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Identify and Evaluate Obstacles and Risks of The Egyptian Building and Construction Sector

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Abstract: Building and construction projects are associated with the country's internal and external conditions, which exposes them to risks throughout their lifespan; hence, the construction industry is one of the industries influencing the country's economy. Therefore, the study aims to identify and evaluate the risks associated with Egyptian building and construction sector conditions. Consequently, this study explained and examined the risk management concept and its emergence in construction projects, along with the five stages of risk management. On the other hand, the study analyzed and demonstrated the concept, characteristics, and significance of the construction industry, its influential role in development plans, the position of that industry in Egypt, and many other factors that hinder this pivotal industry. Therefore, the study investigated many previous studies to identify the most significant risks facing the Egyptian construction sector due to the lack of a fixed database of risks for all projects and classify them according to quality, cost, performance, and schedule. Finally, to assess the significance of these risks and rank them according to the occurrence probability, the hazard size, and the threat degree relative to the Egyptian building and construction industry. A field study was conducted through interviews and a questionnaire based on the Chi-Square test in light of the architectural, urban, and infrastructure projects Egypt is currently undertaking within Vision 2030. Consequently, it will facilitate dealing with, managing, and treating risks and reducing and preventing their consequences as a standardized database.

1. Introduction

The construction industry is considered the most influential in the country's economy [1]. Also, the building and construction sector is defined as a group of actions concerning the concept, innovation, and execution of architectural and urban projects for varied social and economic fields of numerous types, such as many public and private buildings and facilities, besides infrastructure such as roads, bridges, tunnels, ferries, and sewage networks, railways, airports, etc. [2]. However, the Egyptian construction and contracting industry has many obstacles and is exposed to many risks, like in

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many developing and developed countries. The most significant problems in the Egyptian building and construction sector are delays in finishing projects, poor productivity, low quality, changing inflation rates, and expense changes during the project execution duration [3], [4], [5]. Consequently, avoid harmful effects and concentrate on the recommended solutions. As such, identifying the significant and urgent dangers and obstacles preventing the growth of this vital industry was essential. Likewise, companies, bodies, and entities that want to succeed and continue in this robust industry must deal with potential obstacles and risks correctly to ensure that they achieve their interim and strategic goals with the ultimate efficiency and effectiveness. Also, risks are considered one of the qualities of architectural, urban, and infrastructure projects in the construction industry [6]. These risks can be unpredicted or anticipated by partners involved in the contracts. They always result in a tangible increase in project time and cost and an unfavorable impact on quality [7].

Risk can be characterized as an unpredictable state or event that, if it materializes, will impact one or more of the most crucial project objectives (cost, schedule, quality, performance, and environmental and occupational safety) negatively or positively [4]. Hence, it must be dealt with and managed. As a result, risk management is an organized and technological procedure used to identify and assess risks throughout the path of a project and react to them in a way that won't interfere with the project's progress to get an appropriate level of elimination, control, or regulation. Also, any category of construction sector project depends on the efforts of three key partners: the engineer, client, and contractor. However, the engineer is in the lead since they bear the highest responsibility for any good or bad effects that arise from executing these projects in terms of the implementation quality, commitment to completing the project on time, and the targeted cost. While the engineer does not bear sole responsibility for the emergence of such risks affecting the path of these projects, one of the most critical features of such projects is their constant exposure to unintended risks and obstacles [5]. Therefore, the engineer, as an influential party, had to analyze and manage them in a way that would limit them and provide solutions and proposals. Accordingly, project managers can more consistently plan their priorities, distribute resources, and make decisions supporting the project's success and accomplishing its public or private goals following the current conditions, development plans, and country visions.

2. Literature review

There are many previous studies about identifying, evaluating, and managing risks and how to deal with and overcome them within various projects at the local level and in most countries. Some of these studies were investigated and analyzed to identify the most significant risks and obstacles, the most meaningful actions and methods they used, and the outcomes they obtained.

(Akkab, 2009) has provided a detailed definition of risk management, especially the cost risks and their changes and oscillations in projects. A field study was conducted using questionnaires with a group of experts, engineers, and technicians in projects under implementation, and it identified the most significant risks, including the design requirements factor, which is considered the first rank influencing the cost increase. Then, the second rank is the integration lack of the contractor’s contract documents. Then, the third rank is the market situation of fluctuation in prices. The fourth rank is the control factor in the quality of materials and the implementation skill, which has massive

efficacy in increasing and reducing costs. The project management position, which involves reviewing design models and bills of quantities before execution, comes in at number five. The regulation factor of financial flows during the construction cycle comes at number six [7].

According to a study (Ropel, Mikaela, and Ewelina Gajewska, 2011), the most variables contributing to project delays occur during the planning phase. These include inadequate planning, the financial struggles of contractors, inaccurate cost projections, and subpar worksite supervision. This is because a large number of changes and claims may lead to the formation of a new project to deal with the significant variables required in the current project as a result of the requirements of the owner and consultant, the lack of experience of the contractors, design errors, and delays in disbursing contractors' dues. The study has confirmed that one of the most important reasons for project delays, which leads to conflict, is the lack of harmony or understanding between the contractor's work crew and the project consultant's work team [8].

(Rezakhani, 2012) has attempted to create an overview of the primary risks that Korean contracting organizations face and how they impact the progress of projects. A thorough case study of multiple Korean contracting firms was used as support. Questionnaires containing both closed- and open-ended questions were used to obtain the data. The most significant result of the study was to create an ordinal classification of the risks facing any project after identifying these risks so that all potential risk areas can be dealt with according to the potential impact of their occurrence [9].

Additionally, Baghdadi, Ahmad, and Mohammed Kishk (2015) have attempted to enumerate the hazards that Saudi Arabian airport building projects face, define the anticipated outcomes from these risks, and conduct systematic and staged interviews with specialists from airport construction businesses. Then, a thorough assessment of the literature on risk identification and analyzing the data using descriptive statistics. The study identified five critical risks out of fifty-four potential risks for Saudi airport building businesses: the lack of an apparent risk management plan, late payments, design modifications, bureaucratic issues when interacting with the government, and demand changes [10].

