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Risk identification framework in construction of Egyptian mega housing projects

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ABSTRACT

Egypt's population is increasing and expected to exceed 120 million by 2050. Egypt constructed mega housing projects (M.H.P) to cater with that escalation in population. The Egyptian strategy 2030 prioritized the construction of M.H.P. Contractors' in Egypt have struggled to manage construction risks and deliver housing projects successfully. The aim of the paper is to develop a conceptual risk identification framework to improve contractors' risk identification practices during the construction of mega housing projects in Egypt. The objectives of the paper are to analyse risk management practices in Egyptian M.H.P and to develop a risk identification framework (CRIF). The paper reviewed the literature of identified risks in construction of mega projects. Through a constructivism paradigm, the paper adopted the interview technique and allocated contractors' recent risk practice. Qualitative risk information is analysed using NVivo tool for qualitative analysis. The paper used the ISO 31,000 as a backdrop to design a conceptual risk identification framework (CRIF), and a computerized risk identification database (CRID) using visual basic programming. The paper further produced generic guidelines to support the use of the CRIF during construction of M.H.P. Availability of resources, poor financial status, and weak technical training were the most common risks in construction of mega projects worldwide. The paper presented a risk breakdown structure (R.B.S) that included M.H.P common opportunities and challenges in Egypt. Egypt's main challenges in construction of M.H.P included Management of Resources, Project Management, and Cash flow issues. The CRIF guides contractors' in Egypt to improve risk knowledge, and management. The CRID improves the management of identified risks by providing a database for future M.H.P. The guidelines support contractors' in using the conceptual risk identification framework. The paper updates risk identification process by adding multidisciplinary risk elements including risk communication, risk knowledge, and considering the context in building frameworks. The paper enhances contractors' capability in management and identification of risks in construction of M.H.P. The paper allowed researchers to manage challenges and opportunities in construction of mega housing project in Egypt.

1. Introduction

There is a recognized gap in knowledge of identifying risks during the construction of megaprojects [1]. Thus, improving Contractors' risk identification practices and successful delivery of mega housing projects are in massive need in Egypt. The Egyptian strategy prioritized the Importance of mega housing projects (M.H.P) in meeting success in delivery as one of the greatest impacts on Egyptian society [2]. The Egyptian currency lost 52 per cent of its value causing an increase in equipment prices. The escalation in prices of resources added more financial risks to the construction industry

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of M.H.P [3]. The currency devaluation influenced the price of all inputs of the construction process in Egypt. The cost of material transportation and steel prices has increased by 75 per cent adding more risks to Egyptian contractors [4].

A review was performed for challenges in the construction of mega housing projects [5]. Human resource challenges have a high impact on the successful delivery of mega housing projects. Major challenges included client project management, rules and regulations, and governmental supportive policies. The highest challenge that has the greatest impact on mega housing projects success in delivery was the contractors' project management roles. Challenges influencing success included managing mega housing project resources [5].

A framework is a representation of the holistic relationship of terms and concepts of a system [6]. The literature recognized a gap in mega housing studies regarding the development of risk management frameworks [5]. There is no conceptual risk management framework that is computerized and aim at the improvement of contractors' risk management practice in the construction of mega housing projects in Egypt [5]. There is a massive need to develop a risk management framework that can improve the management of risks more proactively concerning the context [7]. Previous studies tended to generalize risks rather than recognizing risks based on actual skills and competencies [8]. The paper aimed to develop a conceptual risk identification framework (CRIF) to improve Contractors' practice and success in the delivery of mega housing projects in Egypt.

The paper used the technique of interviews to collect detailed information on contractors' current risk practices. Analysis of qualitative data is followed to account for most common challenges in the construction of mega housing projects. The paper developed a conceptual risk identification framework that interrelated risk identification process. The framework addressed steps that aimed to provide a broader understanding and improvement of risk identification practice. The framework included defined synthesis as an 'integrated' way to improve risk identification practices. A computerized risk identification database (CRID) is developed using visual basic of excel. The CRID is simple to use by contractors as risk identification repositories to record activities and improve practice. Furthermore, a generic framework is presented to guide contractors in using the frameworks. The paper presented a risk break down structure (RBS) that considered opportunities and challenges in the construction of mega housing projects in Egypt.

2. Research methodology

Fig. 1 highlights the steps performed in this paper. The researcher adopted a pragmatism paradigm as his world-view. Pragmatism reflected the researcher view in solving the risk identification issue as a practical problem in the 'real world' [9]. The paper reviewed the literature on mega projects. A review was performed for challenges in the construction of mega housing projects in developing countries. Interview technique was used to collect information regarding contractors' risk practice and knowledge. Risk parameters are further analysed using NVivo as qualitative analysis software. Risk parameters included challenges, opportunities, risk management knowledge, and skills. The paper further developed a conceptual risk identification framework (CRIF), computerized risk identification database (CRID), and generic guidelines to guide contractors in using the CRIF. The development of both CRIF and CRID will allow contractors to improve their current risk management processes, together with updating their risk management skills, knowledge, and successfully deliver mega housing projects. Microsoft Excel and interrelated using hyperlink formulas supported the development of the conceptual framework. The paper developed a risk break down structure (RBS) that included construction opportunities and challenges. A critical analysis was performed for adopted risk management frameworks in the literature. The paper addressed the pros and cons of the frameworks concerning the developed conceptual risk management framework.

