{100} \cdot n$$
 (6)

Third quartile:

$$Q3 = P75 = \frac{75}{100} \cdot n$$
 (7)

In our own research where the standard deviation is used to reach consensus, the standard deviation must be less than 1.5 (Christie & Barela, 2005) and the interquartile range less than 2.5 (Kittell-Limerick, 2005).

Table 1 of the paper shows a survey containing questions intended for experts involved in the research.

Table 1. Survey with question	ns intended for	experts (	Hollingsworth	& Moore,	2008; Chi	u & F	łuang,
2011; Ng & Wakenshaw, 201	7)						

	1 = very weak / negative	2 = weak	3 = neutral	4 = good	5 = extremely good / very positive
How would you rate the potential benefit of introducing a system for monitoring the arrival and departure of employees at the university?					
How much do you think this system would contribute to a better organization of work at the university?					
How do you assess the faculty's readiness to implement this system?					
How ready would you be to adapt to using the new system?					
How important is it for the faculty to introduce a system for monitoring the arrival and departure of employees?					
How would you rate the level of security of the data that would be collected through this system?					
How would the introduction of this system affect mutual relations among employees?					
Do you think that a system for monitoring the arrival and departure could contribute to improving the discipline and punctuality of employees?					
How would you rate the possible costs associated with implementing the system versus its benefits?					
How likely is it that this system could be considered unfair to employees?					
Do you have additional comments, suggestions, or opinions about this research?					

#### 4. RESULTS AND DISCUSSION

When applying the Delphi method, special emphasis is placed on reaching a consensus among experts. In this study, consensus will be assessed using the following parameters: median, interquartile range, and standard deviation. The following Tables (2, 3, 4, 5, 6, 7, 8, 9, 10, 11) show the responses of experts in the first round of the Delphi method. Tables (12, 13, 14, 15, 16, 17, 18, 19, 20, 21) show the median, standard deviation and interquartile rank for all questions.

*Table 2.* Results of the survey (first round) - How would you rate the potential benefit of introducing a system for monitoring the arrival and departure of employees at the university?

	1 = very weak / negative	2 = weak	3 = neutral	4 = good	5 = extremely good / very positive
Expert number 1.		Х			
Expert number 2.		Х			
Expert number 3.			Х		
Expert number 4.			Х		
Expert number 5.				Х	
Expert number 6.					Х

*Table 3.* Results of the survey (first round) - How much do you think this system would contribute to a better organization of work at the faculty?

	1 = very weak / negative	2 = weak	3 = neutral	4 = good	5 = extremely good / very positive
Expert number 1.		Х			
Expert number 2.		Х			
Expert number 3.			Х		
Expert number 4.			Х		
Expert number 5.				Х	
Expert number 6.					Х

*Table 4.* Survey results (first round) - How do you assess the faculty's readiness to implement this system?

	1 = very weak / negative	2 = weak	3 = neutral	4 = good	5 = extremely good / very positive
Expert number 1.	Х				
Expert number 2.	Х				
Expert number 3.	Х				
Expert number 4.		Х			
Expert number 5.			Х		
Expert number 6.			Х		

•				•	•
	1 = very weak / negative	2 = weak	3 = neutral	4 = good	5 = extremely good / very positive
Expert number 1.		Х			
Expert number 2.				Х	
Expert number 3.				Х	
Expert number 4.				Х	
Expert number 5.					Х
Expert number 6.					Х

Table 5 Survey	v results (	first round	) - How re	bluow vbe	vou he to a	adant to us	sing the new s	system?
<i>Tuble J.</i> Surve	y results (	Inst Iounu	) - 110w 16	auy would	you be to a	auapt to us	sing the new s	y Stem!

*Table 6.* Results of the survey (first round) - How important is it for the faculty to introduce a system for monitoring the arrival and departure of employees?

	1 = very weak / negative	2 = weak	3 = neutral	4 = good	5 = extremely good / very positive
Expert number 1.	Х				
Expert number 2.			Х		
Expert number 3.			Х		
Expert number 4.				Х	
Expert number 5.				Х	
Expert number 6.					Х

*Table 7.* Survey results (first round) - How would you rate the level of data security that would be collected through this system?

	1 = very weak / negative	2 = weak	3 = neutral	4 = good	5 = extremely good / very positive
Expert number 1.		Х			
Expert number 2.			Х		
Expert number 3.			Х		
Expert number 4.			Х		
Expert number 5.			Х		
Expert number 6.					Х

*Table 8.* Survey results (first round) - How would the introduction of this system affect mutual relations among employees?

	1 = very weak / negative	2 = weak	3 = neutral	4 = good	5 = extremely good / very positive
Expert number 1.	Х				
Expert number 2.	Х				
Expert number 3.	Х				
Expert number 4.	Х				
Expert number 5.			Х		
Expert number 6.				Х	

Table 9. Results of the survey (first round) - Do you think that the system for monitoring the arrive	al
and departure could contribute to the improvement of discipline and punctuality of employees?	

	1 = very weak / negative	2 = weak	3 = neutral	4 = good	5 = extremely good / very positive
Expert number 1.	Х				
Expert number 2.		Х			
Expert number 3.			Х		
Expert number 4.			Х		
Expert number 5.					Х
Expert number 6.					X

*Table 10.* Results of the survey (first round) - How would you rate the possible costs related to the implementation of the system in relation to its benefits?

	1 = very weak / negative	2 = weak	3 = neutral	4 = good	5 = extremely good / very positive
Expert number 1.			Х		
Expert number 2.			Х		
Expert number 3.			Х		
Expert number 4.			Х		
Expert number 5.			X		
Expert number 6.				Х	

*Table 11.* Survey results (first round) - How likely is it that this system could be considered unfair to employees?

	1 = very weak / negative	2 = weak	3 = neutral	4 = good	5 = extremely good / very positive
Expert number 1.	Х				
Expert number 2.		Х			
Expert number 3.			Х		
Expert number 4.			Х		
Expert number 5.			Х		
Expert number 6.				Х	

*Table 12.* Data processing based on the results of the survey in the first round (How would you rate the potential benefit of introducing a system for monitoring the arrival and departure of employees at the university?)

	Me	Q1 (P25)	Q3 (P75)	IQR	бn
How would you rate the potential benefit of introducing a system for monitoring the arrival and departure of employees at the university?	3	2	3,5	1,5	1,17

When the standard deviation is less than 1.5 and the interquartile range is less than 2.5, it can be concluded that there is a high consensus among respondents. In this case, with a standard deviation of 1.17 and an IQR of 1.5, it can be concluded that the answers are very concentrated around the median (3), which means that the respondents are largely in agreement in their opinions or attitudes.

*Table 13.* Data processing based on the results of the survey in the first round (How much do you think this system would contribute to a better organization of work at the faculty?)

2	U		2	,	
	Me	Q1 (P25)	Q3 (P75)	IQR	бn
How much do you think this system would contribute to a better organization of work at the university?	3	2	3,5	1,5	1,17

It can be concluded that there is a high consensus among the respondents. In this case, with a standard deviation of 1.17 and an IQR of 1.5, the responses are highly concentrated around the median (3), which means that the respondents are largely in agreement in their opinions or attitudes.