Similarly, the study (Rasheed, 2015) has strongly emphasized efficient planning to assess and handle risks of varying degrees of significance according to a particular and successful strategy based on specialists in the risk management field at the top rank. Next, risk-reaction protocols are created, ensuring that hazards are managed within construction projects. Also, numerous dangers were found in several finished construction projects, as well as in theoretical research and through interviews with many construction industry specialists to ascertain the degree to which these risks affected the goals and safety of the projects. The highest risks were the unavailability of plans for service networks, religious events, sudden holidays, discrepancies between implementation and specifications, poor coordination between the contractor and the employer, and assigning the work to an incompetent contractor [11].

Subsequently, (Sherif et al., 2020) have established criteria and employed KPIs aligned with the Egyptian construction industry, including cost, time, and quality, to augment the worth of Egyptian construction projects and enhance their effectiveness across their life cycle. Two fundamental approaches were combined to review prior research on key performance indicators and critical success factors for construction projects at the local and global levels to identify the most prevalent and significant indicators and success factors globally relevant to the construction market of Egypt. Subsequently, a survey was carried out to leverage Egyptian insights regarding identifying the most influential indicators and relevant aspects of the Egyptian market [3].

Upon scrutinizing and evaluating past studies, the study observed that the vast majority of such studies initiated the risk identification phase through interviews and questionnaires with stakeholders in the construction sector due to the absence of a standardized database for risks across all projects. Accordingly, the study seeks to establish this database regarding the Egyptian construction industry. In addition, prior studies have verified the deficiency in knowledge regarding risk management and its mitigation. Furthermore, such studies have demonstrated how crucial risk management is for project management purposes; hence, risks differ based on their impact degree and occurrence probability according to the type of study, project, country, state, and region. Consequently, this deduced database, or the collected list of risks must be adapted and categorized according to the current conditions of the Egyptian construction sector within Vision 2030. Most importantly, the study seeks to include this list of as many risks as possible that may occur during the life of various current projects.

3. Research problem

Building and construction projects have a particular nature linked to the circumstances of a country. Many internal and external factors influence its nature. These expose projects to risks emerging at every project stage, from planning and concept generation to execution and submission of the finished project. Because there is typically no set database for hazards in all projects in general, especially the Egyptian sector, this expands uncertainty and the likelihood that these risks will materialize [12]. Also, the numerous modifications and claims may equal a new project to address the necessary variables required in the current project because of the consultant and contractor work teams' ignorance of risk management, handling, and suitable reactions [5], [10].

Additionally, there is not enough effort to make stakeholders aware of the significance and gravity of the problem because of their indifference to the presence of risks and their failure to anticipate or predict them, but not taking the necessary precautions to confront their effects is considered very costly to the Egyptian national economy, the contractor, and the client, with a drain on resources and a waste of time [6], [13]. Furthermore, contractors were not supported with risk management tools and information on how these risks affect the project goals [14], [15].

4. The aim and objectives of the research

The study aims to verify, categorize, list, and assess the primary challenges and hazards facing the Egyptian building and construction industry currently within Vision 2030. Hence, examining and evaluating such expected risks that have been accurately identified as a database and then making suitable efforts to deal with them in a way that results in sound and effective risk management procedures. Consequently, the support purposes of construction and building projects are to the greatest extent possible in terms of efficiency and effectiveness. Consequently, the following support objectives are:

1) To Clarify and understand the reality of risk management, its concept, and the stages of conducting and employing it in the construction sector.
2) To explore the concept and importance of the construction industry and its position in Egypt.

3) To determine, gather, and categorize the risks and obstacles presently facing the building and construction sector; and
4) To investigate, check, pick, and rank these risks identified according to the current Egyptian building and construction sector and in light of the projects affiliated with Egypt's Vision 2030.

5. Methods and tools

As shown in **Fig. 1**, the study followed the inductive and analytical approach while clarifying and exploring the management reality of risks and their emergence in construction projects. Also, the study explained the notion of risks, the thought of managing them in the construction industry, and how to manage such risks in its five stages. Then, it demonstrated the concept, nature, and importance of such an industry and explained its influential role in development plans. Thus, it examined the status and condition of the construction industry in Egypt and many other factors that hinder this pivotal industry.

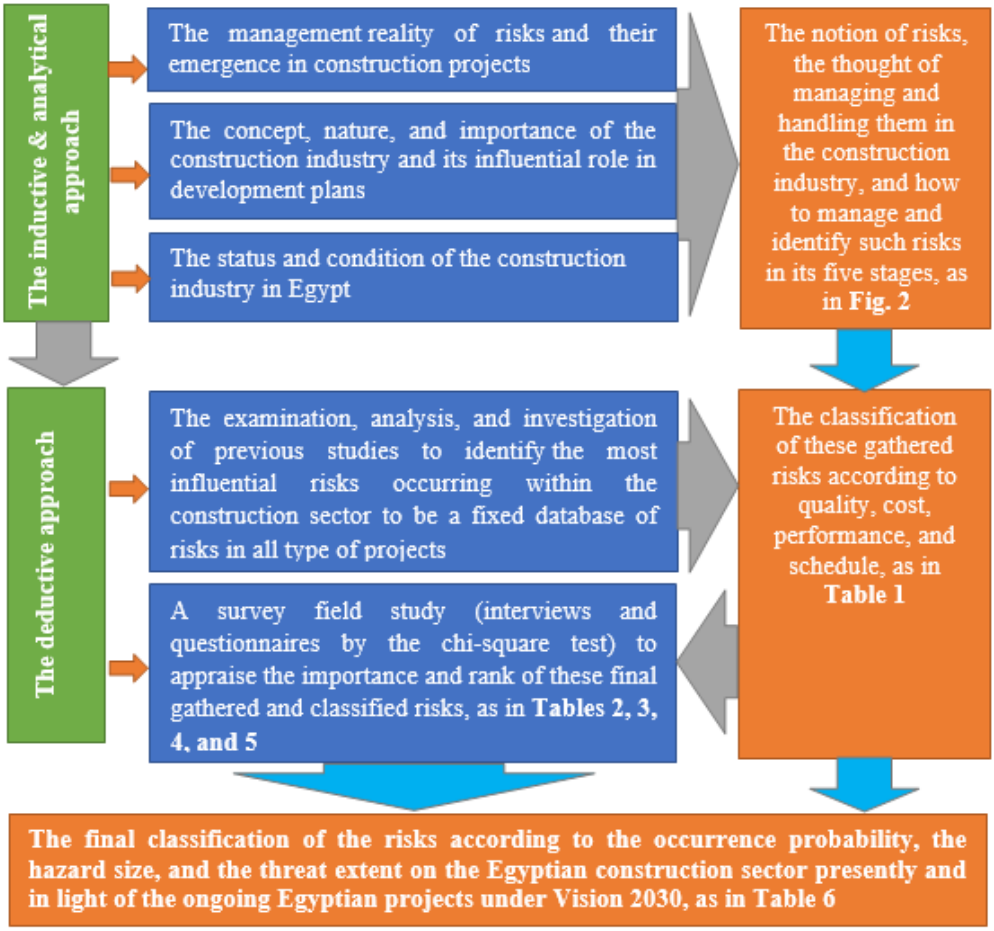

Fig. 1. The study flowchart.