3. Review of risk management frameworks

There is a gap in preparing a risk management framework to manage construction risks based on experience. Most of the construction organizations do not collect and store the knowledge that is obtained from site experience, i.e., they do not have appropriate knowledge management [10]. A responsive human resource

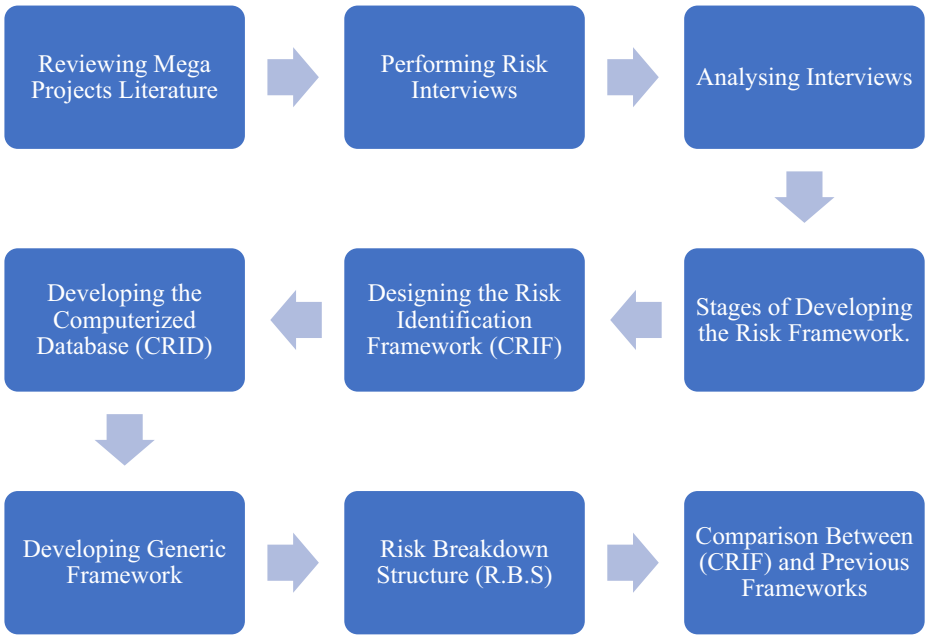

Fig. 1. Research Methodology.

framework was developed for the design and building of mega housing development projects (MHDP) in Egypt. The study reviewed human resource (HR) risks in the design and building of MHDP, which was followed by a qualitative analysis of case studies from countries near to Egypt. A survey questionnaire was implemented that targeted stakeholders involved in MHDP. Egypt needs framework to manage construction risks and to improve HR development in the construction of M.H.P. Also, the results proved that HR efforts must be capitalized to cope with the targets of the Egyptian Strategy 2030. The study did not produce guidelines to help contractors in using the HR framework to improve practice [11].

A performance risk management framework was developed to evaluate the performance of the risk management system. The study provided an evaluation of the performance of enterprise risk management and disaster risk management systems. The Framework obtained performance indicators but is not specific for practice in the construction phase. The framework does not include identification, analysis, and mitigation for risks during construction [12]. A theoretical knowledge risk management framework was developed to improve decision making in managing projects. The Framework provided guidelines for the selection of risk techniques taking into account the most relevant aspects that characterize the managerial and operational scenario of a project. The Framework needs to be tested by contractors'' during the construction of projects. The framework did not include communications and did not provide a means for the management of large scale projects [13].

A web-based safety knowledge management system was built for builders to improve safety performance for construction projects in Australia. The system proposed a safety system to track safety performance during construction. The system helped in reducing workplace accidents and minimized the social costs of construction. The study targeted the safety parameter and did not include other construction risks related to the project construction environment. Construction delivery time and cost were not considered in this study. The system did not improve the management of construction risks and did not integrate risk communications. No means of improvement towards the management of construction risks for future construction projects [14].

Risk management frameworks did not update on risk management knowledge and improve contractors' risk management practices for managing risks in construction of mega housing projects. The designed risk frameworks did not integrate change in context, risk maturity level, risk management communications, and risk principles with risk management processes. Frameworks did not integrate these elements with efficient management of risk information to improve organizations' practice of risk management.