*Table 14.* Data processing based on the results of the survey in the first round (How do you assess the faculty's readiness to implement this system?)

	Me	Q1 (P25)	Q3 (P75)	IQR	бn
How do you assess the faculty's readiness to implement this system?	1,5	1	2,5	1,5	0,98

Given that the standard deviation is less than 1.5 and the IQR is equal to 2.5, it can be concluded that there is a consensus among the respondents on the faculty's readiness to implement the system. This means that the answers are very uniform and most respondents agree on the position that the faculty is not fully ready for implementation.

*Table 15.* Data processing based on the results of the survey in the first round (How ready would you be to adapt to using the new system?)

	Me	Q1 (P25)	Q3 (P75)	IQR	бn
How ready would you be to adapt to using the new system?	4	3	4,5	1,5	1

Based on these statistical data, it can be concluded that there is a relative consensus among the respondents regarding the readiness to adapt to the use of the new system. The median, quartiles, IQR and standard deviation show that most responses are concentrated around the middle of the scale (about 4), and the variation among responses is less than 1.5, which means that attitudes are relatively aligned.

*Table 16.* Data processing based on the results of the survey in the first round (How important is it for the faculty to introduce a system for monitoring the arrival and departure of employees?)

	Me	Q1 (P25)	Q3 (P75)	IQR	бn
How important is it for the faculty to introduce a system for monitoring the arrival and departure of employees?	3,5	2	4	2	1,25
arrival and departure of employees?					

Based on these statistical measures, it can be concluded that there is consensus among the data, as the standard deviation and IQR are within limits indicating little variation among responses. So, the respondents are largely in agreement.

*Table 17.* Data processing based on the results of the survey in the first round (How would you rate the level of security of the data that would be collected through this system?)

	Me	Q1 (P25)	Q3 (P75)	IQR	бn
How would you rate the level of security of the data that would be collected through this system?	3	3	3	0	0,89

The data have a low interquartile range (IQR = 0), which means that all responses are very uniform. The variance and standard deviation are also low, indicating that the data are concentrated around the mean (median). This may indicate a high level of agreement among respondents.

*Table 18.* Data processing based on the results of the survey in the first round (How would the introduction of this system affect mutual relations among employees?)

	Me	Q1 (P25)	Q3 (P75)	IQR	бn
How would the introduction of this system affect mutual relations among employees?	1	1	3	2	1,17

The interquartile range (IQR) is 2, indicating some dispersion of the data between the first and third quartiles. Given that the variance and standard deviation are not very high, the data have a moderate variation in relation to the mean value (median). Although there is some scatter, the data is still relatively consistent.

*Table 19.* Data processing based on the results of the survey in the first round (Do you think that the system for monitoring the arrival and departure could contribute to the improvement of discipline and punctuality of employees?)

	Me	Q1 (P25)	Q3 (P75)	IQR	бn
Do you think that a system for monitoring the arrival and departure could contribute to improving the discipline and punctuality of employees?	3	2	5	3	1,5

In this case, IQR = 3, it can be concluded that **the data are not fully consistent** according to that criterion, because the IQR value is greater than 2.5. According to this criterion, there is a discrepancy in the data, because the dispersion between the first and third quartiles indicates a wider distribution of values.

*Table 20.* Data processing based on the results of the survey in the first round (How would you rate the possible costs related to the implementation of the system in relation to its benefits?)

	Me	Q1 (P25)	Q3 (P75)	IQR	бn
How would you rate the possible costs associated with implementing the system versus its benefits?	3	3	4	1	0,37

In this case, there is consensus according to the criteria for IQR and standard deviation.

*Table 21.* Data processing based on the results of the survey in the first round (How likely is it that this system could be considered unfair to employees?)

	Me	Q1 (P25)	Q3 (P75)	IQR	бn
Do you have additional comments, suggestions, or opinions about this research?	2,5	2	3	1	0,94

In this case, there is consensus according to the criteria for IQR and standard deviation.

To obtain more precise results, it is necessary to perform the second round of the Delphi method. The second round includes those questions for which no consensus was reached in the first round, in this case it is only one question: *Do you think that a system for monitoring arrival and departure could contribute to improving the discipline and punctuality of employees*? Tables 22 and 23 show the results of the second round.

*Table 22.* Results of the survey (second round) - Do you think that the system for monitoring the arrival and departure could contribute to the improvement of discipline and punctuality of employees?

	1 = very weak / negative	2 = weak	3 = neutral	4 = good	5 = extremely good / very positive
Expert number 1.		Х			
Expert number 2.		Х			
Expert number 3.			Х		
Expert number 4.				Х	
Expert number 5.				X	
Expert number 6.					X

*Table 23.* Data processing based on the results of the survey in the second round (How likely is it that this system could be considered unfair to employees?)

	Me	Q1 (P25)	Q3 (P75)	IQR	бn
Do you think that a system for monitoring the arrival and departure could contribute to improving the discipline and punctuality of employees?	3,5	2	4	2	1,1

Based on the results calculated for a given set of data obtained after conducting two rounds of research, it can be concluded that the data are in accordance with the conditions for reaching a consensus. The standard deviation and interquartile range indicate consistency of responses and a high degree of agreement among survey participants.

#### **5. CONCLUSION**

Through the study of the Delphi method, it can be seen that this systematic approach allows organizations to recognize future trends, identify potential challenges and opportunities, and thus make informed decisions that support their long-term development. The Delphi method, with its emphasis on collective knowledge, is proving to be an effective tool for generating reliable predictions.

The results of applying the Delphi method show that experts recognize the significant potential of introducing a system for monitoring the arrival and departure of employees to the

faculty. Most of the participants believe that this kind of technology would contribute to better organization of work, increased efficiency and transparency. However, challenges were also identified, such as the necessity of adequate employee training, investment in infrastructure and ensuring data protection. Expert consensus indicates that good preparation, including system testing and developing strategies to address potential ethical issues, is key to successful implementation. This work provides a basis for further research in this area, with the aim of developing even more effective approaches to technological forecasting and adapting them to the specific needs of different sectors.

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# STRATEGIC CRISIS MANAGEMENT IN 2025: BUILDING ECONOMIC RESILIENCE IN A VOLATILE WORLD

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Abstract: As the global economy faces ongoing instability, the need for long-term economic resilience has taken center stage in policy and business discussions. Rather than responding reactively to individual crises, today's organizations must adapt to an environment where shocks are persistent and interconnected. This article investigates how resilience strategies are being redefined in 2025, moving beyond traditional financial safeguards toward more integrated approaches that include policy coordination, technological adaptation, and labor market flexibility. Drawing on recent global trends, the paper explores the tensions between short-term economic responses and the long-term investments required to maintain competitiveness and stability. It also assesses the implications of U.S. fiscal and trade policies in shaping global outcomes, with a focus on tax reform, supply chain vulnerabilities, and inflation dynamics. Finally, it considers the role of innovation and workforce transformation, particularly in light of artificial intelligence and shifting skills demands. Through this lens, the article aims to offer insights into how governments and businesses can better prepare for an increasingly complex and uncertain economic future.

