

Integration of AI Supported Risk Management in ERP Implementation

Petya Biolcheva¹, & Miglena Molhova¹

¹ Industrial Business Department, University of National and World Economy, Sofia, Bulgaria

Correspondence: Petya Biolcheva, Industrial Business Department, University of National and World Economy, Sofia, Bulgaria. Tel: +359 887695738 E-mail: p.biolcheva@unwe.bg

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Abstract

The objective of this paper is to show the possibilities for the implementation of artificial intelligence (AI) in risk assessment methodology for ERP projects. Both AI and ERP being solutions built around data, it is of great importance how this data is organized and processed, and how it can be used on the one hand to manage the business process in a more efficient way and on the other to address risk factors that might compromise the ERP system in a way, which standard risk assessment methodologies might miss. AI can add value to such risk assessment methodology as it can process large amounts of data and even automate repetitive and heavy load risk management steps. AI can allow risk managers to respond faster to new and emerging threats in an ERP project. By acting in real time and with some predictive capabilities, AI supported risk management could reach a new level in improving the managers' decision-making for building the ERP system of the company. The literature review is given of the main AI and machine learning techniques of benefit to risk management and ERP projects. Then an analysis, using current practice and empirical evidence, is carried out of the application of these techniques to the risk management fields in implementing an ERP system. The paper also presents a showcase of how Bulgarian companies address the issues of risk assessment and AI implementation in it to build ERP systems.

Keywords: AI, risk assessment, ERP, methodology

1. Introduction

It is already a well-established practice for business organizations to look for integrated solutions for the overall management of their business and all the processes that take place in it. Among the most used solutions is Enterprise Resource Planning (ERP). ERP provides a fast connection between all employees and departments, through software module management, helping companies implement resource planning by integrating all processes in one system. The ERP system is a key tool for planning business strategies, transmitting information, performing tasks, and controlling them related to the organization's resources, including material resources, financial resources, tools, and employees, within different areas (Khan, Asim, Manzoor, 2020). ERP is a complete system of applications supporting various business processes using a common database. The main contributions are reduced to complete information about the activity and results of the organization (Żółtowski, 2021).

Along with the many advantages of the system, there are certain risk related problems connected with its implementation (Taghipour, Shabrang, Machiani, Shamami, 2020). The market for ERP products is highly intensive (Żółtowski, 2021), and a serious analysis of competitive individual products is usually done prior to their implementation. The paper discusses the risks that accompany ERP system implementation, claiming that the risk analysis and management should be an integral part of the implementation process itself.

The paper further investigates the added value of integration of artificial intelligence (AI) in the risk management during an ERP implementation project. There are several reasons to choose such a solution. AI is increasingly entering all stages of business process automation. AI integrates into existing platforms, integrates with ERP systems, or adapts to them through various communication methods. One of the reasons for the need of integrating AI in an ERP system is working with large databases (Viorel- Coston, 2022), since the company could conduct intelligent machine learning (ML) analyzes based on multiple algorithms and a combination of information flows and semantic analysis from different sources.

Undoubtedly, the introduction of ERP projects is very challenging for any organization - a large investment, a

new information system, new management requirements, a new level of communication channels and many others (Sumner, 2020).

The paper claims that risks emerging from ERP projects implementation can be managed using artificial intelligence in the process. The entry of AI in various spheres of life outlines a long-term trend, the beginning of which has already been set. Authors believe that in the next decade AI will be a major competitive advantage for all business organizations. The primary hypothesis of the study is that the integration of AI supported risk management in ERP implementation can help companies achieve faster and better risk identification and management in their ERP projects. Considering there is still public distrust (mainly fear of people being displaced by machines) in AI integration in business processes in general and in ERP projects implementation in particular, we are conducting an empirical survey amongst energy company managers to check the hypothesis of the paper as well as their evaluation of the methodology proposed here.