Accordingly, the study employed the deductive approach in examining, analyzing, and investigating many previous studies to identify the most influential risks occurring within the construction sector due to the lack of a fixed database of risks in all projects in general. Then, they were classified according to quality, cost, performance, and schedule. All of the above is in preparation for

conducting a survey field study on these collected and classified risks to review, select, and investigate the risks related to or to which the Egyptian building and construction sector is exposed presently and in light of the architectural, urban, and infrastructure projects that Egypt is witnessing according to Vision 2030. The survey field study relied on a chi-square test to conduct interviews and questionnaires with specialists and workers in the building and construction sectors at all levels. To review and select the most occurring or most likely risks that threaten the Egyptian construction sector. The survey study was based on the concept that the most probable event occurring is the most dangerous and threatening lately within the architectural, urban, and infrastructure projects Egypt is witnessing regarding Vision 2030. Consequently, it will facilitate identifying, dealing with, managing, and treating risks according to their frequency and the degree of danger and threat.

6. The reality of risk management and its emergence in construction projects

Construction projects are exposed to many obvious risks that interact with each other complexly [11]. Finally, they lead to poor results that impact cost, time, and implementation. Contracts are considered the most significant administrative means that can serve or harm any project type, especially mega projects [4]. Therefore, it has become necessary for contracts to contain all requirements, clauses, responsibilities, obligations, incentives, and penalties in a completely accurate, detailed, and apparent way. To ensure that the owner's goals for the project are realized, the owner must select a contractual approach that considers these factors [12]. Also, the risks must be identified and explained to the other parties who will bear them. Especially those that increase implementation time or directly affect the final cost and the implementation contractor's productivity.

Because of the evident and latent risks that directly affect the cost, significant activities must be managed properly, like the project's funding or budget [16]. Besides, delay in implementing projects outside the specified time is one of the most common problems facing construction projects because delay increases the project cost for most parties concerned [6]. Also, the risks arising due to hasty implementation at the expense of quality derail the project from its correct track [7].

Construction projects have three main objectives: to finish the projects as quickly, cheaply, and with the best quality possible. By avoiding the expenses of fixing errors and defects, re-executing some non-conforming works, gaining owner satisfaction, and lowering maintenance costs, establishing quality in the construction sector provides significant economic benefits that contribute to lower construction costs. They aid in extending the project's financial life, winning the implementing agency's trust in its performance, growing its market share, and giving it a chance to compete.

7. The concept of risks and the thought of their management in the construction industry

In the future, risk is the likelihood that an event will arise for the project that, if it happens, will either positively or negatively affect or result in one or more of the project's goals. Thus, a collection of procedures determining how future events impact the intended objectives can be called risk management [5]. Then, it analyzes and evaluates these events and develops appropriate

response policies. It ends with oversight of risk management itself. Covering every administration level through this integrated, thorough, and ongoing procedure [8]. It is significant to consider that risk management seeks to eliminate hazards, lessen their negative consequences, fully benefit from present opportunities, and maximize positive outcomes to increase the market value of construction businesses and projects [9].

7.1. How to manage risks

It cannot be employed risk management as a technique for future prediction. It is a tool, though, to help with the project and to help with making better judgments based on enough facts. Put another way, this approach prohibits making decisions without sufficient knowledge [4]. Five steps make up the project risk management process, as **Fig. 2** illustrates, which are as follows:

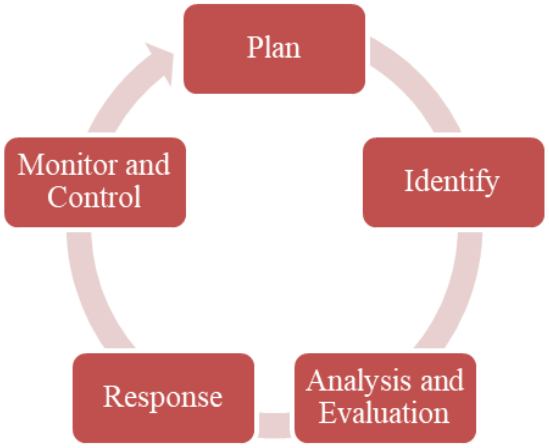

Fig. 2. Process for managing project risks.

- First: Plan stage:

The approach used to apply risk management activities in a project is predicated on deliberate and transparent planning to increase the five risk management stages' success probability. Planning is essential for ensuring that the risk management theory and vision are commensurate with the project's importance and dangers [9]. Creating a report outlining strategies for handling the risk, how to prepare for it, and how to define and coordinate activities is all part of creating a risk management plan.

- Second: Identify stage:

It is the process of locating risks that impact the project and recording the unique qualities of those risks. Since new risks emerge or become apparent as the project evolves during its life cycle, it is considered an iterative process. Risk identification involves three steps, namely inputs, risk specification techniques, and outputs. The project documentation, schedule management plan, quality management plan, cost management plan, and risk management plan are some risk inputs. Identifying risks is regarded as one of the most significant and complicated processes. Strategies and approaches for gathering data and creating an accurate database must be used for the best outcomes. Typically, a document known as a risk register contains the results from the risk identification stage [11]. These are the first entries in the risk register, which are the results of the risk identification procedure. Many techniques are used at this stage, such as document review,

SWOT analysis, scenario-based identification, the Delphi and brainstorming technique, checklists, expert consultation, interviews, and questionnaires, more than any other technique.

- Third: Analysis and Evaluation stage:

There are two methods employed in this stage: quantitative and qualitative. However, using qualitative approaches should be prioritized above quantitative ones:

1) Qualitative analysis

The scope and magnitude of a prospective risk's impact are measured in qualitative risk analysis, meaning that the risks are prioritized based on how much they could affect the project's goals. By quantitative and graphical techniques, qualitative risk analysis is essential for assessing the significance of risks and deducing which ones require examination before others [6]. Assess the likelihood and impact of risks, and the risk categorization matrix is the most crucial step in the many techniques and instruments utilized in qualitative risk analysis.