Keywords: economic resilience, strategic crisis management, tariffs, volatile, instability.

#### 1. INTRODUCTION

The modern global economic environment is highly volatile, driven by a combination of geopolitical instability, energy crises, inflation, and technological shifts (Malynovska, Bilonizhka, Hrynchuk, 2025). In an era defined by compounding crises, economic resilience has become a fundamental priority for businesses and governments alike. The volatility of global markets, shifting geopolitical tensions, and rapid technological advancements demand a recalibrated approach to strategic crisis management. Organizations are no longer simply reacting to disruptions; they must anticipate and integrate resilience into their core strategies

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to sustain long-term growth. However, despite increasing awareness of these challenges, many institutions remain unprepared for the scale and complexity of modern economic shocks.

As businesses strive to navigate uncertainty, resilience-building has moved beyond financial safeguards and digital fortification to encompass proactive scenario planning, adaptive leadership, and cross-sector collaboration. Yet, a critical gap persists between recognizing the importance of resilience and effectively embedding it into long-term strategic frameworks. While defensive measures, such as short-term risk mitigation and crisis response, continue to dominate corporate agendas, forward-looking investments in innovation, workforce adaptability, and macroeconomic stability are often sidelined.

This article examines the evolving dynamics of strategic crisis management in 2025, focusing on key economic and policy shifts that will shape global resilience. It explores the implications of U.S. economic exceptionalism, particularly in its dual role as a driver of global growth and a source of disruption, exemplified by its tax policy shifts that impact multinational businesses worldwide. Additionally, it analyses price volatility, considering how inflationary pressures may ease even as supply chain fragilities persist. Lastly, the paper delves into the evolving labor market, highlighting the transformative role of artificial intelligence in reshaping workforce dynamics. By addressing these critical issues, this study aims to provide a comprehensive framework for building economic resilience in an increasingly unpredictable world.

# 2. THE PARADOX OF THE U.S. ECONOMIC EXCEPTIONALISM: GROWTH ENGINE OR GLOBAL DISRUPTOR?

As newly re-elected President Donald Trump embarks on his second term, his administration has wasted no time in making bold economic moves. From his first days back in office, he has reinforced his commitment to what he sees as a pro-American economic strategy, one that prioritizes domestic manufacturing, job security, and reduced reliance on foreign goods. At the heart of this approach lies an aggressive tariff policy, a tool that President Trump has frequently touted as essential to correcting trade imbalances and protecting U.S. industry. However, while these measures are designed to stimulate domestic production, their broader impact extends far beyond American borders, triggering responses from global markets and igniting concerns over economic volatility.

President Trump's tariff-heavy strategy is not just a domestic maneuver; it has reshaped international trade relations, prompting retaliatory actions from some of the world's largest economies. The ripple effects of these policies raise critical questions: Does economic protectionism genuinely foster resilience, or does it introduce new vulnerabilities? As businesses, consumers, and foreign governments react to these sweeping measures, the world watches closely to determine whether the U.S. is steering global economic growth or inadvertently fuelling disruption.

At its core, a tariff is a tax imposed on imported goods, increasing their cost for domestic buyers. President Trump has long advocated for tariffs as a mechanism to reduce trade deficits, incentivize local production, and boost government revenue. His administration's latest wave of tariffs specifically targets key trade partners, including China, Mexico, Canada, and the European Union, with duties placed on a broad range of goods, from raw materials like steel and aluminium to consumer products such as cars and electronics. The rationale behind these measures is twofold. First, by making imported goods more expensive, the administration hopes to encourage American consumers and businesses to prioritize domestic alternatives. Second, tariffs serve as a bargaining tool, pressuring foreign governments to negotiate more favourable trade terms with the U.S. However, this approach is not without its risks. While tariffs can strengthen certain sectors in the short term, they also have the potential to drive up consumer prices, strain diplomatic relations, and disrupt global supply chains.

Date	Tariff Policy	Targeted Goods	Intended Economic Impact	Potential Consequences	
4 feb.	10% tariff on imports from China	Various consumer and industrial goods	Reduce trade deficit with China	Higher prices on imported goods; strain on U.SChina trade relations	
7 feb.	Exemption for shipments under \$800 from China	Small-value goods	Reduce impact on small businesses and consumers	Limited effect on overall trade dynamics	
4 mar.	10% tariff on Chinese goods increased to 20%	Electronics, raw materials, manufactured goods	Increase pressure on China, encourage local production	Cost increases for businesses; supply chain disruptions	
4 mar.	25% tariff on Mexican and Canadian goods; 10% on Canadian energy imports	Automobiles, industrial goods, energy products	Support U.S. industry, decrease reliance on foreign energy	Rising fuel prices; possible retaliation from Canada and Mexico	
5 mar.	Temporary tariff exemption for North American cars	Cars produced under existing free trade agreements	Support regional trade partners, stabilize auto industry	Potential loopholes in tariff impact	
6 mar.	Tariff exemption expanded to more North American goods	Televisions, air conditioners, avocados, beef	Reduce costs on key consumer goods	Mixed economic effects; benefits consumers but maintains trade reliance	
6 mar.	Tariffs on potash reduced from 25% to 10%	Fertilizer component	Support U.S. agriculture, lower costs for farmers	Price volatility in the global fertilizer market	
12 mar.	25% tariff on all steel and aluminum imports	Global steel and aluminum	Protect domestic metal industries, create jobs	Increased production costs for U.S. manufacturers	
2 apr.	25% tariff on imported cars	Foreign automobiles	Promote U.S. auto industry	Higher prices for consumers; potential retaliation from trading partners	
May or later	25% tariff on imported car parts	Auto parts from global suppliers	Encourage domestic auto parts production	Increased vehicle maintenance costs; impact on supply chains	

Table 1. Summary of Trump's 2025 Tariff Policies and Their Impact

Source: created by the author based on the BBC "What are tariffs and why is Trump using them?" article (March 27th, 2025)

While the long-term impact of tariffs may eventually reach savers when their savings are used for consumption, the immediate financial burden is placed on current consumers. In addition to their regressive nature, tariffs introduce economic distortions by shifting resources toward industries where the U.S. lacks a comparative advantage, and away from more productive sectors. Given that the U.S. economy operates close to full employment, increased domestic production of previously imported goods does not expand total output but rather reallocates resources from other areas, such as export-oriented industries. Although proponents argue that higher consumer prices are a worthwhile trade-off for increased domestic manufacturing, this perspective often ignores key consequences. A large portion of U.S. imports consists of intermediate goods, so tariffs on these inputs raise production costs and undermine the global competitiveness of American manufacturers. Moreover, retaliatory tariffs imposed by trade partners directly impact U.S. exports, adversely affecting workers in export sectors. This was evident during the U.S. - China trade tensions under the Trump administration, when much of the tariff revenue was used to compensate American farmers harmed by retaliatory measures (Clausing, 2025).