The paper is organized into six sections. After the introduction, literature review of the theoretical and practical implications of the problem is done. Section 3 reveals the importance of risk management in the implementation of ERP projects. The added value of AI in the standard risk management methodology is described in Section 4. The results of the study are presented in Section 5. Section 6 presents the discussion and conclusion of the study as well as possible future studies.

2. Literature Review

Scientific interest in the topic of risk management and ERP has been the subject of numerous studies and scientific papers (Lopez and Jose, 2014), (Sumner, 2020), (Aloini, Dulmin and Mininno, 2012), (Mannini, Prado, Grotta, Rezende, 2020). This is because in recent decades a global number of companies have implemented corporate ERP systems to help manage and efficiently use resources (materials, human, finance, etc.) (Aloini, Dulmin, and Mininno, 2007). ERP provides a stream of real-time knowledge for the entire organization. Uses a single interface and relational databases needed for organizational operations (Sheik, Sulphrey, 2020). Many researchers consider the relationship related to firm success, organizational performance, and the use of ERP systems (Ray, *et al.*, 2016), (Suprpto, Tarigan, and Basana, 2017).

On the one hand, ERP is considered as a source for dealing with a wide range of negative risks to the results, activities, processes, and resources of business organizations, on the other hand, risks related to it are also considered. According to Lopez, and Jose (2014), the use of ERP can bring many benefits by improving organizations' decisions, both in operational and strategic contexts. Its implementation helps to achieve a competitive advantage by improving the quality, competitiveness and business performance of the organization (Alexis, 2008). At the same time, it interacts positively with risk management activities. This is due to the opportunities he opens up for business organizations.

On the other hand, if we look at the risks (threats) associated with the use of ERP in organizations, the literature review indicates a large number of risk groups. They stem from the fact that ERP projects are among the most critical IT projects, posing serious risk challenges (Aloini, Dulmin and Mininno, 2012). Their implementation takes a long time for the implementation process and often exceeds the actual budget (Sheik, Sulphrey, 2020). The reasons for this lie in the high complexity between software and business systems. Their aspects of manifestation include technological, communication, psychological and other aspects. According to Bhatti (2005), the reasons for the risks are related to the lack of support from senior management, opposition from staff, poor choice of suppliers and ERP packages, insignificant results, etc. Lopez, and Jose (2014) discuss the risks associated with the stage of operation of ERP projects, dictated by insufficient software maintenance, and hence reduce its usefulness to the organization. Part of the risks are aimed at the challenges related to the implementation (Menon *et al.*, 2019), others with the factors determining its success (Alzoubi and Snider, 2020), third with the satisfaction of the management (Estebanez, 2021), fourth with the risk of adaptation in the specific organizations (Yadav and Joseph 2020), risks in staff training (Krupcala and Januszewski), etc. It can be summarized that ERP projects are accompanied by risks of operational, technical, strategic importance (Nigam *et al.*, 2022).

Our focus is on the introduction of this type of project. In a narrower range among the significant risks, here are the failed redesign of existing business processes; poor integration in terms of functionality; insufficient training and skills of the employees involved, software users, etc.

3. Importance of Integrating a Risk Management Methodology in ERP Project Implementation

In the recent past, managerial neglect of risk is among the main reasons for the failure of any software project, together with the fact that managers do not properly assess and manage the risks associated with their projects.

Understanding their risk management, involves additional work and unnecessary costs (Aloini, Dulmin, and Mininno, 2007). Fortunately, this process is now recognized and implemented, through several innovative approaches, such as Agile Risk Management (Prakash, Viswanathan, 2021) and even artificial intelligence (Addo, 2019).

In business practice, choosing an appropriate risk management strategy is extremely important for the successful implementation of an ERP project. According to the authors of this paper, the most appropriate in this case would be a proactive strategy. It implies prevention at the early level of project management, planning and impacts on likely risks. Through it, the ERP project becomes sustainable-responsive-flexible" (Saglam, et al., 2021). Resilience enables quick recovery and flexibility of business management and in emergency situations (Siegel, 2017)., the ability to respond quickly and effectively to the names in the environment, and the ability to quickly adapt to change (Saglam et al., 2021).

