Presenting A Model For Using Artificial Intelligence In Risk Management Of Construction Companies

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Abstract

The aim of the study was to present a model for using artificial intelligence in risk management of construction companies. According to the purpose and nature of this research, in terms of method, it was a qualitative research that was conducted by interviewing research experts. The study approach has been grounded theory. The statistical population was university professors in the field of management and senior managers of construction companies. The basis of the work of the qualitative part of the study was the ground theory method (foundation data theory) and three types of open, central and selective coding. The results showed that the model of using artificial intelligence in the risk management of construction companies includes the main categories of factors related to construction companies, factors related to the risk of artificial intelligence technology, training, functional components, managerial factors, and factors related to employees.

Keywords: artificial intelligence, risk management, construction companies.

- Introduction

Risk refers to the possibility of failure of an economic complex due to various factors such as market failure, lack of financial resources, insufficient demand and technological limitations (Ramazani et al., 2018). Companies must have a suitable strategy to recognize, investigate and control the i[1]nternal and external environment so that in addition to identifying related risks, they can collect information from the environment and recognize the changing trends of such risk and through timely risk management, products and market their services successfully (Asgar Nejad Nouri et al., 1401).

Among the risks that companies face are related to the simultaneous attention to talent management, financial risk management, cost-benefit analysis, team building, maintaining the project rhythm, avoiding the project going out of scale, being operational, morale management, and organizational culture. Also, the occurrence of uncertain events can have consequences on the schedule or cost of the project in construction companies, and the risks of the project can include environmental aspects such as incorrect and poor project management or dependence on external uncontrollable factors. The source of the risks of construction companies is the

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uncertainty that exists in all projects. In this regard, known and specific risks are: risks that have been identified and analyzed and can be planned for, and unknown and unknown risks are: risks that cannot be managed.

In construction companies, risk management is essential to improve the quality of work. The project management process in such companies begins with the recognition and identification of user needs, project limitations, required resources, and considering real goals in order to achieve strategic goals. This process may have an iterative process because new information will always be available to the manager through the efforts of experts. The construction phase is also very important because the quality of the completed project has a direct relationship with construction management. The quality of the construction depends on the completion and quality of the contract documents prepared by the designer, laborers, field supervisors and the quality of the materials. Also, having a skilled workforce and effective management over them are among the essential requirements for improving the quality of the project (Ingle and Mahesh, 2022; Mihailovic and Apostolska, 2020). Risk management is the process of identifying, analyzing and responding to risk factors that may occur during the life of a project. If risk management is done correctly, it can prevent possible risks by controlling future events. Proper risk management will reduce not only the probability of its occurrence, but also the scope of its effects. In addition to identifying risks and determining their quality, risk management systems can also predict the effects they have on the project. Accepting or not accepting risk usually depends on the resilience level of the project manager. If risk management is done regularly to identify potential problems and find their solution, it will easily complement other processes such as organization, planning, budgeting and cost control. A project manager who is a pioneer in this field can largely prevent the occurrence of unexpected events during the life of the project. Risk management should be done not only at the beginning of the project, but throughout the life of the project. For example, if the estimated time for a project is three months, risk assessment should be done at least at the end of the first month and the end of the second month. At each stage of the project's life, new risks must be evaluated and managed after identifying and determining the quality. After the project team has identified all possible risks that may jeopardize the success of the project, they must now select the risks that are most likely to occur. This choice should be based on past experiences, learnings, available information, etc. Usually, there are many risks at the beginning of a project, and as the project progresses, it gets closer to those risks; Therefore, risk management should start from the very beginning of the project and proceed step by step. The important point here is that, in general, opportunity and risk remain at a relatively high level during project planning (the beginning of the project life cycle); But because the amount of investment at this stage is low, the amount of financial risk will be small. On the other hand, during the implementation of the project, the risk levels gradually reach their lowest level; because ambiguous cases are identified little by little; But as the invested resources required to complete the project increases, so does the amount of financial risk. (De Almeida et al., 2021; Zhang et al., 2021).

On the other hand, technological advances and changes have always affected different aspects of human life and activities. The ever-increasing inventions and innovations in this field have changed our lifestyle to a great extent. Artificial intelligence is one of the latest technologies that plays an important role in this transformation. Even though only a few decades have passed since the emergence of the subject of artificial intelligence, many developments in this field and its influence and use in various fields have made it more tangible and usable for us. This technology has changed almost all aspects of human life; From its application in medicine, industry, data mining, expert systems and electronic commerce to its use in home appliance control (Azimi et al., 1400). Artificial intelligence, as a tool with extraordinary capabilities, gives us the ability to have more access to the resources of potential and actual customers and competitors' customers and their opinions in various virtual and social networks, and helps in

the development of better, more accurate and efficient services from that information and data (Yuping Liu et al., 2022).