The international response to Trump's tariffs has been swift and, in many cases, retaliatory (Table 1). China, for example, has implemented counter-tariffs on American agricultural products and high-tech industries, directly impacting U.S. farmers and corporations. Similarly, the European Union has announced new levies on American exports, including alcoholic beverages and steel, escalating the risk of a prolonged trade conflict. Canada, one of U.S. key trading partners, has imposed tariffs on U.S. steel and other goods. Mexico, the second key trading partner, has taken a more measured approach and has opted for negotiations rather than immediate retaliation.

These countermeasures highlight the interconnected nature of global trade, where economic actions in one country inevitably reverberate across others. A growing concern among economists is that prolonged tariff disputes could disrupt supply chains, reduce investment confidence, and ultimately slow global economic growth. The prospect of a full-scale trade war remains a looming threat, as escalating tariffs risk pushing economies into cycles of tit-for-tat retaliation, where no party emerges unscathed.

Economically, this strategy poses severe risks, since factors such as limited upward mobility and job market inequalities shall persist and further weaken the United States socially and economically (Chohan, 2024). While the administration frames its tariff policy as a strategy for strengthening American industry, the reality for businesses and consumers is more complex. Higher import costs are often passed down to consumers, leading to increased prices for everyday goods such as fuel, food, and household appliances. Industries that rely on foreign raw materials, such as automotive manufacturers and technology companies, may see production costs rise, potentially leading to job losses or lower profit margins.

Trump's broader tariff proposals would cost the typical American household over\$2,600 a year Distribution of gains from TCJA extensions and losses from Trump's tariff proposals, percent change in after-tax income. The tariff estimates examine a 20% tariff on most imported goods and a 60% tariff on imports from China. The net effect bars show the combined net effect of the loss (tax increases) from proposed tariffs and the gain (tax reductions) from TCJA extensions. Tariff calculations follow the method detailed in Clausing and Lovely (2024) and its extension, which uses 2022 estimates from the Tax Policy Center; these do not include many business provision extensions that have been proposed (Clausing, 2025).

Small and mid-sized businesses, in particular, face heightened challenges. Unlike large corporations, which may have the resources to absorb increased costs or shift supply chains, smaller enterprises often lack such flexibility. For them, tariffs can mean slimmer profit margins, reduced competitiveness, and, in extreme cases, the inability to sustain operations.

<u> </u>	8		
	Gains from TCJA extensions, 2025	Consumer loss from proposed tariffs	Net Effect
Lowest Quintile	0.5 %	-6.3 %	-5.8 %
Second Quintile	1 %	-5.3 %	-4.2 %
Middle Quintile	1.3 %	-4.1 %	-2.7 %
Fourth Quintile	1.4 %	-3.4 %	-1.9 %
Top Quintile	2.1 %	-2.9 %	-0.7 %
Top 1%	2.3 %	-1.4 %	0.9 %

*Table 2.* Distributional Impact of TCJA Extensions and Proposed Tariffs by Income Quintile, 2025 (Net Percentage Change in After-Tax Income)

TCJA = Tax Cuts and Jobs Act

Sources: Tax Policy Center (2022) provides the TCJA distribution data. Consumer Expenditure Survey data are from the US Bureau of Labor Statistics, and data on incomes are from the US Treasury from Clausing, K. A. 2025. Eight Principles for the 2025 Tax Policy Debate (that Republicans and Democrats Should Be Able to Agree On)

On the other hand, certain sectors stand to benefit. Domestic manufacturers in industries like steel and aluminum may experience increased demand as tariffs make foreign alternatives less competitive.

President Trump's tariff strategy embodies a classic economic dilemma: balancing protectionism with the need for economic stability. While shielding domestic industries from foreign competition can provide short-term gains, excessive reliance on trade barriers risks alienating key partners, triggering inflation, and stifling innovation.

Looking ahead, the question remains whether the administration will adjust its stance to mitigate risks or double down on its aggressive approach. The coming months will be critical in determining whether these measures will bolster U.S. economic strength or contribute to a broader global downturn. As nations respond, retaliate and adapt, the true impact of President Trump's economic vision will become clearer, not just for the U.S., but for the world.

# **3. NAVIGATING PRICE VOLATILITY: INFLATION, SUPPLY SHOCKS, AND MARKET STABILITY**

The global economy in 2025 remains highly unpredictable, shaped by a convergence of crises that have significantly impacted price stability, supply chain resilience, and business strategies. Inflation, geopolitical tensions, and supply shocks continue to create economic turbulence, forcing policymakers and businesses to adapt in real time. In the context of the war in Ukraine, the armed conflict in this region has caused significant disruptions in food supplies, which has contributed to the increase in grain prices worldwide (Kacperska et al., 2025). This and trade frictions between major economies, and fluctuations in commodity markets have all contributed to the volatility of global markets. In this environment, price instability is no longer a short-term challenge but a persistent factor influencing investment decisions, consumer behavior, and economic growth trajectories.

Volatility, widely recognized in financial markets, refers to fluctuations in asset values

over time, regardless of whether changes are positive or negative. Typically measured by standard deviation from a central value, it applies to indicators like prices, exchange rates, or inflation. While it complicates long-term planning by increasing uncertainty, low-volatility environments often offer limited opportunities, usually dominated by established players who guard their positions through entry barriers (Klimczak & Shachmurove, 2025).

As inflationary pressures ease in some regions, supply constraints in others keep price volatility at the forefront of economic concerns. While central banks adjust monetary policy in response to shifting inflationary trends, the underlying structural weaknesses in global supply chains present long-term challenges. Companies must now approach risk management with a multi-dimensional strategy, incorporating financial foresight, digital adaptation, and operational resilience to withstand future shocks.

#### **3.1. Pressures and Policy Adjustments**

Inflation has been one of the defining economic challenges of recent years, with price surges initially driven by pandemic-related disruptions, followed by supply chain constraints and energy crises. Although some inflationary pressures have begun to subside in 2025, businesses and consumers continue to grapple with the long-term effects of price instability. The tightening of monetary policy by central banks worldwide has yielded mixed results, reducing inflation in some sectors while exacerbating borrowing costs and slowing economic activity in others. Strategic government actions, including policy frameworks, subsidies and investment in critical infrastructure, create the necessary conditions for private capital to flow and thrive (McKinsey & Company, World Economic Forum, 2025).

The U.S. Federal Reserve, for example, has been cautious in its approach to interest rate adjustments, balancing the need to curb inflation without stifling economic growth. Meanwhile, the European Central Bank faces additional complexities due to varying inflation rates across EU member states, requiring a more flexible monetary strategy. In emerging markets, currency devaluation and capital outflows have further intensified inflationary challenges, making it increasingly difficult for governments to maintain financial stability without resorting to interventionist policies.