The process of implementing ERP in any organization has several stages. It starts with initiating the project, planning, development, testing and training, review & improve, go-live and finally sustain (Thangamani, 2018). All these phases aim to have the goals, objectives, and deliverables of the project defined in the beginning, so that the organization knows where it wants to be after the project is implemented and how to get there. ERP implementation and risk are tightly linked; the environment in which the conception and development of ERP projects take place is complex, hence, a systematic risk assessment methodology is essential for any ERP implementation project (Thangamani, 2018).

Integrating a risk assessment methodology in ERP project implementation will help the organization to better understand the risks at each stage of the project and control them. The graph below (fig. 1, Integrating risk management in ERP project lifecycle) shows our idea of the agile approach in combining risks management with ERP implementation life cycle. Working with the graph the user can clearly see that the risk management methodology allows it to be applied at every stage of the ERP project implementation.



Figure 1. Integrating risk management in ERP project lifecycle

For example, risk identification at the "Initiate phase" will point out the possible risks that might have an impact on the project's objectives. If we move the circle right and go to the "Plan phase" by applying the risk identification, we can point out the weak and crucial points in the planning of the ERP project and take into consideration which risks are acceptable and which are not. Thus, we move ERP closer to the business process management because the implementation of risk management can give a more precise process focus and more detailed view of the ERP project, which can support the organization in better analyzing the impact of changing their processes by implementing innovations through the ERP project.

4. Upgrading the Standard Risk Management Methodology for ERP with AI Implementation

Now the most significant challenges facing ERP projects are the dynamic changes in the business environment. Constantly changing market requirements, increasing competition and customer expectations, as well as striving to reduce overall costs and performing specific tasks in less time. This means that ERP projects require constant development and adaptation to the environment (Haider, 2021). All this is a reason to seek the help of artificial intelligence. AI enables people to make more rational decisions based on in-depth analysis. Haider (2021) writes about the overall place of AI in ERP projects. Despite the growing interest in AI, in recent years, the review of a few scientific bases does not show research that is aimed at its use in the risk management process in the implementation of ERP projects. This also determines the relevance of this paper.

To understand the essence of the added value of AI, here are some of its main contributions to the development of risk management, namely:

- Reasonable decision-making based on analysis of large amounts of data (from both structured and unstructured databases);
- Better work efficiency;
- Improving the time for risk identification and management in ERP projects;
- Work in real time;
- Reducing costs and optimizing activities by automating daily assistance and guidance in risk management processes;
- Improving the identification of new risk exposures;
- Increasing risk prevention options;
- Better response time in critical situations;
- Making optimal decisions through a greater forecast and visibility of risk, etc. (Biolcheva, 2021).

The risk management methodology in ERP projects based on artificial intelligence follows the requirements of ISO 31000 and is applied to the individual stages of ERP implementation, as it takes into account the risk in them.

The limitation is placed here that this paper describes the intelligent (AI technology based) risk management methodology in the implementation of ERP projects, only in its conceptual part. The specific AI tools are applied in separate stages, as well as the specific algorithms of working with an object of research interest related to future development of the topic.

The risk management methodology begins with the identification of all the main phases of the implementation of the ERP project and all the potential risks that accompany them (see fig. 2 Risk management methodology in ERP projects based on artificial intelligence). The individual phases of the project can be summarized in the following sequence:

- first of all, the risks related to the goals and tasks of the project are identified, with their usefulness for the development of the organization; teams and responsibilities. In general, the risks associated with achieving the objectives of the ERP project are identified here.
- secondly, the risks related to the whole planning process are identified - the risks from the external and internal environment, the requirements for ERP from the point of view of the future development of the organization; the risks associated with reengineering and transformation of business processes; user requirements, risks related to the budget and schedule for project implementation, etc.
- thirdly, the identification of risks is related to the development of the ERP software itself. Threats in terms of process customization are important here; adaptation with modules of suppliers and customers; integration of existing applications and databases to new software and hardware systems; development and testing of functionality.
- fourth, the risks related to the quality of the finished software product are identified; the requirements of the stakeholders and the end-user; staff training; feedback; the need for adjustments.
- In fifth place are the threats and opportunities in the implementation of the ERP project. Here, the risk associated with the implementation strategy must be identified; initial operation; the presence of residual defects from the development, etc.