Undoubtedly, today, achieving artificial intelligence technology is one of the national and business priorities in the countries of the world. Private businesses are the driving force behind technical progress in artificial intelligence, and a large portion of the world's AI research and development is conducted by a small number of large tech companies. A report from the McKinsey Institute, which surveyed 35 major technology companies, found that they spent $18-27 billion internally on AI development in 2016, and other companies spent $8-12 billion on investments and acquisitions. are active in this field. The American Council of Science and Technology Advisors predicts that American companies will spend more than $100 billion annually on AI research and development by 2025 (National Science and Technology Council, 2020).

Most projects are implemented in a complex environment; In such a way that risk and uncertainty are part of their integral features and it is not possible to completely remove them and they can create problems in the implementation and achievement of goals. In construction projects, most of the risks are assigned to the contractor; This action has negative effects on the costs of the parties to the contract. Therefore, identifying, measuring risk and planning to control it can play a significant role in the success of the project. Doing these things in the context of the implementation of construction projects can bring beneficial results for the successful completion of projects, in the form of cost, time and attracting the opinions of project stakeholders. Therefore, the main concern of the researcher and the problem of this research is the correct and maximum use of artificial intelligence for risk management in construction companies.

The risk of granting facilities to knowledge-based production type 2 companies was lower than to start-up and production type 1 companies. Fertash et al. (1401) investigated the risks of companies related to information technology. Their results showed that weakness in concluding international contracts and development of the export market, lack of executive guarantee and mechanisms related to compliance with privacy, content ownership and security, weakness of intellectual property as a means of regulating the internal competition environment and limitations in financing companies from Among these risks has been. Taghipour et al. (1400), sought to identify, evaluate and rank the risk of maritime companies using hybrid models. The results showed that "political and legal" and "education" risk categories were more important and had an impact on other risk categories. Esfahani Zanjani et al. (2019) studied meta-analysis explanation of supply chain sustainability and risk management. According to the results obtained from the research on the prevalence of solid, liquid and gas waste throughout the supply chains and the creation of various economic, social and environmental risks and damages in the industries, he emphasized the necessity of trying to find solutions to provide the best possible services. Tapaninaho et al. (2022) studied energy company risks in Finland. Their results showed that things like stakeholders, creating common value, sharing circular economy strategy, creating common knowledge for political decision-making, industry development, creating local ecosystems and business model modification, as well as presenting the concept of multidimensional and multifaceted value. Among the risks of these companies. Labens (2022), studied the risks of non-governmental organizations. The results showed that nine structural components of the ecosystem, communication with customers, government and government institutions, cultural and social factors, implementation processes, production and distribution processes, product service processes, product design and technology were among these risks. Hina (2022) studied the risk of technology companies. His results showed that these risks are divided into internal (company policies and strategies, financial barriers, technological barriers, lack of resources, cooperation and partnership, product design and internal stakeholders) and external (consumer barriers, legal and economic barriers, supply chain and

social, cultural and environmental barriers) are related. Bahar Gava et al. (2021) in a research entitled employees' perception of the implementation of artificial intelligence and intelligent automation and their relationship with job satisfaction, job security and employability found that five important findings were obtained regarding the perception of artificial intelligence. It shows that a) human touch and soft skills remain irreplaceable and cannot be replaced by artificial intelligence, b) employees should perceive artificial intelligence as an opportunity and not a threat, c) employees may experience job satisfaction. experience, but they are in two ways of job security and organizational progress, and d) organizations must be well prepared before and after industrial changes. Inyang and Okonkwo (2021) studied the risks of technology-related companies. Their results showed that the problems related to laws and regulations related to customs and exports, the complexity of government regulations and the weakness in the transparency and efficiency of regulatory mechanisms, the lack of transparency of procedures and the strict implementation of insurance and tax laws, and the challenges related to taxes, duties and high interest rates. It is among these risks. Ohman et al.'s study (2020) is one of the few comprehensive international reports focusing on identifying and facing business risks. In his research, he made a comprehensive review of the studies conducted regarding the identification of risks faced by businesses in the stages of designing and introducing new products and divided them into four groups: management, technology, market and others. Although in these studies, knowledge-based companies were not considered, but since the topic of new product/service development is a key issue in most knowledge-based companies, this classification can be a good guide for knowledge-based companies as well. Chatterjee (2020) examined the challenges of artificial intelligence adoption. His results showed that several policies such as access to industry data, increasing the awareness of professionals, access to infrastructure, and upgrading manpower and talents needed in the field of artificial intelligence are important to improve performance.