#### 3.2. Supply Shocks and Market Fragility

One of the most pressing concerns for businesses today is the fragility of global supply chains, exacerbated by geopolitical instability and trade restrictions. Sanctions, export and import bans, and shifting trade alliances have disrupted traditional sourcing strategies, leading to increased costs and delays in the production cycle. The energy sector has been particularly affected, with oil and natural gas prices experiencing dramatic fluctuations due to ongoing geopolitical conflicts and production cuts by major suppliers.

The impact extends beyond energy markets. Essential commodities such as agricultural products, rare earth minerals, and industrial components have seen price spikes due to supply bottlenecks. For example, disruptions in the Black Sea grain corridor have led to food price volatility, affecting both developed and developing economies (Kacperska et al., 2025). The semiconductor industry, critical for modern technology and manufacturing, continues to face intermittent shortages, forcing companies to reassess their dependency on global supply networks.

Currency fluctuations further compound these challenges, making international

transactions more unpredictable. Businesses operating across multiple markets must contend with fluctuating exchange rates, which can erode profit margins and complicate financial planning.

# 4. THE FUTURE OF WORK: TALENT SCARCITY, AI DISRUPTION, AND THE PRODUCTIVITY DILEMMA

It is widely acknowledged that we are navigating a period marked by rapid and often disruptive transformations, with technological innovation standing out as a key driving force. One significant consequence of this dynamic is the swift evolution of job roles and the shifting landscape of skills. A central debate in this context concerns the role of emerging "intelligent machines", whether they are likely to replace human workers or function more as supportive "intelligent assistants." Much of the discussion hinges on the differentiation between routine and non- routine tasks, the former being more easily automated, and the latter considered resistant to automation. Similar distinctions are often made between manual and cognitive labour, reflecting underlying assumptions about their respective vulnerability to technological replacement (Salazar-Xirinachs, 2016).

The fourth industrial revolution, according to (Schwab 2016), is characterized by a blurring of the distinctions between physical, digital and biological spheres, as major technological advancements are having a profound impact on economies, businesses and the personal lives of people throughout the world (O'Reilly et al., 2018).

As organizations integrate smart technologies into their operations, the workforce must adapt to keep pace with evolving job requirements. One of the central debates surrounding the future of work revolves around whether AI and automation will ultimately replace human jobs or serve as intelligent assistants that enhance human productivity. While some roles may become obsolete due to increased automation, others will be transformed rather than eliminated. The most significant shift is likely to occur in hybrid job models, where human expertise is augmented by AI-driven tools, leading to increased efficiency and innovation. This transformation was significantly accelerated by the COVID-19 pandemic, which forced businesses worldwide to adopt remote and hybrid work models at an unprecedented pace. The rapid shift to digital collaboration tools, cloud computing, and AIpowered automation reshaped workplace dynamics, proving that many jobs could be performed effectively outside traditional office settings. Five years later, hybrid and remote work remain a possibility, particularly in industries that have embraced digital transformation. However, a growing number of companies are now attempting to reverse this trend, urging employees to return to physical offices. This shift is driven by concerns over collaboration, company culture, and perceived productivity losses, despite resistance from workers who have grown accustomed to the flexibility of remote work.

In sectors such as finance and healthcare, AI continues to revolutionize processes by streamlining operations and reducing errors. Rather than making these roles redundant, AI is redefining them, allowing professionals to focus on higher-value tasks that require human judgment, creativity, and ethical considerations.

The manufacturing sector is experiencing a similar transformation. The rise of Industry 4.0, the integration of AI, robotics, and smart production technologies, is enabling businesses to optimize production lines, minimize waste, and enhance precision. The pandemic further highlighted the importance of automation in manufacturing, as labor shortages and supply chain disruptions forced companies to accelerate their adoption of smart technologies. As a result, intelligent factories, equipped with interconnected systems and realtime analytics, are becoming the new standard, balancing efficiency with adaptability in an increasingly volatile economic landscape.

Given the rapid pace of economic transformation, financial adaptability is no longer optional, it is a prerequisite for survival and growth. Businesses, governments, and individuals must embrace continuous financial monitoring, leveraging AI and data analytics to refine budget allocations in real time. Strategic financial agility enables organizations to remain competitive in shifting economic conditions while maintaining fiscal responsibility (Edo-Osagie, 2025).

#### 5. CONCLUSION

The volatility of 2025 highlights the pressing need for businesses and governments to prioritize long-term resilience over short-term fixes. Inflation and supply shocks are no longer temporary disruptions but ongoing realities that demand continuous adaptation. While monetary policy adjustments play a role in stabilizing price fluctuations, true economic stability will require a proactive approach from the private sector. Companies must invest in technological innovation, diversify supply chains, and adopt agile financial strategies to withstand future uncertainties.

At the core of these economic decisions lies an unspoken truth: in the financial world, there is little room for emotion. The primary objective remains the relentless pursuit of economic growth, often at the expense of consumer impact. Whether through cost-cutting measures, automation-driven efficiency, or supply chain restructuring, businesses prioritize profitability and competitiveness above all else.

As the global economy navigates this uncertain landscape, collaboration between governments, businesses, and financial institutions will be crucial in fostering long-term stability. The ability to anticipate disruptions and implement adaptive solutions will determine which companies and economies not only survive but emerge stronger in the face of continued volatility. In an era defined by rapid change, resilience will not be an option - it will be a necessity.

However, the unpredictable nature of 2025 calls for further research, as the economic trajectory of the year remains uncertain. Given the established volatility, unexpected shifts in policy, markets, or geopolitical events could redefine the challenges and opportunities that lie ahead.

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# EXPLORING THE ROLE OF ETHICAL LEADERSHIP IN EMOTIONAL LABOR: A CROSS-CULTURAL PERSPECTIVE WITH A FOCUS ON INDIAN WORKPLACES

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Abstract: This research explores the impact of ethical leadership on emotional labor within Indian service-sector workplaces. Ethical leadership plays a crucial role in shaping employee behavior and emotional experiences, especially in service-oriented environments where emotional expression is central to job roles. The study aims to understand how leaders' ethical conduct influences the emotional regulation strategies such as surface acting and deep acting employed by employees. Data was collected from 100 respondents using a structured questionnaire that captured insights into their perceptions of leadership and emotional experiences at work. To analyses the data, descriptive statistics including mean and standard deviation were used to summarize the central tendencies and variability in the responses. Furthermore, regression analysis was applied to examine the relationship between ethical leadership and the dimensions of emotional labor. The findings contribute to existing literature by highlighting how ethical leadership can serve as a buffer against the negative consequences of emotional labor, thereby promoting a healthier and more supportive work environment. These insights offer practical implications for organizational policies and leadership training programs, particularly in culturally diverse and emotionally demanding service industries in India.

Keywords: ethical leadership, emotional labor, service industry, employee well-being.