2) Quantitative analysis

Based on the likelihood of accidents and the potential financial or other value-based outcomes, it offers a determined mathematical depiction of the risk in terms of risks and possibilities [17]. A few techniques to analyze quantitatively are interviews, sensitivity analysis, probability distributions, error trees, Monte Carlo simulations, event trees, probability and effect matrices, and the Analytical Hierarchy Process (AHP) [9].

- Fourth: Response stage

It creates options and suggests courses of action to maximize possibilities and lessen risks to the project's goals. Generally, each agreed-upon and paid risk response is assigned to a single person [8]. Prioritizing risks and allocating resources and activities according to the budget, timeline, and project management plan are all part of the risk planning process [18].

- Fifth: Monitor and control stage

This phase seeks to manage the process of putting risk response plans into action, control tabs on found hazards, maintain an eye on those still there, find new risks, and assess how the risks work well with specific project components [19]. In construction projects, risks are taken in four different ways: risk avoidance, risk retention, risk reduction, and risk transfer.

With a thorough grasp of the project, one may discern the advantages of implementing risk analysis and management from the preceding five stages of the process. Consequently, determining the project's time and cost requires developing reasonable and coherent planning. All project participants are also helped and supported in specifying how to manage these risks and selecting the best kind of contract. Understanding the project's hazards also enables a rational, careful evaluation of the emergency reserve that considers the risks, moving away from chance. However, using risk management discourages the approval of financially inefficient initiatives. Apart from facilitating the development of statistical data on risks that aid in the appropriate project design, it also makes it simple to take oversized risks more sensibly, thus increasing the value derived from taking risks. Lastly, it facilitates the differentiation between terrible luck and poor management and good luck and good management following the current Egyptian conditions, development plans, and country visions.

8. Construction and building industry in Egypt

8.1. The concept of the construction and building industry and its influential role

The construction industry differs from other industries because the nature of its products is distinct from any other product; they are characterized by a life cycle with a specific beginning and end. The construction sector serves other economic sectors and industries by providing services, and it typically supplies its goods in response to distinctive needs and goals. These goods range from simple projects to intricate undertakings requiring advanced technology and expertise [12], [19]. Also, it acts as a controller of economic evolution because the expansion of the construction industry and economic growth are positively correlated [4]. However, it's a complicated industry with a broad range of participants with diverse backgrounds in the real world, such as government sectors, unions, consulting firms, geologists, city planners, technicians, accountants, financiers, and engineers from many fields [18]. In addition, the final product is a composite of an enormous number of materials with different properties and shapes, in addition to many diverse mechanical and electrical equipment and supplies [6].

Building economies is one of the construction industry's foremost functions, and its success leads to achieving a large percentage of the desired development and stability purposes. The risks, obstacles, and pitfalls concerning this industry affect the economy due to the complex and unique nature of such projects relative to other manufacturing. Correspondingly, this industry contributes a massive and tangible share of the national product and absorbs large numbers of the workforce. Most importantly, it provides a large market for the products of many factories and workshops related to the building and construction industry, such as cement, iron, wood, marble, glass, and so on.

8.2. The situation of the construction and building industry in Egypt

In recent periods, the Egyptian construction sector, like other service and economic sectors, has witnessed a remarkable development in the level of implementation techniques and means or the extent of the use of modern products at the level of the Egyptian sector actually and in light of the architectural, urban and infrastructure projects that Egypt is witnessing per Vision 2030 [3].

This progress is considered relative compared to the tremendous progress that has recently occurred in the construction fields at the global or regional levels. The construction industry is affected by the overall performance of the economy, both negatively and positively, as the period at the beginning of the eighties witnessed relative economic stability and an influx of foreign aid [4], [16]. Likewise, during the 1990s, the construction sector faced many challenges and risks that affected its performance for several reasons, the most significant of which were problems related to imposing a sales tax and weak confidence between banks and investors, which led some banks to stop financing any new construction projects, and inflation, represented by the rise in the prices of building materials and price fluctuations. With the reduction of incentives, the performance of contracting companies and the risks associated with the Agreement on Liberalization of International Trade in Services (GATT) have been heavily impacted. In addition, an increase in labor wages was brought about by the liberalization of the pound's exchange rate and the inflation of administrative authority dues [1].

Many other factors hinder projects related to project parties, such as the owner, which are delays in reviewing and approving design documents, ineffective delay fines, and awarding the bid to the lowest price [17]. Concerning the contractor, such as poor planning, lack of adherence to the

schedule, delays in the work of subcontractors, a weak and inappropriate system for classifying and qualifying contractors, and not using modern technologies [10]. Also, the consultant does not fulfill his assigned role and causes delays in issuing and approving building permits, weak contract documents, and quality problems. Regarding the risks associated with materials and equipment, there are the unavailability of materials on the market, changes in specifications and quantities of materials, and equipment inefficiency [5].

Finally, the most significant factor is occupational and environmental safety, which includes failure to implement the safety system, frequent accidents, and failure to consider weather conditions and fluctuations. On the other hand, structural design problems such as design errors, lack of clarity of plans, and design modifications should not be neglected or overlooked. Similarly, there is a lack of application laws and legislation.

9. The most significant risks facing the Egyptian building and construction sector

Based on what was studied, analyzed, and investigated in numerous previous studies, the 44 most significant risks to which the construction sector is commonly exposed were identified and compiled at the local and global levels or in other countries. Then, they were classified according to the triangle of value engineering: quality, cost, and performance = function, and the project management triangle: quality, price, and schedule [3], [16], as listed in **Table 1**. Accordingly, a survey field study on these risks can be conducted at the level of the Egyptian sector at present and in light of the architectural, urban, and infrastructure projects following Egypt Vision 2030.

Table 1. The classification of construction sector risks extracted from the previous studies [1], [3], [4], [5], [6], [7], [8], [11], [12], [16], [18], [19], [20].

Code	Timetable	Code	Performance	Code	Cost	Code	Quality
T1	Pouring prefabricated concrete elements in places far from work	P1	Ineffective communication and coordination between the contractor and the owner	C1	Not allocating a place to throw rubble.	Q1	Misinterpretation of the designs and specifications leading to discrepancies between the required requirements and the execution
T2	Religious occasions and unexpected holidays	P2	Assigning the work to an incompetent contractor and the weakness and inappropriate system of classifying and qualifying contractors	C2	Different nature of the land	Q2	Absence of plans for the energy, telephone, water, and other service networks that traverse the site.