- Sixth, last is the identification of the risk associated with the operation of ERP in the organization, maintenance, continuity and improvements.

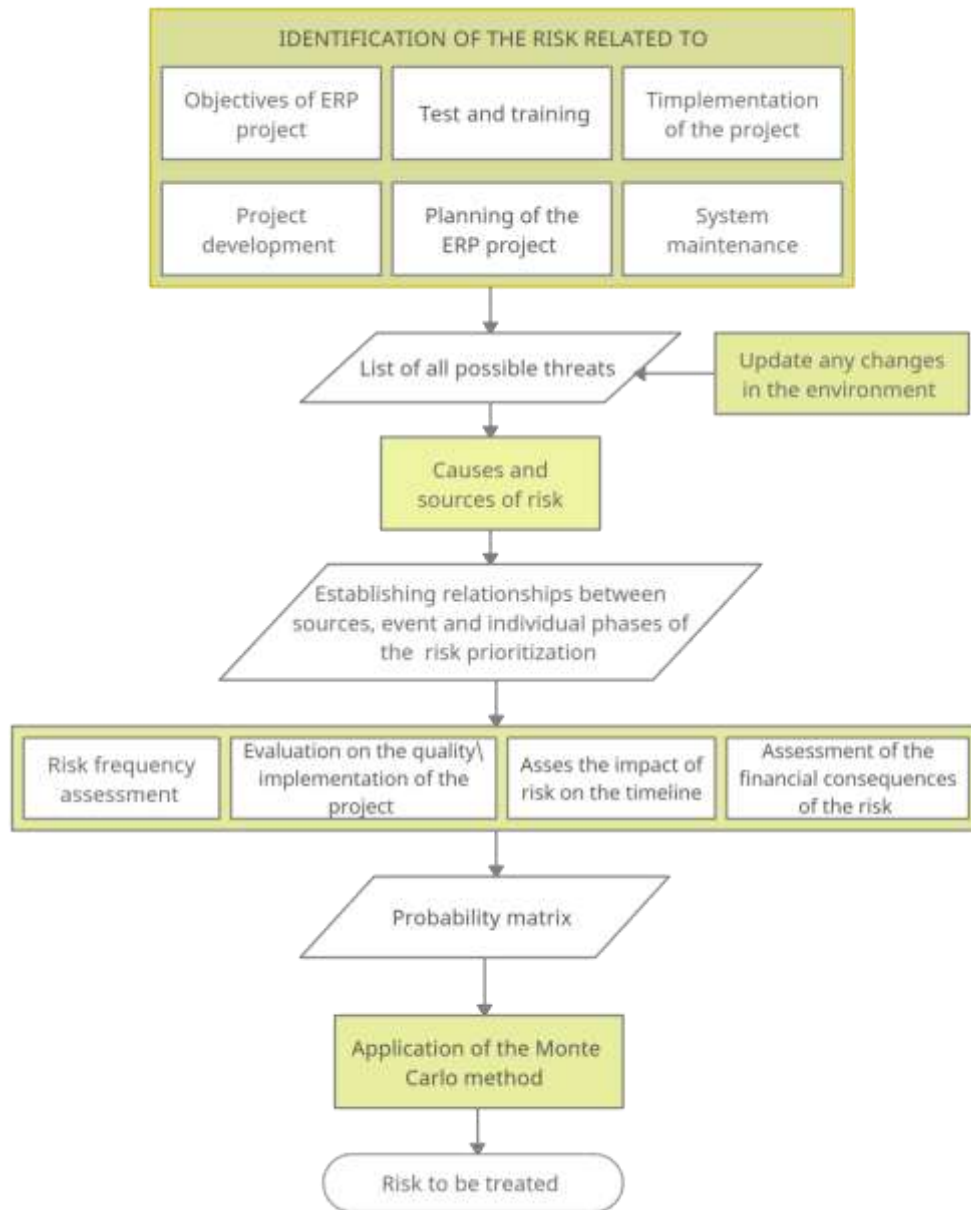


Figure 2. Risk management methodology in ERP projects based on artificial intelligence – part 1 risk assessment