#### 1. INTRODUCTION

In today's fast-paced and emotionally demanding work environments, especially in service-oriented industries, employees are often required to regulate and manage their emotions to meet organizational expectations. This effort to display appropriate emotions at work, whether it's staying calm during customer complaints or appearing cheerful in stressful situations is known as emotional labor. While emotional labor is essential for customer satisfaction and overall organizational success, it can also lead to emotional exhaustion, stress,

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and burnout if not managed properly. At the same time, leadership plays a crucial role in shaping how employees experience and cope with emotional labor. In particular, ethical leadership which refers to leaders who are honest, fair, compassionate, and act with integrity has emerged as a key factor influencing employee well-being and emotional experiences at work. Ethical leaders create a trustworthy and respectful work environment, where employees feel valued, heard, and supported. This kind of leadership helps reduce negative outcomes of emotional labor and encourages healthier emotional expression.

Several recent studies from the Indian context have highlighted the importance of ethical leadership in managing emotional labor. For example, research shows that ethical leaders help reduce emotional exhaustion by promoting deep acting (genuine emotional expression) rather than surface acting (fake or forced emotions), which is often associated with stress and dissatisfaction. Other studies have found that ethical leadership improves job satisfaction, lowers turnover intentions, and supports employee mental well-being. Furthermore, ethical leaders also strengthen emotional commitment and encourage open communication, making it easier for employees to deal with emotional challenges.

The relationship between ethical leadership and emotional labor is especially relevant in India, where the service industry is growing rapidly, and workplace stress is on the rise. Despite existing laws and organizational policies, many employees still struggle with emotional pressure and lack of psychological safety. Ethical leadership offers a potential solution by fostering a culture of empathy, respect, and ethical behavior that supports employees both emotionally and professionally.

This paper aims to explore how ethical leadership influences emotional labor among employees in Indian organizations. By reviewing relevant literature and real-life research findings, it seeks to highlight the importance of ethical behavior in leadership and how it can help employees manage their emotions effectively, reduce stress, and perform better in their roles. Understanding this connection is essential for creating healthier, more ethical, and emotionally balanced workplaces in today's complex business world.

#### 2. LITERATURE REVIEW

Lu and Guy (2014) examined the relationship between ethical leadership and emotional labor among public sector employees in China. They conducted a quantitative survey and applied regression analysis to assess how ethical behavior by leaders influences employees' emotional display at work. The study found that ethical leadership encourages deep acting sincere emotional expression while reducing the need for surface acting. They concluded that ethical leadership plays a significant role in enhancing employee engagement and recommended training programs that build emotional intelligence in leaders.

Kim et al. (2018) explored the effects of ethical leadership on emotional exhaustion by studying the emotional labor strategies of employees in South Korea. The research involved survey data from 259 employees and used structural equation modeling to examine the mediating roles of surface and deep acting. The findings revealed that ethical leadership lowers emotional exhaustion by encouraging more authentic emotional expression. The authors emphasized the importance of promoting ethical conduct among leaders to support employees' emotional health.

Byrne et al. (2011) developed a scale to measure emotional labor, focusing on emotional regulation, emotional expression, and the emotional demands of the workplace. Their scale is widely used to study how emotional labor affects employee well-being and job performance. Brown et al. (2005) defined ethical leadership as the promotion of ethical behavior through personal conduct and organizational practices. They developed an instrument to measure ethical leadership, which emphasizes fostering trust, fairness, and positive employee outcomes. Their model highlights the influence of ethical leadership on employee satisfaction, performance, and organizational culture.

Singh and Bansal (2019) investigated how ethical leadership, moral intensity, and affective commitment affect emotional exhaustion in Indian corporate settings. Using a structured questionnaire and regression analysis, the study found that ethical leadership significantly reduces emotional burnout, particularly when employees value ethics and maintain emotional bonds with their organization. The authors concluded that fostering ethical awareness and emotional commitment could mitigate the harmful effects of emotional labor.

Zhou et al. (2020) analyzed how ethical leadership affects emotional exhaustion among Chinese airport staff by promoting organizational embeddedness. They conducted a large-scale survey of 460 employees and used moderated mediation analysis to test their hypotheses. The study concluded that ethical leadership enhances employee connection to the organization, which in turn reduces emotional strain. The authors recommended encouraging fairness and transparent behavior in leadership to support employee well-being.

Chaudhry and Song (2020) focused on how ethical leadership influences job stress and service quality among hotel employees. They distributed structured questionnaires and conducted statistical analysis on the collected data, which revealed that ethical leadership reduces job-related stress and improves service performance. The authors concluded that hospitality managers should be trained in ethical practices to create supportive and high-performing work environments.

Ali et al. (2021) explored the mediating roles of psychological empowerment and emotional exhaustion in the link between ethical leadership and employee performance. Using survey data collected from IT professionals and analyzed through structural equation modelling, the study found that ethical leadership enhances feelings of empowerment, which helps in lowering emotional exhaustion and improving overall performance. The authors recommended developing leadership styles that foster employee autonomy and purpose.

Zhou et al. (2022) examined the relationship between ethical leadership and emotional exhaustion through the mediating effects of workplace relationships. Drawing data from 447 airport employees, the study used SPSS-based moderated mediation analysis to explore how organizational networking and embeddedness contribute to emotional resilience. The results indicated that ethical leadership reduces emotional strain by strengthening interpersonal bonds at work. The authors suggested embedding ethical values into leadership training to safeguard employee mental health.

Chen et al. (2022) investigated how leaders' own emotional labor influences their servant leadership style and its impact on employee satisfaction. The study collected data from both leaders and their subordinates across service industries and employed multilevel modeling for analysis. It revealed that leaders who engage in deep acting are more effective in adopting servant leadership behaviors, which in turn increase employee satisfaction and reduce emotional fatigue. The authors recommended emotional regulation training for leaders to build stronger team dynamics.

Ramírez and Rodríguez (2023) studied the impact of ethical leadership on emotional exhaustion in virtual work environments. They surveyed 448 employees in the Colombian energy sector and used moderated mediation analysis to test the effect of job autonomy on this relationship. Their findings showed that ethical leadership significantly reduces emotional

strain, especially when employees have flexibility in managing their work. The study highlighted the importance of ethical conduct and autonomy in remote workplace settings.

Bukhari and Rahman (2023) investigated how ethical leadership influences emotional labor strategies and employee well-being in the banking sector. The study used structured questionnaires and applied mediation analysis to assess how surface and deep acting mediate this relationship. Results indicated that ethical leaders encourage genuine emotional expression and reduce harmful emotional suppression, thereby improving employee wellbeing. The authors concluded that ethics-based leadership training is key to creating emotionally healthy workplaces.

Sharma and Singh (2023) explored the relationship between emotional labor strategies and emotional exhaustion among hospitality employees in India. Through a quantitative study involving surveys, they found that surface acting was positively associated with emotional exhaustion, while deep acting had a negative association. The research emphasizes the need for training programs that encourage deep acting strategies to reduce burnout in the hospitality industry.