Code	Timetable	Code	Performance	Code	Cost	Code	Quality
T3	Bad weather conditions	P3	Absence of essential details and tardiness in official correspondence reaching the construction site	C3	Change work location	Q3	Lack of clarity in contractual obligations.
T4	The consultative body's approval of the implementation plans is being delayed.	P4	Internal problems occur among members of the contractor team.	C4	Difficulty reaching the site (the site is in a remote area)	Q4	The existence of various impediments on the property, including foundations, water pipes, groundwater, electricity, drainage, fire, and pumps
T5	Prolonged postponement of project commencement (progress)	P5	Limited space within the site, difficulty in moving equipment, lack of a place to prepare materials, and traffic congestion in the area	C5	Security procedures caused a delay in the shipment of materials.	Q5	The mismatch between plans such as structural, architectural, mechanical, electrical, plumbing, or contract documents
T6	Delay in transferring the site's preparation to the contractor.	P6	Conflicts between work teams during the building phase	C6	Certain project components sustained damage as a result of security events.	Q6	Change the techniques and methods used during implementation.
T7	Certain materials and equipment arriving later than expected from their country of origin	P7	The deterioration of the security conditions in the project, in addition to the repeated explosion of equipment	C7	Inadequate funding to finish the project and a hold-up in receiving operational advances	Q7	Inaccurate surveying related to the project location by the first-party
T8	Delayed design completion or design modifications	P8	Death of contractor	C8	Price changes and inflation during the project's implementation	Q8	Claim the contractor for a price difference due to the increase in the cost of materials due to the delay

Code	Timetable	Code	Performance	Code	Cost	Code	Quality
T9	Delayed procedures for transferring work to heirs	P9	Difficulty obtaining licenses and work permits	C9	A significant increase in the prices of rebar	Q9	Inaccurate project scheduling
T10	The contractor cannot assume control of the site due to security issues, war conditions, or a military unit occupying the project for an extended period.	P10	Fluctuations in productivity rates of machinery and labor (human resource problems)	C10	The owners have not paid for the project's costs; the property belongs to the state.	Q10	Bribery and administrative corruption
T11	Putting off finishing the products because the contractor lacks cash flow management and financial liquidity	P11	Equipment inefficiency	C11	Not benefit from the project due to deficiencies, such as elevators or the completion of some service spaces.	Q11	Bid sorting problems

9.1. A field survey of the most significant risks currently threatening the Egyptian building and construction sector

In light of the architectural, urban, and infrastructure projects executed in Egypt following Vision 2030, the survey field study seeks to assess, choose, and investigate the current dangers of the Egyptian building and construction sector based on the risks previously described in **Table 1**.

Since there isn't a single database of risks associated with all projects, it can help experts identify risks before interviewing and surveying parties involved in the construction sector on each project. It also discusses the gaps in knowledge about risk management and how to close them. All of this is because risk management is crucial to achieving project objectives and development plans during a project path. It is critical to recognize that risks differ based on the kind of research, project, nation, state, and region, in addition to the degree of their impact and probability of occurring.

9.2. Preparing the questionnaire, its procedural steps, and verifying the results

The study used the Chi-square test, so personal interviews were held, and questionnaires were designed and constructed to review and select the risks most associated with the Egyptian construction sector in terms of threat and danger. The questions in the questionnaire are:

1) The first question: What is the taking place probability of the following risks representing a threat to quality in the construction industry in Egypt?
2) The second question: What is the taking place probability of the following risks representing a threat to costs in the construction industry in Egypt?
3) The third question: What is the taking place probability of the following risks representing a threat to performance in the construction industry in Egypt?

4) The Fourth question: What is the taking place probability of the following risks representing a threat to the timetable in the construction industry in Egypt?

In addition, under each of the previous four questions, there is another question about whether there are other risks that can be added to the mentioned risks belonging to each classification and ranked according to their importance and degree of impact concerning the rest of the risks mentioned previously in the tables given under each question.

Then, the questionnaire results were verified after arranging and analyzing the responses. Then, the study extracted results utilizing the SPSS software (Statistical Package for the Social Sciences) and performed the Chi-Square test to determine the significance of the previously collected risks. This test is to verify the validity of specific hypotheses about the unknown population parameter when data about these parameters is unknown in the population under study. Hence, using samples and the information available about these parameters in the sample drawn from the study population, inferences were made by conducting statistical hypothesis tests about this parameter, as follows [21], [22], [23], [24]:

1) Accepting the null hypothesis means that this element or risk mentioned in the questionnaire is insignificant. Accordingly, determining the significance or non-significance of the elements or presented risks is by the alternative or null hypothesis, which is accepted based on the following rule: Reject the null hypothesis and accept the alternative if the P value is less than or equal to 5% (the confidence level). That indicates that this element or risk mentioned in the study is significant as one of the determinants of the proposed risks that threaten the Egyptian building and construction sector.
2) The exploratory sample's standard error is contrasted with the standard error established by the investigator at the start of the investigation:

- When the researcher's specified standard error equals or exceeds the survey sample's standard error, the survey sample's standard deviation is determined; and
- The number of sample members is increased by conducting further questionnaires until the survey sample's standard error falls within or equals the researcher's set standard error if the provided standard error is less than the survey sample's standard error.

9.3. Identifying the study sample (the type and size of the sample of participants)

The research employed questionnaires and interviews with samples of seasoned executives in the field of construction, as well as technical and consulting offices, contracting firms, government organizations involved in the building industry, and employees working on the construction industry's numerous projects. [25]. Thus, it will facilitate the identifying, handling, managing, and treating of the risks. The distribution of participants was as follows: 65 individuals, including 15 implementation engineers, 17 technical office engineers, 18 consulting engineers, and 20 engineers working in state institutions, considering that they worked on many types of projects and not only one architectural, urban, and infrastructure projects.