The listed phases of implementation are standard and applicable in business practice, the identification of risk in them is also a process that is clear, necessary and applied. This methodology suggests that the process be performed much more precisely, with a wider range and in real time, applying AI. In identifying the risk in the individual phases of the ERP project implementation, a consistent analysis by AI is applied. It refers to the identification of potential risks from available databases from previous periods (projects) of the host organization. In addition, the analysis continues in other available databases relevant to the project (they can be purchased or owned by the developers of the ERP system). The use of databases related to various macro indicators and other structured information is appropriate. Next, AI conducts a semantic analysis over the Internet of structured and unstructured data, from which it extracts relevant project data. Although the AI analysis is sufficiently extensive and covers areas and relationships for which people would not allow dependencies, the expertise of the project teams and other specialists in the implementing organization should not be neglected. They are also used as a source to identify potential risks that a particular ERP project would face. Therefore, the process is designated as a joint between AI and the human factor. Based on the various sources through which the risk is identified, the possibility of generating the most complete list of potential opportunities and threats to the project

implementation is revealed.

The results of the risk identification analysis are presented as a list of all potential threats and opportunities in the individual phases of ERP project implementation. To make this data relevant throughout the life cycle of the project, AI can again be helpful. It updates in real time any change in the environment and hence the emerging risks. Another advantage of AI is the ability to detect the root causes, and relationships between individual factors provoking the risks. This reveals the nature of the risk, what can trigger it, and shows where else it would manifest itself within the ERP project. AI also prioritizes risks.