- Research Methodology

According to the purpose and nature of this research, in terms of method, it was a qualitative research that was conducted by interviewing research experts. The study approach has been grounded theory. The statistical population was university professors in the field of management and senior managers of construction companies. In this section, sampling was done theoretically. In theoretical sampling, events are sampled, not necessarily people. If people are also referred to, the main and key goal is to explore events. Although there is no specific rule for sample size in qualitative strategy, 6 to 8 units for homogeneous groups and 12 to 20 units for heterogeneous groups are suggested. The interviews continued until theoretical saturation was ensured. In this study, saturation happened with 12 experts (university professors in the field of management and senior managers of construction companies).

Sampling was done in the framework of the logic of the qualitative method and purposefully. Two methods of targeted and snowball sampling were used in sampling. Usually, in qualitative researches, in order to obtain the most information, purpose-based sampling is used, so the researcher chose the participants who were so-called "rich in information". It means that based on the principle of qualitative research, samples were selected that presented a strong picture of the phenomenon under study. The participants were selected based on the sampling method of university professors in the field of management and senior managers of construction companies who were also willing to be interviewed. The basis of the work of the qualitative part of the study was the ground theory method (foundation data theory) and three types of open, central and selective coding, which was done with MAXQDA software. Grounded data theory (also known as data-driven theory, grounded theory, and grounded theory) is a general, inductive, and interpretive research method developed in 1967 by Barney Glaser and Anselm Strauss.

- Research results

According to the findings, it can be seen that for the 39 identified open codes, 6 categories were identified and entered the axial coding stage.

Table 1: The main and subcategories of the research

Main article	Subcategory
Factors related to construction companies	Using modern technologies
	Accurate and fast access to information
	to be transparent
	Innovation
	Attitude towards artificial intelligence
	Company background
Education	Training employees about artificial intelligence
	Individual ability
	Building trust in personnel
	Better information
	Transparency of the goals of construction companies
Factors related to the risk of artificial intelligence technology	Create motivation to use
	Usage experience
	Personal Information
	Privacy
	Expected values
	Data protection
	Management
	Trust in technology
Management factors	Acceptance of artificial intelligence technologies
	Functional principles
	Correct management principles
	Moral Values
	Creating sustainable value
	Intelligent control and monitoring
Functional components	Organizational Agility
	Knowing the risks
	Classification of risks
	Better understanding of the importance of risks
	Organizational complexities
	Organization Structure
	Service and product quality
Factors related to employees	Responsibility for risks
	The mental state of the personnel
	Moral issues
	Employee effectiveness
	Rule of law
	Professional construction skills
	mistakes

Axial coding is the second stage of analysis in foundational data theorizing. The purpose of this stage is to establish the relationship between the classes produced in the open coding stage. The relationship of other classes with the central class can be realized in five topics, which are causal conditions, central phenomenon, strategies and actions, intervening conditions, contextual conditions and consequences (Strauss and Corbin, 1998). Therefore, with the opinion of professors and experts, categories were determined from all the obtained indicators. From the qualitative analysis of the content of the interviews, 6 categories (main category) and 39 subcategories were obtained.

Table 2: Selective coding

Paradigm	Selective coding
Background conditions	Factors related to construction companies
Causal conditions	Education
A central phenomenon	Factors related to the risk of artificial intelligence technology
Intervening conditions	Management factors
Strategies and actions	functional components
consequences	Factors related to employees