4. Mega-projects challenges in developed and developing countries

The construction of Megaprojects faced construction challenges that influenced the objectives of contractors. Mega-projects are classified as complex projects that face numerous external and internal challenges [15]. The construction of Mega-projects is characterized by diverse connotations regarding its internal and external environment. The relation between the external environment and human resource development ensures the institutional setup of the country for the improvement of organizations successful engagement in the construction of new Mega-projects. It is also realized that human resource development constructing new Mega-projects consequently needs the knowledge and technology to succeed in constructing Mega-projects. Thus, managing mega-projects challenges to serve different societies are said to be a forward improvement knowledge-based production process [16].

Table 1 and Table 2 present Mega-projects construction challenges for developed and developing countries. Mega-projects challenges are illustrated differently since the context differs regarding the country constructing Mega-projects. Mega-projects challenges are classified into either internal or external challenges. Internal challenges present the challenges induced within Mega-projects stakeholder's which can impact a mega project's budget cost and schedule. External challenges include the external construction environment for stakeholders adding more Mega-projects challenges. The tables are classified into reference, publish date, country, classification of a challenge, and challenge codes. The challenges are thus coded either external or internal. CE presents external construction challenges and CI presents internal construction challenges.

Stakeholders in developing countries faced resource scarcity and experienced difficulties in their management during construction. Mega-projects construction required well-qualified and trained workers which is found to be scarce in developing countries. Most external challenges facing developing countries included security for construction workers, a poor technological workforce in supply from a country to a stakeholder. Week stakeholder policy and regulations were observed.

However, there are joined challenges agreed between both developing and developed countries. Countries including all of Egypt, Pakistan, Atalanta, and China prioritized the importance of maintaining accurate database. More reliable database and information will fascinate the working conditions for Mega-projects employees and improve chances of managing risks. Providing a safe construction environment for workers is also one of the most important internal challenges especially in Pakistan, Africa, and

Table 1
Challenges for construction of Mega-projects in Developed Countries.

Reference	Case Study	Challenges	Code
(Ina 2014; Harry et al. 2015) [17,18]	The city of Wein,	The flexibility of Policy Makers	C E
		Optimized Use of Resources	C E
	Waterfront Toronto,	Optimum integration of Resources	CI
		Interaction with Talented Work Force	CI
	The city of Atalanta,	Decentralized Work Sites	CI
		Combination of formal and informal Governments	CI
	European Smart Mega Cities,	Economic Decline	CI
		Mono sectoral Economy	C E
	China Yinchuan City	Safety and Security	CI
		Lack of DataBase	CI
		Multicultural Diversity	CI
		Talent Gap inside Organizations	CI
		Construction Technology	CI

Table 2
Challenges for construction of Mega-projects in Developing Countries.

Reference	Countries	Challenges	Code
(Egypt Vision 2030, 2016; Helfert et al. 2015; Meed 2015; Atkins 2015; Amid East ILO 2014)	Egypt	Government Policy Flexibility	C E
		Governance Instability Systems	C E
[2,19-22]	Morocco	Economy Weakness	C E
		Lack of Competitiveness	C E
	Tunisia	Low Educational Level HR	CI
		Urban Violence and Insecurity	C E
		Resources Scarcity for Construction	CI
		Workforce Diversity	CI
		Innovation and Research used within Organizations	CI
		Lack of Database	CI
		Poor Technical Training Application	CI
		Providing a long-term Human Resource Strategy	CI
		Poor HR Skills	CI
		A safe and secure working environment	C E
		Revolutions and Unsafe Working Environment	CE

some European countries. One of the major concerns was Multicultural diversity. This was clear in both countries Egypt and Dubai.

Most of the countries prioritized the importance of the availability of an effective governance system to support the construction of new Mega-projects. Most of developing and developed countries emphasized to improve countries policies to be flexible and cooperate with construction stakeholder's before, during and after the construction of Mega-projects. Poor financial situations clearly realized in countries especially developing countries of Egypt and Tunisia and other African countries. Most of the countries depend on loans which need a very efficient financial strategic plan before the commencement of mega-projects construction.

5. Risk management interviews

The paper adopted the interview technique to gather risk information to develop a risk identification framework. The technique implied risk management to theory building. The literature review of risk management studies helped in developing a correlational study design and supported the development of the risk identification framework [5]. The paper involved semi-structured interviews to collect empirical primary data from targeted professionals directly involved in managing construction risks during the execution of the mega housing project.

Interviews included open questions with open answers to allow more extraction of ideas from the experts. The Interviews designed on the essence of literature review including risk management processes, success in delivery, risk management knowledge, risk management skills, challenges, and opportunities in the construction of mega housing projects. The interview outcome coupled with the literature findings supported in the development of a conceptual risk identification framework (CRIF) and a computerized risk Identification database (CRID).

6. Case study

Since Egypt have started recently in the construction of Mega Housing Projects. The New Capital Mega Housing Project selected for the Interviews process. Egypt 'New Capital Project' is built on an area of 700 km2, making it almost as large as Singapore, and targets a population of almost seven million people. The city consisted of 20 main residential districts from R1 to R20. Each residential district divided into a group of mega housing projects.