Rajan and Kumar (2024) investigated the impact of ethical leadership on organizational outcomes, considering the mediating role of emotional labor and the moderating role of followers' personality traits. The study employed a survey-based methodology and found that ethical leadership positively influences organizational outcomes through the mediation of emotional labor. Additionally, the relationship was moderated by followers' personality traits, suggesting that individual differences play a role in how ethical leadership affects emotional labor and, subsequently, organizational outcomes.

Varma (2025) examined the influence of ethical leadership on employee turnover intentions in India's hospitality sector. The study utilized a survey of 283 frontline employees across 18 hospitality firms and employed a moderated mediation model using the PROCESS macro for SPSS. Findings indicated that ethical leadership reduces turnover intentions by enhancing employee well-being and mitigating occupational stress. Furthermore, work-life balance was found to strengthen these effects, highlighting its critical moderating role.

#### 2.1. Literature gap

Although many international studies have examined the impact of ethical leadership on emotional labor, research focusing specifically on the Indian context is still limited. Most available studies tend to focus on general leadership styles or stress management, without paying enough attention to how ethical leadership directly influences emotional labor. Furthermore, there is a need for more practical and industry-specific insights, especially in growing sectors like hospitality, education, and retail, where emotional labor is most intense. This study fills that gap by reviewing Indian literature and case studies to understand the realtime connection between ethical leadership and emotional labor.

#### 2.2. Objectives

- 1. To understand the nature and effects of emotional labor among employees, especially in service-oriented roles.
- 2. To examine the relationship between ethical leadership and emotional labor based on existing literature and research studies.
- 3. To identify how ethical leadership influences the emotional well-being of employees.

4. To suggest practical strategies for organizations to promote ethical leadership for better emotional support at the workplace.

#### 2.3. Hypotheses

- I. H0: Ethical leadership does not help employees to manage emotional labor better.
- II. H1: Ethical leadership help employees to manage emotional labor better.

#### 3. DATA AND METHODOLOGY

#### 3.1. Research design

This study uses a quantitative research method to understand how ethical leadership affects emotional labor in Indian service-based workplaces. This method helps collect data in a structured way and analyze it clearly. Emotional labor was measured using a scale developed by Byrne et al. (2011), and ethical leadership was measured using a tool created by Brown et al. (2005). Both these tools were used to collect primary data directly from the respondents.

### **3.2.** Sampling technique

A random sampling technique was employed to select participants from diverse service sector organizations, including IT, hospitality, education, healthcare, and retail. This method ensured that the sample represents varied cultures and leadership styles.

#### 3.3. Sample size

The study surveyed 100 participants across different service-based organizations. The sample included both male and female employees in various roles, allowing for a diverse perspective on emotional labor and ethical leadership in the workplace.

#### **3.4.** Data collection method

Primary data was collected through a structured questionnaire designed specifically for this study. The questionnaire included items related to participants 'perceptions of their leaders' ethical behavior and their own emotional regulation strategies. Secondary data from academic journals, previous research reports, and organizational policies, was also referenced to strengthen the study's foundation.

#### 3.5. Data analysis tools

The responses were analyzed using Microsoft Excel and appropriate statistical techniques. Specifically:

- Descriptive statistics such as mean and standard deviation were used to summarize central tendencies and variability in responses.
- Regression analysis was applied to test the relationship between ethical leadership and emotional labor dimensions.

#### **3.6.** Ethical considerations

Participation in the study was entirely voluntary. Respondents were informed about the purpose of the research, and their confidentiality and privacy were strictly maintained throughout the study. No identifying information was collected, and all responses were used solely for academic purposes.

#### 4. RESULTS AND DISCUSSION

Table 1 provides results of standard deviations and means for each question, shedding light on the central tendency within the dataset.

Sr. No.	Item Statement	Mean	SD
1.	My religious spiritual experience helps me to decide how to	3.26	1.22
	manage my emotions at work.		
2.	I can control and manage my emotions well because of my faith in	3.26	1.15
	religion and then social support of the religious group.		
3.	I manage my emotions during work because of my spiritual values.	3.45	1.15
4.	Leaders of my organizations make fair and balanced decisions.	3.76	0.99
5.	Leaders of my organization generate trust in subordinates.	3.85	0.94
6.	Leaders of my organizations discuss business ethics or values with	3.99	0.95
	employees.		
7.	Leaders of my organizations have set an example of how to do	3.92	1.036
	things in the right way in terms of ethics.		

Table 1. Results of Mean and Standard Deviation

#### Table 2. Results of Regression Analysis

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Hypothesis	<b>Regression Path</b>	Beta	$\mathbb{R}^2$	F	p-value	Hypothesis
						Supported
H1	Ethical Leadership – Emotional Labour	0.269	0.048	4.9274	0.0288	YES

This study investigates the relationship between ethical leadership (ELS) and emotional labor (EML) in IT Indian sector.

These findings indicate a statistically significant but modest positive relationship between ethical leadership and emotional labor (Table 2). Ethical leadership accounts for approximately 4.8% of the variance in emotional labor, suggesting that while ethical behavior in leadership contributes to employees' emotional regulation, other organizational or psychological factors may also play a role.

To analyses the relationship between ethical leadership and emotional labor, a simple linear regression was conducted using responses from 99 participants. The goal was to test whether ethical leadership has a significant impact on employees' emotional labor in serviceoriented workplaces.

The regression output indicated a positive and statistically significant relationship between ethical leadership and emotional labor. The unstandardized coefficient ( $\beta$ ) was 0.269, which means that a one-unit increase in ethical leadership corresponds to a 0.269 increase in

emotional labor. This shows that when employees perceive their leaders as ethical demonstrating honesty, fairness, and integrity they are more likely to engage in emotional regulation on the job.

The model's R-squared ( $R^2$ ) value was 0.048, indicating that ethical leadership explains about 4.8% of the variance in emotional labor. Although this is a relatively small percentage, it still highlights a meaningful influence in the organizational context.

The overall regression model was statistically significant with an F-value of 4.927 and a p-value of 0.0288. Since the p-value is less than 0.05, the result is considered statistically significant. Therefore, the null hypothesis (that there is no relationship between ethical leadership and emotional labor) is rejected.

These findings support the hypothesis (H1) and confirm that ethical leadership has a significant impact on emotional labor. Employees under ethical leadership are more likely to manage their emotional expressions effectively, likely due to the supportive and principled work environment created by such leaders.

In summary, ethical leadership positively influences how employees perform emotional labor, which is especially relevant in service-sector jobs where emotional interactions are a key part of work.

#### 5. CONCLUSION

In conclusion, the role of ethical leadership in managing emotional labor has proven to be an important area of study, especially within the context of Indian workplaces. Ethical leadership, which involves leaders acting with fairness, transparency, and empathy, plays a significant role in helping employees navigate the emotional challenges they face in their jobs. Emotional labor, which is the process of managing emotions to meet job requirements, is a common experience for employees, especially in customer-facing roles. However, when not properly managed, it can lead to emotional exhaustion, stress, burnout, and decreased job satisfaction. This research highlights how ethical leadership can be a powerful tool in reducing these negative effects and improving the overall work experience for employees.