10. Results and discussion

In this section, the field study results were extracted and discussed. From the results of the interviews and the questionnaire, the significance level of the risks collected from previous studies

was determined, and which of them are the most threatening, probable to occur, and dangerous to the Egyptian building and construction sector, concerning its changing circumstances, and reconsidered in terms of rearranging, replacing, or adding new risks through four stages:

- To review the value (P. Value), where the lower its value, the more the element (the studied risk) is significant, and vice versa. If the value is equal, the arithmetic mean is used.
- To arrange according to the arithmetic mean value of the occurrence probability for each risk in a proportion of the samples, such that the elements or variables having a greater mean have greater probabilities of occurrence.
- However, if the differences in the value of the arithmetic averages are equal, making the comparison according to the standard deviation based on the elements or variables having a lower standard deviation have a greater occurrence probability.
- If the standard deviation is equal, the comparison is made based on the smaller Chi-Square value, the greater the probability of occurrence.

It was noted from the results of analyzing the answers to the distributed questionnaires that the P.Value for all items is less than 5%, which is the item's level of significance. That means accepting the alternative hypothesis, which means that all the risks collected and proposed are significant and influential and occur in the Egyptian building and construction sector. As shown in **Tables 2, 3, 4, and 5**, the statistical analysis findings of the significance of risks in the column (Asymp. Sig.). According to their classification (quality, cost, performance, and timetable), the risks were also redistributed and arranged based on the field study so that the most frequent is the most dangerous and threatening. Then, as previously explained, the study arranged them according to the frequency or probability of occurrence and the most dangerous threat to the Egyptian building and construction sector according to the mean, standard deviation, and chi-square, as shown in **Table 6**, which is the final ranking of risks according to the state and circumstances of the Egyptian building and construction sector presently and in light of the ongoing Egyptian projects under Vision 2030.

Table 2. The importance and ranking of Quality-related risks for the Egyptian construction sector.

Quality code	Chi-Square	df	Asymp. Sig.	N	Mean	Std. Deviation
Q11	86.800a	2	.000	65	4.0615	.34807
Q8	86.800a	2	.000	65	3.9385	.34807
Q9	86.800a	2	.000	65	3.9385	.34807
Q4	86.800a	2	.000	65	3.0615	.34807
Q6	86.800a	2	.000	65	3.0615	.34807
Q7	86.800a	2	.000	65	2.9385	.34807
Q1	86.800a	2	.000	65	2.0615	.34807
Q3	86.800a	2	.000	65	2.0615	.34807
Q5	86.800a	2	.000	65	2.0615	.34807
Q10	86.800a	2	.000	65	2.0615	.34807
Q2	43.215b	1	.000	65	1.0923	.29171

a. The anticipated frequencies for 0 cells (.0%) are less than 5. 21.7 is the lowest anticipated cell frequency.
b. The anticipated frequencies for 0 cells (.0%) are less than 5. 32.5 is the lowest anticipated cell frequency.

Table 3. The importance and ranking of Cost-related risks for the Egyptian construction sector.

Cost code	Chi-Square	df	Asymp. Sig.	N	Mean	Std. Deviation
C8	43.215b	1	.000	65	4.9077	.29171
C9	43.215b	1	.000	65	4.9077	.29171
C7	86.800a	2	.000	65	3.9385	.34807
C4	86.800a	2	.000	65	3.9385	.34807
C6	86.800a	2	.000	65	3.8462	.44126
C10	86.800a	2	.000	65	3.0615	.34807
C5	86.800a	2	.000	65	3.0615	.34807
C2	86.800a	2	.000	65	3.0615	.34807
C3	86.800a	2	.000	65	3.0615	.34807
C11	86.800a	2	.000	65	2.0615	.34807
C1	86.800a	2	.000	65	1.9385	.34807

a. There are 0 cells (.0%) with predicted frequencies lower than 5. 21.7 is the minimum anticipated cell frequency.
b. There are 0 cells (.0%) with anticipated frequencies lower than 5. 32.5 is the minimum anticipated cell frequency.

Table 4. The rank and importance regarding Performance-related risks for the Egyptian construction sector.

Performance code	Chi-Square	df	Asymp. Sig.	N	Mean	Std. Deviation
P5	86.800a	2	.000	65	4.0615	.34807
P4	86.800a	2	.000	65	3.9385	.34807
P6	86.800a	2	.000	65	3.9385	.34807
P10	86.800a	2	.000	65	3.8462	.44126
P2	86.800a	2	.000	65	3.0615	.34807
P9	86.800a	2	.000	65	3.0615	.34807
P11	86.800a	2	.000	65	3.0615	.34807
P3	86.800a	2	.000	65	2.9385	.34807
P1	86.800a	2	.000	65	2.0615	.34807
P8	86.800a	2	.000	65	2.0615	.34807
P7	86.800a	2	.000	65	1.9385	.34807

a. The anticipated frequencies for 0 cells (.0%) are less than 5. 21.7 is the lowest anticipated cell frequency.

Table 5. The importance and ranking of Timetable-related risks for the Egyptian construction sector.

Timetable code	Chi-Square	df	Asymp. Sig.	N	Mean	Std. Deviation
T2	86.800a	2	.000	65	4.0615	.34807
T6	86.800a	2	.000	65	4.0615	.34807
T1	86.800a	2	.000	65	3.9385	.34807
T7	86.800a	2	.000	65	3.9385	.34807
T11	86.800a	2	.000	65	3.8462	.44126
T3	86.800a	2	.000	65	3.0615	.34807
T5	86.800a	2	.000	65	3.0615	.34807

Timetable code	Chi-Square	df	Asymp. Sig.	N	Mean	Std. Deviation
T8	86.800a	2	.000	65	3.0615	.34807
T9	86.800a	2	.000	65	3.0615	.34807
T4	86.800a	2	.000	65	2.9385	.34807
T10	86.800a	2	.000	65	1.9385	.34807
a. The anticipated frequencies for 0 cells (.0%) are less than 5. 21.7 is the lowest anticipated cell frequency.						

Table 6. The final rank of risks depended on the likelihood of occurring and the most threatening to the Egyptian building and construction sector at the current time and within Egypt's 2030 vision.