The following paradigm shows the model of using artificial intelligence in the risk management of construction companies.
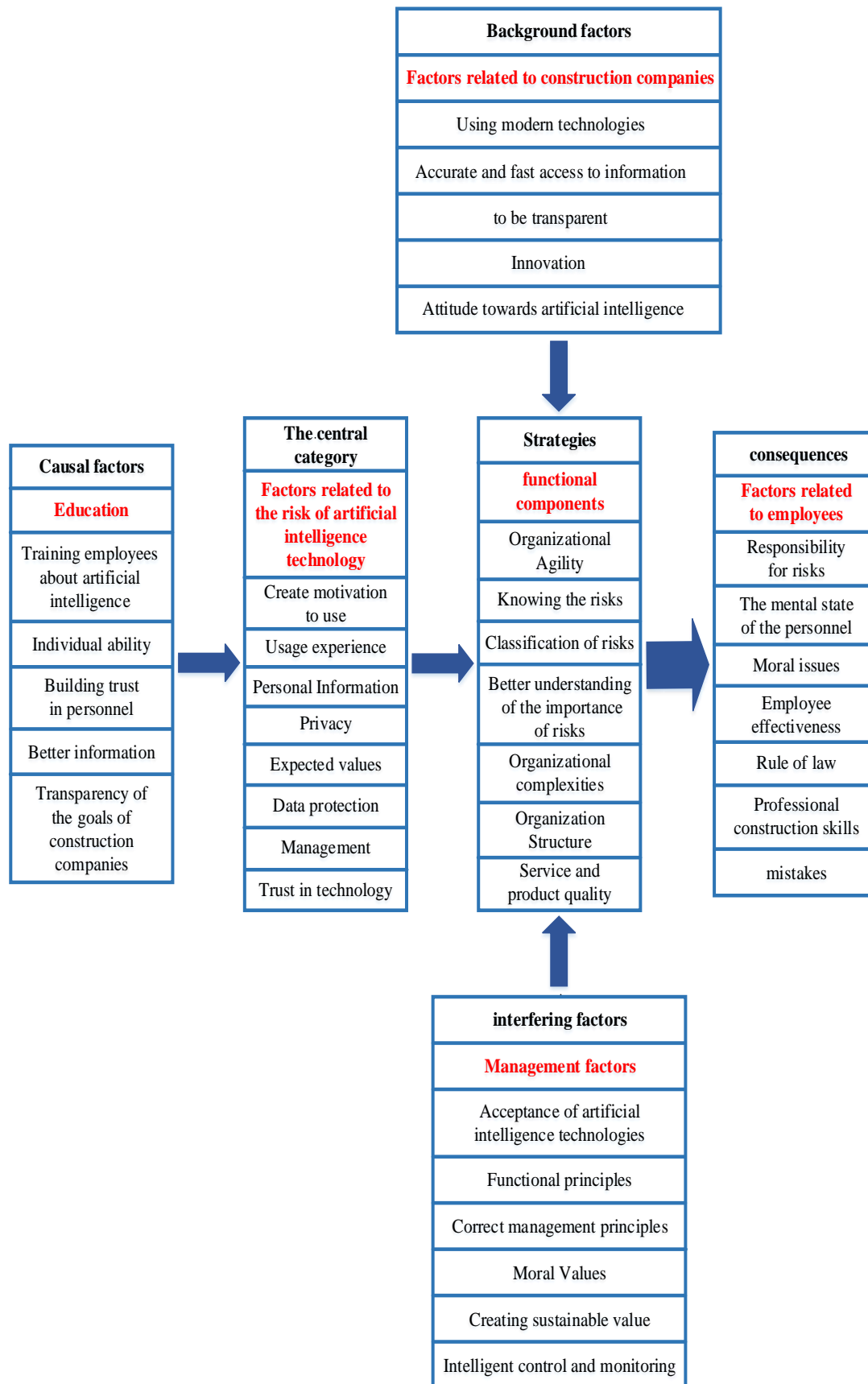
Background factors

Factors related to construction companies

Using modern technologies

Accurate and fast access to information

to be transparent

Innovation

Attitude towards artificial intelligence

Causal factors

Education

Training employees about artificial intelligence

Individual ability

Building trust in personnel

Better information

Transparency of the goals of construction companies

The central category

Factors related to the risk of artificial intelligence technology

Create motivation to use

Usage experience

Personal Information

Privacy

Expected values

Data protection

Management

Trust in technology

Strategies

functional components

Organizational Agility

Knowing the risks

Classification of risks

Better understanding of the importance of risks

Organizational complexities

Organization Structure

Service and product quality

consequences

Factors related to employees

Responsibility for risks

The mental state of the personnel

Moral issues

Employee effectiveness

Rule of law

Professional construction skills

mistakes

interfering factors

Management factors

Acceptance of artificial intelligence technologies

Functional principles

Correct management principles

Moral Values

Creating sustainable value

Intelligent control and monitoring

Figure 1: The model of using artificial intelligence in the risk management of construction companies

- Discussion

The results showed that the model of using artificial intelligence in the risk management of construction companies includes the main categories of factors related to construction companies, factors related to the risk of artificial intelligence technology, training, functional components, managerial factors, and factors related to employees. . Artificial intelligence is a powerful, versatile and flexible technology that can advance many industries and businesses. This science is not a new phenomenon and many of its theoretical foundations and technology have been developed by scientists over the past 70 years and have been used to some extent in many industries and businesses (Yadav, 2020). However, in today's world, thanks to the increase in computing power, the availability of large data sets, and algorithmic progress in machine learning, artificial intelligence has turned from an academic discipline into a practical and influential technological innovation in industries, businesses, and society. Is. Over the past several years, artificial intelligence technologies have changed the nature of business interactions at an accelerated pace (Lee et al., 2021).

From the point of view of organizations, risk is a threat to the success of the project, and the risks that are considered as threats to the project are accepted if they are in balance with the reward of accepting the risk. Therefore, it is necessary that the organization is committed to risk management throughout the project. Risk management as one of the nine elements of strategic project management plays a significant role in project success (Ebrahimi et al., 2019). Many companies are far from having a full understanding of the wide range of opportunities that AI offers in creating and sustaining a competitive business advantage. Artificial intelligence enables companies to gain new insights into people's behavior and increase the efficiency of business operations. So that approximately 84% of commercial agencies are interested in implementing artificial intelligence and machine learning projects, and 75% of large companies have improved customer satisfaction by 10% with artificial intelligence (Batta Piat Kowska, 2022).

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