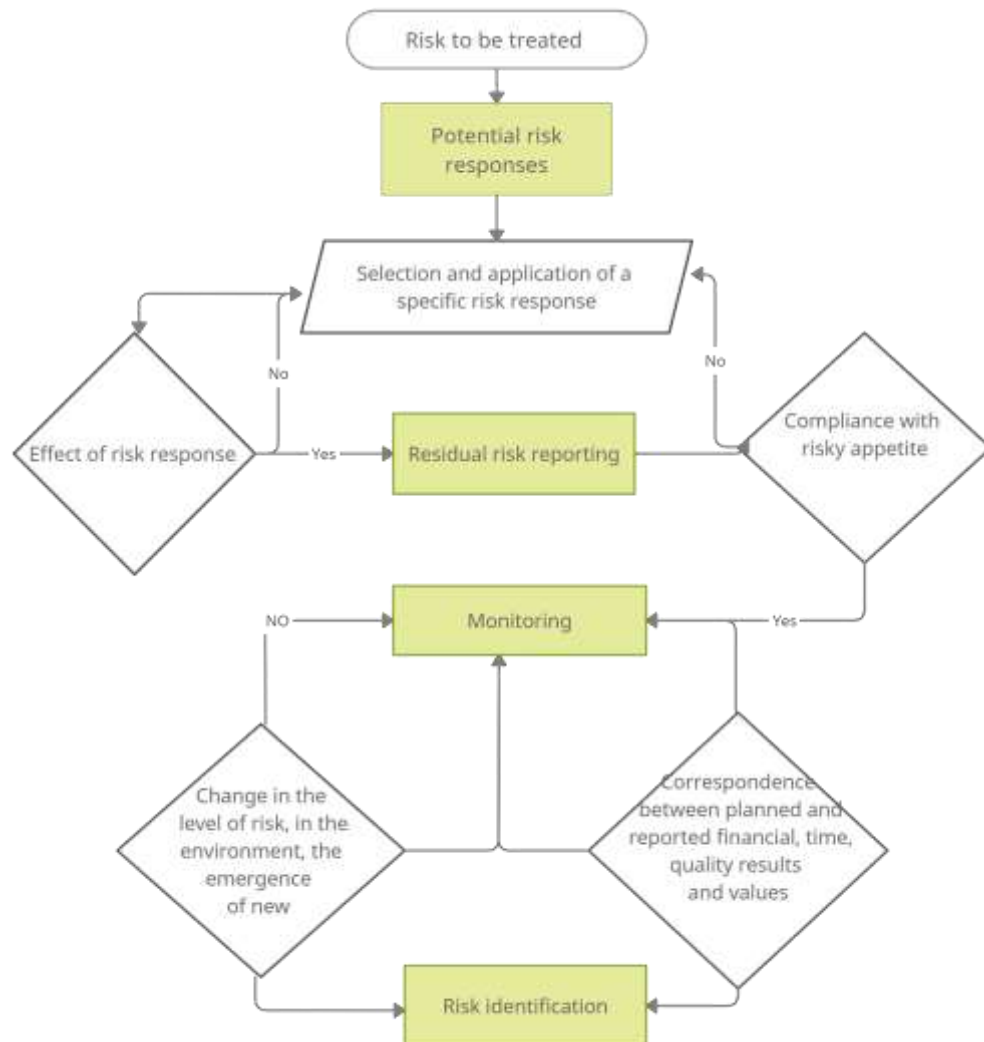


Figure 3. Risk management methodology in ERP projects based on artificial intelligence – part 2 risk treatment and monitoring

The next stage of risk management in ERP projects is focused on risk assessment. The standard procedure provides for a qualitative and quantitative risk assessment. In practice, various expert methods for quality assessment are applied. The quantitative assessment is mainly based on the Monte Carlo simulation. Here this process is refined through the capabilities of AI.

When conducting a qualitative assessment, by analyzing databases from past periods of the organization and conducting semantic analysis, artificial intelligence performs the assessment. This makes it clear:

- The frequency of risk;
- The magnitude of the risk manifestation in terms of quality implementation of the ERP project;
- The amount of financial consequences that the project would suffer as a result of the realization of the risk;
- Risk assessment against the implementation of the implementation timetable.

The results of this qualitative assessment are summarized in a "Probability Matrix", in which each threat and opportunity is arranged according to its specific parameters and degree of risk.

Qualitative evaluation is the basis for conducting a quantitative one, again based on AI. Within its framework, artificial intelligence assists in conducting a Monte Carlo simulation, establishing accurate relationships based on multi-layered analysis at multiple levels. This is how an accurate numerical expression is derived. On this basis, the specific risks on which control will be exercised are determined.

The process continues with the treatment of the risk. At this stage, AI also helps to conduct analysis and draw sound conclusions. In the first place, the improvement of the standard process is aimed at the analysis that artificial intelligence conducts regarding the appropriate possible responses to the specific risks. The choice of an alternative for impact is left in the hands of experts (the human factor). After its application, it is necessary to establish the presence of an effect and its direction - positive or negative. If a positive effect is recorded, the AI calculates the residual risk level. If not, other impact measures need to be implemented. This iteration is repeated until the positive effect of the measures is achieved. In case the level of residual risk is high and does not meet the risk appetite of the project, new risk responses must be sought and implemented. If the residual risk is within acceptable limits, proceed to the last stage of the risk management process, namely monitoring.

By monitoring, the AI is the one who monitors various changes from the pre-set goals, such as budget, schedule, etc. He monitors the change in environmental factors and the potential emergence of new risks. If such is registered, the whole risk management process in the ERP project is reiterated, ie. starts again with risk identification.

5. Method

Despite the widespread penetration of artificial intelligence in various fields, there are still several fluctuations in its introduction into the risk management process in ERP projects. For this reason, the authors of this paper study the opinion and readiness for its introduction among several ERP experts in energy companies in Bulgaria. The energy sector is among the key ones in the country. It is constantly introducing technological innovations, which is the main reason why we choose respondents from this sector. The survey was conducted in the second half of 2021. It was organized through an online survey with questions from a closed test. Respondents were asked questions related to their views on the positive effect of the introduction of AI; its applicability to the individual phases of the risk management process; the threat of change of experts; the main contributing moments, etc.