Rank	Quality	Cost	PERFORMANCE	Timetable
1	External customer satisfaction	Price changes and inflation during the project's implementation	Limited space within the site, difficulty in moving equipment, lack of a place to prepare materials, and traffic congestion in the area	Religious occasions and unexpected holidays
2	Inaccurate surveying related to the project location by the first-party	A significant increase in the prices of rebar	Internal problems occur among members of the contractor team	Delay in transferring the site's preparation to the contractor
3	Claim the contractor for a price difference due to the increase in the prices of materials due to the delay	Inadequate funding to finish the project and a hold-up in receiving operational advances	Conflicts between work teams during the building phase	Pouring prefabricated concrete elements in places far from work
4	The existence of various impediments on the property, including foundations, water pipes, groundwater, electricity, drainage, fire, and pumps	Difficulty reaching the site (the site is in a remote area)	Fluctuations in productivity rates of machinery and labor (human resource problems)	Certain materials and equipment arriving later than expected from their country of origin
5	The mismatch between plans such as structural, architectural, mechanical, electrical, plumbing, or contract documents	Certain project components sustained damage as a result of security events	Assigning the work to an incompetent contractor and the weakness and inappropriate system of classifying and qualifying contractors	Putting off finishing the products because the contractor lacks cash flow management and financial liquidity
6	Changing the techniques and methods used during implementation	The owners have not paid for the project's costs; the property belongs to the state.	Difficulty obtaining licenses and work permits	Bad weather conditions

7	Misinterpretation of the designs and specifications leading to discrepancies between the required requirements and the execution	Security procedures caused a delay in the shipment of materials.	Equipment inefficiency	Prolonged postponement of project commencement (progress)
8	Lack of clarity in contractual obligations	Different nature of the land	Absence of essential details and tardiness in official correspondence reaching the construction site	Delayed design completion or design modifications
9	Electricity, drainage, fire, pumps, etc.	Change work location	Ineffective communication and coordination between the contractor and the owner	Delayed procedures for transferring work to heirs
10	Inaccurate project scheduling	Not benefit from the project due to deficiencies, such as elevators or the completion of some service spaces	Contractor's death	The consultative body's approval of the implementation plans is being delayed.
11	Absence of plans for the energy, telephone, water, and other service networks that traverse the site	Not allocating a place to throw rubble	The deterioration of the security conditions in the project in addition to the repeated explosion of equipment	The contractor cannot assume control of the site due to security issues, war conditions, or a military unit occupying the project for an extended period.

Many participants in questionnaires and interviews confirmed the difficulty of scheduling the project implementation stages. The future steps must be planned and scheduled according to the worst possibilities. That ensures the best results if working conditions improve. At a minimum, guarantee an accurate timetable for the various implementation stages. The issue is that the site's many services, including telephone, water, and electrical networks, are not planned to travel through it. Because plans and requirements are not understood, there is no compliance between implementation and the necessary specifications.

Also, it was clear from the field study that it is necessary to spread the culture of risk management at all levels and executive structures of projects, implementing companies, and the government sector to be able to identify the potential risks they may face accurately. Therefore, prepare to face them optimally, along with many unexpected risks. Also, its harmful effects on objectives and the company are reduced wholly. Furthermore, the study discovered that risks had the most influence on project implementation duration, then project cost, and had the slightest impact on occupational and environmental safety. Finally, work must be done to develop contractual formulas between the owners and the contractor regarding the analysis and management of risks in a way that guarantees the rights of all parties while creating programs to manage these risks.

It should monitor the ownership transfer process of buildings and land of projects and be under more control and careful; hence, if possible, this process should be executed by the actual owner and not through agencies because documents can be forged. Therefore, this may harm the project path and the involved parties.

The results of the field study demonstrated that inflationary threats, which include material costs, labor costs, and transportation charges, are among the primary hazards that the industry faces generally. Furthermore, the fact that many risks remain unidentified makes the lack of a risk management culture a severe danger. Therefore, its effects and results are unknown. However, the observation is that there is a lack of insurance culture across the board, which puts people in a difficult position when risks and accidents at work arise. That helps us deal with many unforeseen accident cases and lessens their detrimental effects on the company's comprehensive objectives. The most crucial thing is the necessity of regulating construction contracts to include in their terms the possibility of price increases and amending the contract value if necessary.

One of the possible risks that could impact the time goals stated is the duration needed to secure building licenses, which harms the construction timeframe. The inability to plan work stages time is due to unforeseen occurrences that can happen at any time.

It is necessary to cooperate between the entities granting building permits to facilitate the essential procedures for granting licenses. Overcoming such a problem involves organizing construction contracts whose duration begins on the date of granting the necessary authorizations.

At the general level concerning assessing the impact and managing risks, the following became clear:

- There is a correlation between the probability and the impact of many risks, which means a relationship between risks. The occurrence of some risks causes other risks to occur, which demonstrates the importance of following up and monitoring risks, as mitigating some risks leads to addressing others in the same procedure.
- It turns out that responding to risks in general and for all answers by setting contractual terms is the preferred procedure for responding to risks, followed by accepting risks, performing risk transfer, and then followed by other processes.
- Among the recommendations that can be adopted in this research study are the following:
- The need to develop the administrative culture of project managers by taking advantage of modern technology in all construction sector projects. Then, to qualify and set engineering cadres in the risk analysis and management area through educational and qualification courses for engineers to apply and benefit from them.
- Cooperation between the state and the relevant construction and building sector parties to restructure the sector in a manner commensurate with its importance and the extent of its contribution to the national economy and working to devise a strategy and mechanism for developing what the construction and building sector offers.
- It is necessary to review international legislation and agreements that affect the competitiveness of the Egyptian contractor, whether in the local or foreign market.
- To improve and develop the legislative system by involving all institutions related to the construction sector, engineering education institutions, the Egyptian Federation of Construction and Building Contractors, the Housing and Building Research Center, and the

Engineers Syndicate in the legislative process to avoid randomness of decisions, to achieve balance between the parties to the contract, and to reduce preventive measures.

- To participate in institutions related to the construction sector in community awareness of the necessity of adopting the principle of transparency in administrative and technical procedures and in activating laws. Also, there is the need to pay attention to the relevant social and environmental sciences by expanding the system of periodic training programs for all specializations of the construction sector to develop the capabilities of technicians and administrators to keep pace with developments in the technical, administrative, environmental and economic systems and by activating the role of indirect directed media.

Finally, the research study emphasizes the necessity of using more than one method to identify risks for determining the enormous possible number of future events that could affect the path of projects and generally the construction sector, as when these methods integrate between them, ensuring the best identification of potential risks. During this stage, the risk register must be updated permanently and continuously, which is a list of all possible risks that could occur during the project to form a database of all such risks.

Accordingly, the study emphasizes that the gains and benefits of risk analysis and management processes are represented through a good understanding of the project. Consequently, developing reasonable and rational plans for project duration, cost estimation, and quality control based on how to confront such risks in various ways and methods, the way to evaluate them, and how to develop policies for appropriate responses to them will achieve the best results. Also, all of this helps and supports all parties related to the project in knowing how to deal with these risks, and the most significant thing is selecting the most reasonable kind of contract.