The mega housing project constructed on the date of this research was the residential district (R5). The mega housing project (R5) called the Garden City Mega Housing Project. The project has an area of 1000 feddan. It consists of mixed residential settlement that included high-rise buildings, buildings, and villas. Interviews were distributed on contractors' who are responsible for the construction of 10 mega housing projects included in the garden city mega project (R5). The projects were selected since they were under construction during the interview process. This allowed the capture of risk management information during construction. Targeted risk information included challenges, opportunities, risk management knowledge, and skills.

The subjectivist view of contractors will dominate due to the hypothesis that existing risk management approaches act upon an objective approach. That emphasized the impact of mega housing projects delivery success chances. The projects were selected since they were under construction during the interview process. This allowed the capture of risk management information during construction. Targeted risk information included challenges, opportunities, risk management knowledge, and skills". The Author clarified and added that purposive selection was used since "New Capital Project" was the only under-construction project in the period of conducting the interviews and that the project included under construction districts that allowed capturing of risk information. The contractors selected were of the first category based on the Egyptian contractors" association. Twenty civil engineer experts of more than five years were interviewed.

7. Assessed participants

The unit of analysis in this research is on-site individuals. The essence of the case explored recent contractors' risk management practices and success in delivery drivers. The semi-structured interview is set to drive in-depth data including a recent level of risk management knowledge, risk management skills, application of risk management processes, a technology available, success in delivering factors, and major construction risks. Table 3 highlighted selected participants. Three project managers, seven site managers, and ten site engineers participated in the interviews.

Table 3
Samples involved in the Interviews.

Mega housing project parties	Participants
Project Managers	3
Site Managers	7
Civil Engineers	10
Total	20

8. Interview analysis

The first step in the qualitative analysis is to import these interviews from the hard drive into the NVivo software. First, the type of document is selected which suits the interview document type. Thus, a word document type is selected which supports the format of interviews files. Files are then selected from the location the interviews are stored on the hard drive. The interviews aimed at analyzing risk management information qualitatively to gather risk data regarding recent practices of risk management during the construction of mega housing projects in Egypt. The analysis of the interviews included tree analysis and network diagrams that captured the most frequent issues in the practice of risk management in the construction of mega housing projects in Egypt. That allowed the Author to analyze experts' opinions about that query. Furthermore, the Author highlighted that the paper explained the frequently risk challenges that are highlighted in the analysis.

8.1. Tree analysis

Fig. 2 illustrated the tree analysis as a technique of qualitative graphical analysis. The tree visualization highlighted the context of "skills or knowledge". All possible and related searches for items "skills or knowledge" are presented in Fig. 2. Related items and text ensured that most experts recognized communication skills, computer skills, technical skills, Risk analysis Knowledge, Risk Knowledge as the greatest issues that can influence the practice of risk management and successful delivery of mega housing projects in Egypt.

Fig. 3 highlighted the Tree Analysis Query of item "Delay". Sources related to the text delay is recognized. This included change order made by the owner during construction, limited budget available with some contractors, delay in submitting design drawings and quality control procedures. Delay in handing the project at the start of the construction to the contractors, delay due to weak resource management and shortage of materials. These sources are major risks that can negatively influence the construction delivery of mega housing projects in Egypt.

8.2. Network diagram

Fig. 4 illustrates the network diagram indicating the relationship between nodes linked to interview 1 and interview 2. Interviews 1 and interview 2 visualized including the relationship overlap. Nodes in common are visualized between the two interviews. In interview 1 the node delay is recognized but in interview 2 the node material is visualized as a dependent node. Thus, interviews in these cases are not sharing common nodes. Interview 2 highlighted that the most frequent risk issues addressed was the materials. Interview 1 included delay, injury, safety, optimum response, need of compensation for delays, change order, and need to improve communications as the main challenges of risk management.

9. Development stages of the conceptual risk identification framework (CRIF)

The CRIF assists contractors' in integrating risk management into their construction activities and functions. As presented in Fig. 5, framework development encompasses integrating, designing, implementing, evaluating and improving risk management across the organization. Integrating risk management relies on an understanding of organizational structures and context [23]. The research included Interviews that seek the identification of the level of understanding of Contractors' individuals to their organization structure and risks based on the context. Interviews shall also recognize how risk management is well integrated into the contractors' organization in a dynamic and iterative process, and its customization to meet the organization's needs.

10. Design of the conceptual risk identification framework

Fig. 6 presents the developed conceptual risk management Framework (CRIF). The input–output pattern organised the structure of the framework. Inputs of the CRIF included risk management parameters. This included risk management knowledge, skills, construction challenges & opportunities. The risk management processes work in a cyclic process. Inputs of the risk identification included risk management principles as a platform for effective risk management practice. International standardisation adopted these principles of risk management [24]. The standard targeted improvement in contractors' risk management practices. The input steps captured construction challenges Step 1.1, construction opportunities Step 1.2, risk management knowledge Step 1.3, and risk management skills Step 1.4.