6. Using AI in Risk Management: Case Study of Bulgarian Companies

In general, respondents are positive about the use of AI in risk management in ERP projects. A significant part of them (55%) expresses their strong support for its introduction. According to others, about 32% use it appropriately, but not urgently now. Moreover, there is a small percentage (just over 10%) who are more conservative in this regard. Their view is that we still cannot fully trust artificial intelligence. None of the respondents categorically denied the benefits of implementing AI in ERP projects. This shows that the practice needs a gradual introduction of smart management, so that experts can more easily reach it without having the danger of negative effects.

The observation also affects the opinion of the respondents related to the applicability of artificial intelligence in different phases of application of the process. Almost half of the project managers see opportunities to apply AI throughout the process. According to 9.1%, the greatest effect would stand out in the identification of risk, with the ability to analyze large databases. For 13.6% the key place is assigned to the risk analysis. There are so many opinions that it can be applied mainly in risk assessment and thus to obtain an impartial assessment that considers many aspects. According to a small percentage (4.5%), the application of AI is mainly in the choice of reaction solutions. This is due to the general expert opinion that "when it comes to choosing key solutions, expert judgment is most important". The monitoring phase has also been identified as a possible alternative in which to use the opportunities offered by modern technologies. The analysis of this question shows consistency with the statement above.

Many business experts still have a negative attitude towards AI. This was proven by research. Some of the respondents feel some kind of insecurity and threat from the use of artificial intelligence. However, over 45% of respondents do not feel threatened by AI and believe that the risk management process in ERP can be improved by the opportunities provided by AI, but key decisions will continue to be made by managers. According to about 25% of experts, artificial intelligence is still incomparable with the full emotional intelligence and human intelligence of experts. Another 10% are also not pressured because they find the use of artificial intelligence mainly in routine activities. The survey shows another group of respondents (about 20%) who are aware of the

accuracy of artificial intelligence and the fact that it is based on data and algorithms, such as the availability of initial data, current data collection strategy, ordering of collected data, determination of useful characteristics, data transformation, data transformation in response to the requirements of a specific model, selection of appropriate algorithms, evaluation of multiple algorithms to determine accuracy, comparison with other algorithms and determination of model speed. In other words, its capabilities far exceed those of the best experts in the field.

Evaluation of the threads is important, but the benefits and contributions that artificial intelligence can bring to the practice are a priority. There are 10 different benefits systematized here, from which the practice can take advantage by introducing AI. They do not exhaust all the benefits but aim to establish the attitude of the respondents to the contributions. The benefits are systematized in Graph 4, showing the assessment to the respondents of each of them (the assessment was performed on an ascending scale from 1 to 5).