The findings from this study suggest that ethical leadership not only creates a positive and supportive work environment but also significantly influences how employees manage emotional labor. Ethical leaders set a tone of trust, fairness, and integrity within the organization, which fosters an environment where employees feel safe, respected, and valued. This environment encourages employees to engage in *deep acting* (genuine emotional expression) rather than *surface acting* (faking emotions), which leads to improved emotional well-being, reduced emotional exhaustion, and better job satisfaction.

This research emphasizes the importance of ethical leadership in reducing emotional exhaustion among employees. Leaders who display ethical behavior create a more emotionally supportive atmosphere, where employees are not just expected to "fake" positive emotions but are encouraged to genuinely engage with their emotional experiences. This approach reduces the strain caused by emotional labor and results in better mental health for employees. The positive effects of ethical leadership also extend to higher levels of job satisfaction, as employees feel more connected to their work and motivated by the support they receive from their leaders.

Moreover, ethical leadership helps in building a culture of openness and communication, where employees feel they can express their concerns and seek support when dealing with emotional challenges. This is especially important in high-stress work environments, such as the service industry, healthcare, and hospitality sectors in India, where emotional labour is a significant part of the job. By providing emotional support and guidance, ethical leaders can

mitigate the risks associated with emotional labor, such as burnout and disengagement, and improve employee retention.

In the Indian context, where workplace culture is often hierarchical and can lack openness, ethical leadership offers a refreshing approach to promoting emotional well-being among employees. This research highlights that ethical leadership can be a key factor in overcoming the challenges of emotional labor, particularly in Indian workplaces, where the demands of customer service and high-stress situations can take a toll on employees' mental and emotional health.

The study's findings have several practical implications for organizations. To create a healthier work environment, it is essential for companies to train leaders in ethical decisionmaking, emotional intelligence, and empathetic communication. Leaders should be encouraged to lead by example, demonstrating the importance of ethical behavior in day-today interactions with employees. Organizations should also implement policies and practices that promote emotional well-being, such as providing support systems for employees dealing with emotional labor and offering stress-relief initiatives.

In conclusion, ethical leadership is not only beneficial for improving employee emotional well-being but also contributes to the long-term success of the organization. Ethical leaders enhance employee morale, boost job satisfaction, and reduce the adverse effects of emotional labor, leading to a more productive, motivated, and loyal workforce. Therefore, organizations, particularly in India, should prioritize ethical leadership to build a healthier, more supportive workplace culture. The benefits of ethical leadership extend beyond just employee well-being to overall organizational success, making it a critical factor in todays competitive and emotionally demanding work environments.

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# ECOTOXICOLOGICAL EFFECTS OF MICROPLASTICS IN FOOD CHAINS (EISENIA FETIDA AND PELOPHYLAX KL. ESCULENTUS)

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Abstract: The presence of microplastics in soil ecosystems is an emerging environmental issue with significant implications for biodiversity and ecological balance. These small particles, often derived from synthetic materials, can be ingested and accumulated by soil organisms, potentially causing harmful effects and entering aboveground food chains. In this study, combining field and laboratory approaches, we investigated microplastic (MPs) exposure across different model organisms within the food chain. Adult earthworms Eisenia fetida (Savigny, 1826) were exposed to increasing concentrations of fluorescent microplastics (7.5%, 10%, 12.5%, and 15%). After exposure, the fate of MPs was followed when the earthworms were consumed by frogs (Pelophylax kl. esculentus). The experiment lasted four weeks, during which growth, mortality, reproduction, development, and metamorphosis were monitored and compared to a control group. Significant differences were observed in all treated groups compared to the control. The highest earthworm mortality occurred at 15% MP concentration. Dissection showed microplastic particles in the digestive and muscle tissues of earthworms, and in the digestive tract of frogs in an unchanged form. The results obtained could contribute to the development of a comprehensive description of the risks that MPs cause in food chains and terrestrial ecosystems.

Keywords: microplastic, Eisenia fetida, Pelophylax kl. esculentus, food chains, toxicity.

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# DIGITAL PLATFORM FOR SHARING RESOURCES ORIENTED TOWARDS THE DEVELOPMENT OF INNOVATION IN DEEPTECH STARTUPS

#### Lucas Sampaio Motta, João Pedro Passos, Selma Oliveira\*

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Abstract: Despite the prevalence of research on innovation intermediaries, there is limited understanding of how digital platforms contribute to resource sharing oriented towards product development and launch by deep tech start-ups in an innovation ecosystem. Identifying the resources offered by innovation ecosystems can encourage the development and launch of new products by deep tech start-ups. Thus, this project presents a (conceptual) proposal for the development of a digital platform to share resources and encourage the development and launch of new products by deep tech startups in an innovation ecosystem. This proposal is an important priority for several reasons, for example: (a) to identify strategic resources offered by innovation intermediaries to foster innovation and technological entrepreneurship in the Southern Fluminense region of the state of Rio de Janeiro; (b) it provides a valuable contribution to academia by proposing a conceptual framework for resource orchestration that can explain the performance of start-ups in the Southern Fluminense region's innovation ecosystem; (c) it serves as a guide for entrepreneurs seeking to improve product innovation in start-ups in the Southern Fluminense region context

**Keywords**: modeling for digital platform, resource sharing, new product development, deep tech startups, innovation ecosystem.

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# A SYSTEMATIC REVIEW OF RESEARCH ON DIGITAL PLATFORMS - DEEPTECH INNOVATION: BROADENING OUR HORIZONS

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Abstract: The growing importance of deep tech on a global scale is driven by its potential to disrupt industries, address global challenges, and provide economic and strategic advantages. As innovation continues to accelerate, the role of deep tech in shaping the future of societies and economies becomes increasingly critical. Platformization and AI technologies are expanding the innovation opportunity set and impacting the overall sustainability of innovation ecosystems. Despite the growing awareness of the need for substantial support of deep tech innovation to address societal and economic challenges, innovation ecosystem research rarely explores the cultivation of this innovation. While the potential benefits of deep tech start-ups have been widely reported, innovation ecosystem research rarely explores the current state of deep tech innovation in innovation ecosystems. Therefore, this study aims to systematize published studies that address the conceptual framework of an integrative and collaborative platform oriented towards deep tech start-ups in innovation ecosystems. Through a systematic literature review, this paper makes significant contributions: (a) it provides an overview of the existing literature on this topic in recent years; (b) it proposes gaps in the literature to promote future research on deep tech start-ups in innovation ecosystems; (c) it offers lessons for business professionals who intend to strengthen the development and launch of new products by deep tech start-ups; and at the same time promote deep tech innovation ecosystems to improve sustainability. This topic is of extreme relevance, especially in light of a new reconfiguration of markets following revolutionary changes, such as the advancement of new technologies (e.g., platformization and deep-tech), which may stimulate inequalities between nations, regions, and local communities in the world.

**Keywords**: digital platform, construct, resources, DeepTech innovation, DeepTech start-ups, DeepTech entrepreneurship, innovation ecosystem, systematic literature review.

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