Step 2 highlighted risk identification techniques. That included risk breakdown structure (RBS) in Step 2.1 and Interviews in Step 2.2. The risk breakdown structure categorized the risks into challenges and opportunities. Risk groups ease the process of populating risks in an organized structure. Step 3 indicated the output of the risk identification process. That included five outputs steps starting from Steps 3.1 to 3.5. The risk identification process allowed gathering risk management knowledge & skills (Steps 3.1 & 3.2), construction challenges and opportunities (Step 3.3 & 3.4), and risk breakdown structure (R.B.S) as Step 3.5.

11. Development of the computerized framework

This paper aimed at the development of a computerised risk identification framework that improved risk management practices and success in delivery during the construction of mega hous-

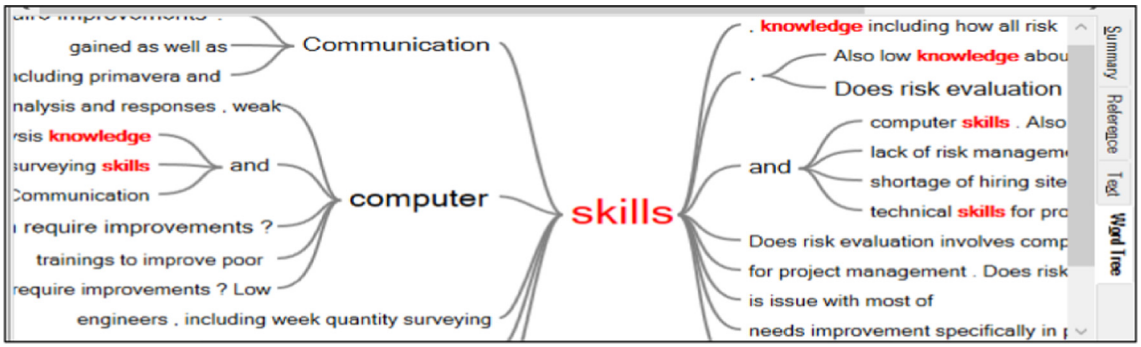

Fig. 2. Tree Analysis of Query Skills.

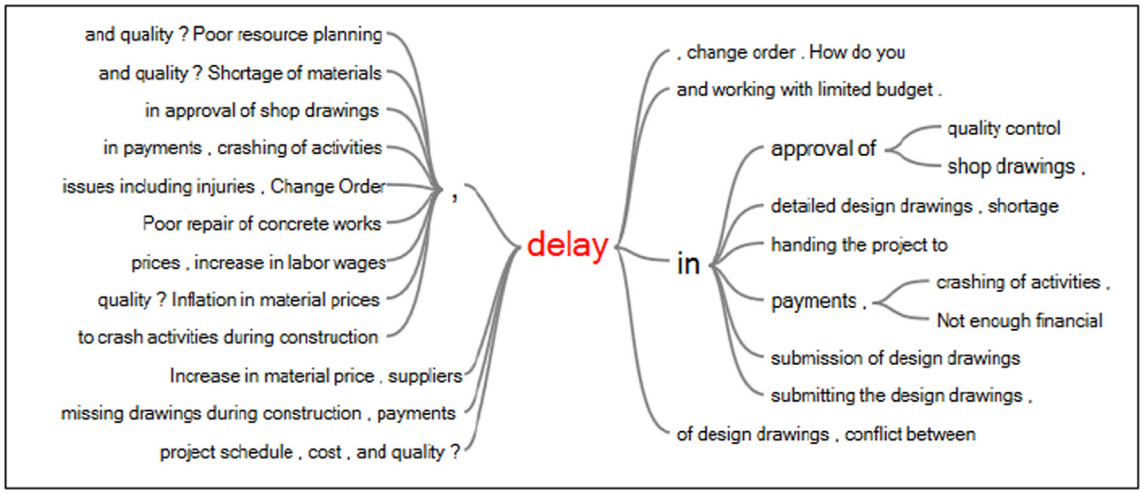

Fig. 3. Tree analysis of Query Item Delay.