11. Conclusions

The pivotal conclusion is to list and arrange the most influential risks that are most likely to occur and the most threatening and dangerous within the current Egyptian building and construction sector in light of the architectural, urban, and infrastructure projects being executed now in Egypt within Vision 2030. The field survey study outcomes identified the final listed risks by investigating the collected and classified risks to inspect them. Then, the field study ensured the degree of association of such risks with Egyptian building and construction sector conditions according to the occurrence probability and the degree of danger and threat according to the current conditions of the Egyptian construction sector within Vision 2030

Based on what the study examined and investigated many previous studies to identify the most influential risks related to the construction sector faced throughout its projects due to the lack of a fixed database for risks in all projects. Then, the study classified the collected risks according to quality, cost, performance, and schedule.

That is after the construction industry's position in Egypt was explained in the recent period, as have other service and economic sectors, due to its remarkable development at the level of techniques and means of implementation or the use level of modern products at the Egyptian sector level at present in light of the architectural, urban, and infrastructure projects that Egypt is witnessing according to the vision of 2030.

The study emphasized the significance of risk management and its emergence in construction projects, understanding risks, and the concept of managing them within the construction industry. Then, the study explained and clarified its five phases for treating and managing anticipated and possible hazards in light of the notion, character, and significance of the construction industry's significant influence in realizing the nation's development goals.

The study explored many other factors that hinder this pivotal industry, the most significant of which is the rapid global economic and political changes. Therefore, it becomes apparent the implication of identifying and evaluating the obstacles and risks that are the most occurring and the most threatening to this pivotal sector to analyze and evaluate them and take appropriate measures to confront and deal with them later in a way that restricts them and presents solutions and proposals.

Accordingly, project managers have to schedule their priorities, allocate resources, and make more reliable judgments with the guidance and assistance of risk management.

Thus, it should be considered and governed the final listed risks contribute to successfully finishing the projects and achieving their private and public goals, which has advantages for the government economy and helps the countries progress.

The most significant factor contributing to this heightened uncertainty and likelihood of these risks materializing is the absence of a fixed database for risks in all projects; this is what the study targeted and achieved. Based on the above, it is necessary to study and investigate each risk in detail and how to handle it in construction projects and work to establish a list of risks according to the type of each project; subsequently, establishing a record and store of solutions that support and aid in governing the consequences and hazards of these particular risks. Finally, the potential and appropriate response to them and other future ones is to identify the risks that are the most likely to materialize and have the highest impact on all kinds of projects.

12. List of abbreviations

- T1, T2, T3, T4,…, and T11: The codes of the collected Risks related to Timetable
- P1, P2, P3, P4,…, and P11: The codes of the collected Risks related to Performance
- C1, C2, C3, C4,…, and C11: The codes of the collected Risks related to Cost
- Q1, Q2, Q3, Q4,…, and Q11: The codes of the collected Risks related to Quality
- SPSS: (Statistical Package for the Social Sciences) SPSS Statistics is a software package for interactive or batched statistical analysis.
- Chi-Square: It is a test for the examination of contingency tables with large sample sizes, this statistical hypothesis test is employed.
- P.Value: The likelihood that a specific statistical measure of an expected probability distribution, like the mean or standard deviation, would be more than, equal to, or, in some cases, less than, the actual findings.
- df: It is a degree of freedom to determine the significance level of the statistic.
- Asymp. Sig.: It is the p-value, or Asymptotic Significance, of the chi-square that a researcher just ran in SPSS. The statistical significance of the link a researcher just investigated is determined by this value.
- N: It is the number of questionnaires.

- Std. Deviation: The standard deviation, abbreviated as σ, quantifies the degree of dispersion of the data concerning the mean.

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حصر وتقييم العقبات والمخاطر لقطاع البناء والتشييد المصري

الملخص

مشروعات البناء والتشييد ترتبط بظروف الدولة وتؤثر عليها عوامل داخلية وخارجية. مما يعرضها إلى المخاطر خلال فترة حياة المشروع بالكامل. ومن ثم فهي من الصناعات المؤثرة في اقتصاد الدولة. وبالتالي تهدف الدراسة إلى حصر وتقييم المخاطر الأكثر احتمالية حدوثا والأكثر تهديدا لقطاع البناء والتشييد المصري لكي يتم تحليلها وتقييمها واتخاذ الإجراءات المناسبة لمواجهتها والتعامل معها فيما بعد. لذلك تمت تناول إدارة المخاطر ونشأتها في مشاريع التشييد وفهم المخاطر وفكر ادارتها في صناعة التشييد بمراحلها الخمسة. ومن ناحية اخري تناولت الدراسة مفهوم وطبيعة واهمية صناعة التشييد والبناء عموما وبيان دورها المؤثر في خطط التنمية ثم موقف صناعة التشييد والبناء في مصر والعديد من العوامل الأخرى التي تعرقل هذه الصناعة المحورية. وبالتالي فحصت وحللت الدراسة العديد من الدراسات السابقة من اجل الوصول لأهم المخاطر التي يتعرض لها قطاع التشييد والبناء عموما وذلك لعدم توفر قاعدة بيانات ثابتة للمخاطر في كل المشروعات عموماً. ثم تمت تصنيفها طبقا للجودة والتكلفة والأداء والجدول الزمني واخيرا تمت إجراء دراسة ميدانية على هذه المخاطر المجمعة والمصنفة لمراجعة وترتيبها طبقا للأكثر حدوثا هو الأكثر خطورة والأكثر تهديداً والتي يتعرض لها قطاع البناء والتشييد المصري في الوقت الحالي وفي ضوء المشروعات المعمارية والعمرانية والبنية التحتية التي تشهدها مصر طبقا لرؤية ٢٠٣٠. وبالتالي سيسهل التحديد والتعامل مع المخاطر وإدارتها ومعالجتها طبقا لمرات الحدوث ولدرجة الخطورة والتهديد وتقليل آثارها والوقاية منها بإعتبارها قاعدة بيانات موحدة.

الكلمات المفتاحية

قطاع البناء والتشييد المصري ; رؤية مصر ٢٠٣٠; إدارة المخاطر؛ تكلفة ; أداء ; جدول زمني ; جودة ; اختبار مربع كأي