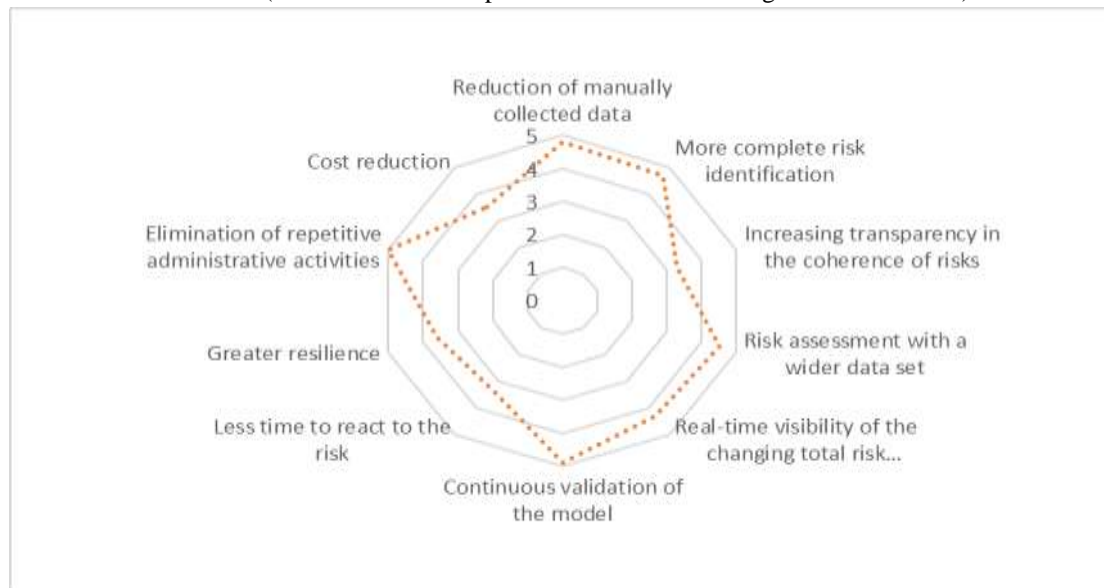


Figure 4. Advantages of AI for the project risk management process (rated on a scale from 1 to 5 with increasing gradation)

The summary of the study presents the analysis of the results related to the formulated problems of project risk management in the overall management of the ERP. All respondents find it necessary and important to add value to risk management in the functioning of the ERP. Most of them appreciate the contribution of risk management to achieving strategic goals. Respondents were asked to identify important risk management contributions to the overall governance of the ERP and could choose more than one. For a large part of the respondents (77.8%), the risk management of ERP projects is primarily related to reducing the negative consequences. The next most important (55.6%) find better control of future events. Next is the option to use the opportunities (40.7%). The least importance is given to the opportunity to participate in each of the project activities, through which better implementation can be achieved.

7. Discussion and Conclusion

AI goes deeper and deeper into the business world. Its application in ERP in the form of an additional risk management tool raises your questions. On the one hand, additional intelligent functionality improves the overall system and makes the work of individual business processes in the organization more reliable and sustainable in different places. This allows a better opportunity to use strategic goals.

On the other hand, there are still issues related to choosing the right solutions from AI. Many experts are concerned about this. Their dangers are that AI solutions cannot always replace the human mind. They are also afraid of being replaced, and their expertise is unnecessary. Concerns are that in the event of a technical failure in a time of crisis, people will lose adequate responses and will not be able to cope on their own. Here we can say that it takes time to prove the possibility of intelligent risk management in ERP systems. The risks associated with the development of ERP projects in organizations are significant. ERP projects are among the most critical IT projects. Integrating a risk assessment methodology in ERP project implementation will help the organization to better understand the risks at each stage of the project and control them. With AI applied in the risk

management methodology for ERP project implementation, companies can work with larger amounts of data (from both structured and unstructured databases) and make better informed decisions, improve work efficiency, and decrease the time for risk identification. The utilization of AI allows for increasing the certainty in the data by determining the inputs and reducing the range variation of risks. This process can mimic the human procedures, can resume the evaluation of similar criteria and experience from completed similar situations, and therefore reproduce the evaluation system with high liability. Another advantage is that AI allows to include considerations of uncertainty. The case study of Bulgarian companies shows that AI has its place in the modern management of ERP project risk, however, evidence shows that its introduction is a process that requires step-by-step activities, starting with routine ones.

The innovation offered in this material shows that the complex processes of implementing ERP projects can be performed much more efficiently by reducing the frequency and severity of the consequences of the risks that accompany them. This will optimize the process, make it more flexible, allow compliance with previously established deadlines and the planned quality of the software, according to the company's processes. The benefits are aimed at both the introducing organization and the user company. Through the intelligent methodology of risk management, a solution can be sought for many problems relevant at the present time. This gives us reason to predict that within the next 5 to 10 years, confidence in the capabilities of AI will be justified, and the results of its use visible. Therefore, it is necessary to continue and deepen the scientific research on the subject described here. Future work should focus on both the conceptual developments and the specific algorithms and their training.

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