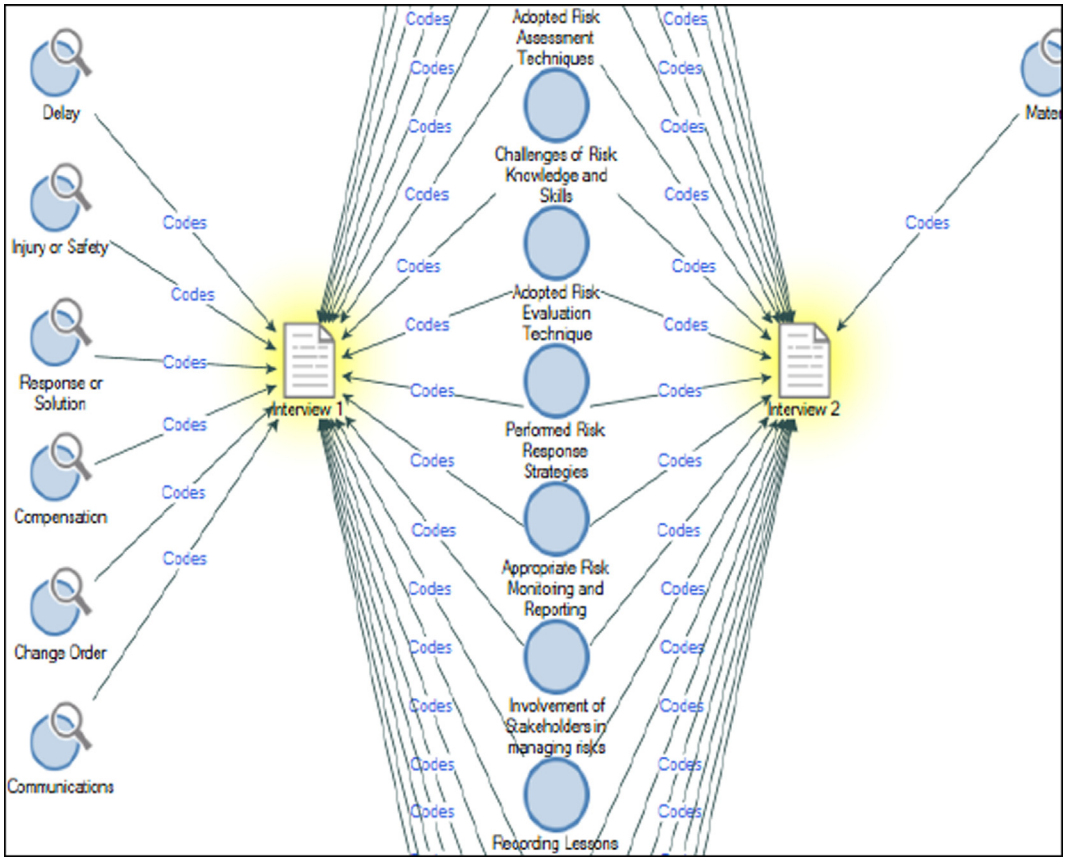

Fig. 4. Network Diagrams – Relationship between nodes in interviews 1 and 2.

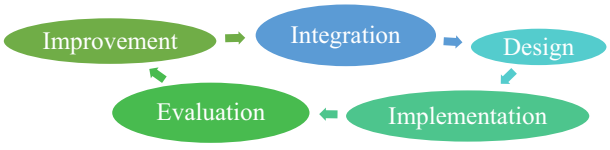

Fig. 5. Development Stages of Risk Management Framework.

ing projects in Egypt. The literature highlighted a recognized gap in providing a risk identification framework that is computer-based and supports contractors' in Egypt in managing risks during construction. Fig. 7 illustrated a sample of the developed Computer Based Conceptual Risk Identification framework (CRIF) using visual basic programming in Microsoft excel. Output steps of the risk management processes interrelated to a group of risk management repositories. Information is to be up to date by a mega housing project team in an automated process. The framework provides a plat-

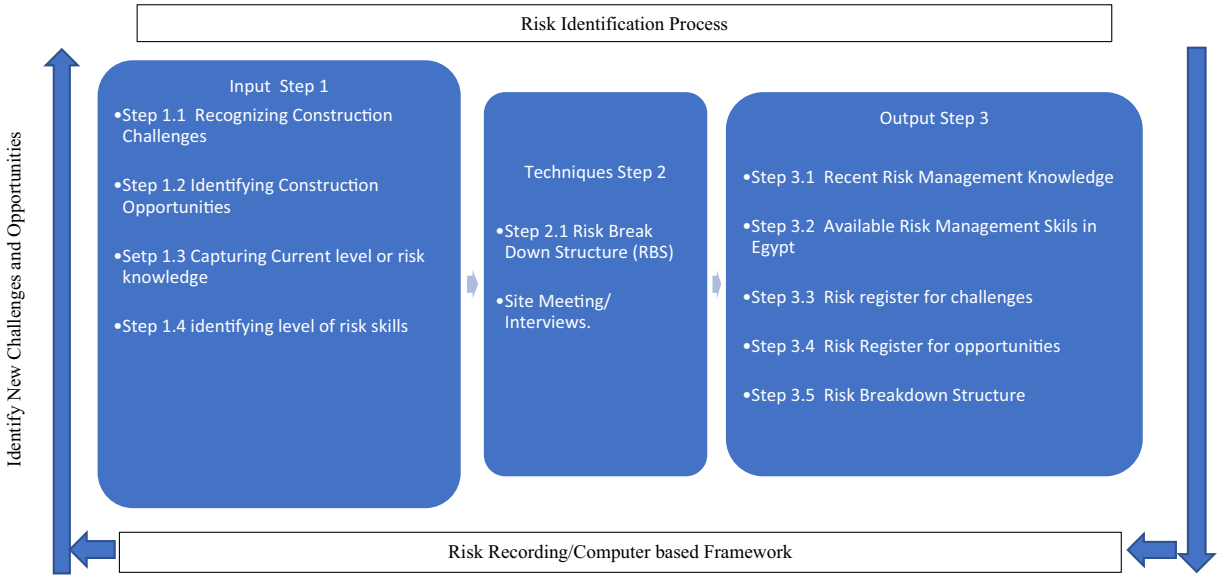

Fig. 6. Conceptual Risk Identification Framework.

Risk Identification Output – STEP 1.0				
STEP 1.1 - Risk Knowledge	Risk Knowledge			
STEP 1.2 - Risk Skills	Risk Skills			
STEP 1.3 - Construction Challenges	M.H.P Challenges			
STEP 1.4 - Construction Opportunities	M.H.P Opportunities			
STEP 1.5 - Risk Breakdown Structure – R.B.S	R.B.S			
↓				
Qualitative and Quantitative Risk Analysis Processes – STEP 2.0				
Computer-Based Risk Framework	Risk Knowledge	Risk Skills	Construction Challenges	Construction Opportunities

Fig. 7. Computer Based Risk Identification Database.

form for the project team to update risk identification during construction.

The computerized risk identification database (CRID) eases contractors' practice in recording risk identification activities. Fig. 7 presents a programmed excel sheet that includes buttons beside each step in the framework. Linkable cells in Fig. 7 are indicated by boxes as "Risk Knowledge, Risk Skills, M.H.P Challenges, M.H.P Opportunities, and R.B.S. Visual basic programing of excel software was used to create these cells and that are linked them to repository sheets at the bottom of the figure. The project team can smoothly update and share risk reports. The tool is accessible since most Egyptian Contractors' use of excel software. The tool eases the management of risks that can influence a massive number of construction resources and mega housing activities.

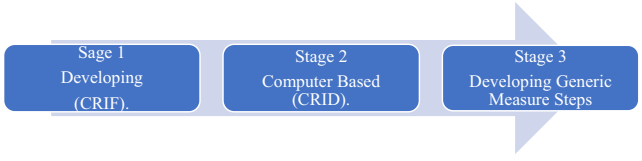

Fig. 8. Stages of Risk Identification framework development.

12. Stage of developing a generic risk framework

The study included a design of generic risk identification framework to guide contractors in using the conceptual framework. Fig. 8 illustrated stages of generic framework development. The process consists of three main stages, developing the Conceptual Risk Identification Framework, Computerized Risk Identification Framework (CRID), and proposed generic measures for supporting the CRIF. Fig. 9 illustrated a flowchart of the generic steps used to guide contractors in using the CRIF. To present the proposed conceptual risk management framework, the following steps are to improve contractors' risk identification practice:

Step 1: Form a team of Risk Decision Making

Step 2: Gather data of risks, knowledge, and skills.

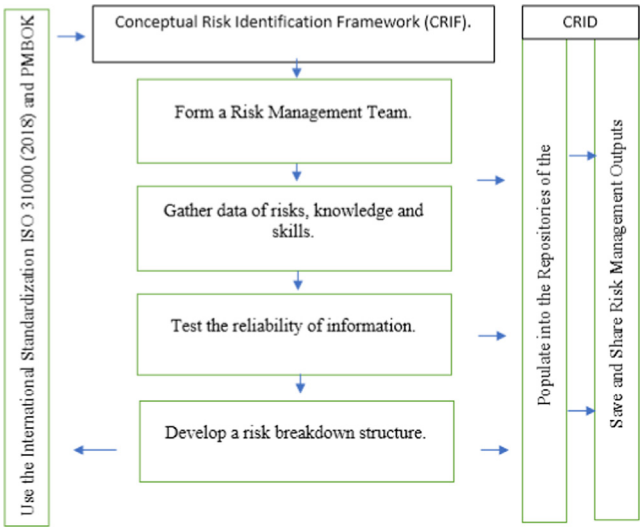

Fig. 9. Generic Measures steps to guide contractors' in using the CRIF.

Table 4
Risk Management Knowledge.

Group of risk management knowledge factors
Risk identification
Risk analysis inputs and tools
Risk response strategies
Solving conventional risk management problems
Understanding the risks and probability of occurrence

Table 5
Risk Management Skills.

Risk management skills
Risk Analysis Skills
Software Skills
Data Management Skills
Presentation Skills during Risk Meetings
Writing Skills in Reporting and Updating Risks
Technical Skills in monitoring resources
Project Manager Leadership Skills

Step 3: Test the availability, accuracy, and reliability of gathered information

Step 4: Develop a Risk Breakdown Structure (R.B.S) based on Categories of risks

Step 5: Populating repositories of the computerized risk management framework (CRID).

Step 6: Save the framework securely on a computer's hard drive.

Step 7: Sharing risk information between the project team and project manager on a "One Drive."

13. Output of risk identification process

Table 4 presents the parameters of risk management knowledge. This includes risk identification, risk analysis, risk response, solving conventional risk management problems, and understanding risks and their probability of occurrence. These parameters were adopted from the international standardization and were highlighted as issues in the interviews [24].

Recognized risk identification skills in Table 5 included risk analysis skills, software skills, data management skills, presentation skills of risks during meetings, writing skills for efficient risk reporting, technical skills for accurate monitoring and management of mega housing construction resources, and leadership skills within project manager. Maintaining and improving these risk management skills can improve risk practices and enhance the successful delivery of mega housing projects in Egypt.

The Risk Break down Structure (R.B.S) in Fig. 10 included challenges and opportunities that are coded and categorized based on their risk group. The risk breakdown structure highlighted all identified risks that can negatively influence the construction schedule or budget of mega housing projects in Egypt. Project management challenges included training of human resources, managing mega housing projects resources including management of labours, materials, & equipment, risk of the unqualified workforce, labour absenteeism, material damage, shortage of materials, delivery of drawings, and approval of shop drawings and inspection requests.

Chances of bankruptcy and facing financial crisis was monitored in Egypt due to the external economic environment related to the reduction of the currency value and escalation of material prices during the construction of mega housing projects in Egypt. Safety risks included injuries due to inefficient safety inspection and equipment accidents that require stricter safety regulations and induction training sessions before the commencement of construction. Government support risks as presented in Group D include slow permit extraction, shortage of materials, and law & policy changes during construction of mega housing projects in Egypt.

14. Critical analysis and comparison of frameworks

Risk management frameworks adopted by risk management standards are reviewed through this study. Reviewed standards and papers are presented in Table 6. The table highlights the risk frameworks adopted by researchers and risk standards, successful aspect achieved by frameworks, and comparison concerning the paper's conceptual risk management framework that was developed for Egyptian mega housing projects.

15. Conclusion

The paper reviewed the literature of challenges and opportunities in the construction of mega housing projects in developing countries. Interviews are analysed using the NVivo qualitative analysis software. Interviews allowed the collection of qualitative data that included contractors' current risk knowledge, skills, challenges, and opportunities during construction of the "New Capital" mega housing project. The ISO 31,000 supported the design of a conceptual risk identification framework (CRIF) to guide contractors in recognition and management of challenges. The paper developed a computerized framework (CRID) using visual programming in excel.

Challenges in construction of megaprojects included the scarcity of construction resources, poor project management, and financial funding issues. Query analysis highlighted the main challenges that included management of resources, human resource impact, and explored the most frequently repeated keywords in the interviews. Interviews highlighted risks and contractor's level of practice in construction of mega housing projects. There was a poor knowledge of risk management processes within contractor's organizations. Risks included delay in payments, delay in submitting design drawings, client change orders, and safety issues. The results proved that most of the Egyptian Contractors' rely on adding contingencies to avoid risks.

This paper updated the knowledge of risk identification process by integrating risk identification process with multidisciplinary

Fig. 10. Challenges and Opportunities in Construction of Mega Housing Projects.

Table 6
Critical Analysis and Comparison of Frameworks.

Author	Framework	Advantage	Comparison with the CRMF and CRID
(Abroon et al. 2016) [25]	A Theoretical RM Framework	The Framework supports decision-making risks using simulation technique. The research focused on Project Complexity and Interdependency Modelling.	It does not focus on how to manage execution risks. It is also based on simulation modelling which seems complex for project managers use and project team understanding on-site
(Rafaela et al. 2015) [26]	RM Framework for Mega Transport Projects/ Croatia	The Framework was successful in guiding organizations in learning methods to manage risks that arose from project governance regimes.	The Framework is based on case studies in developed countries and does not include developing ones. The framework focuses on one type of projects that is the Mega Transport projects with no evidence on the capability of success on other projects types.
(PMI 2017) [27]	Risk Management Framework	The Framework deals with management responsibility for the process and links to the wider project management process.	Ranges across qualitative and quantitative risk analysis methods but does not link these together directly.
(Khameneh et al. 2016) [12]	Performance RM Framework	Some research has been conducted about evaluating the performance of enterprise risk management systems and disaster risk management systems.	The Framework obtained performance indicators doesn't focus on the construction phase, not including identification, analysis, and mitigation performances during construction

risk elements including risk communications, risk responsibilities, management of risk information, and risk knowledge. The risk framework provided future insight for improvement of risk identification process in construction of mega housing projects. Risk management repositories are provided for contractors' to store risk information during construction. The risk framework improves contractors' communication between the project manager and the project team, improves risk identification knowledge, engages the project team in to the process of decision making, and eases the storage of risk information to update the risk register in construction of future mega housing projects. The paper recommends practitioners' to consider the context of construction in developing risk frameworks.

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