Transactions on Engineering and Computing Sciences - Vol. 12, No. 1
Publication Date: February 25, 2024
DOI:10.14738/tecs.121.16260.

Abdelalim, A. M., Hassanen, M. A., & ElSamadony, A. (2024). Risk Allocation and Sharing in Mega Industrial Projects from the Perspective of the New Yellow Book -FIDIC-2017 to Approach a Balanced Construction Contract. Transactions on Engineering and Computing Sciences, 12(1). 54-102.

SERVICES FOR SCIENCE AND EDUCATION

Risk Allocation and Sharing in Mega Industrial Projects from the Perspective of the New YellowBook -FIDIC-2017 to Approach a Balanced Construction Contract

Ahmed Mohammed Abdelalim
ORCID: (0000-0003-3359-715X)
Faculty of Engineering at Mataria,
Helwan University, Cairo, Egypt

Mona Abdelhamid Hassanen
Faculty of Engineering at Mataria, Helwan University

Adel ElSamadony
Faculty of Engineering at Mataria, Helwan University

ABSTRACT

Owners frequently allocate excessive risks to contractors and utilize (custom) contracts to fit their project needs and specifications. The MENA region has seen a boom in industrial projects in recent years, which has made it imperative to examine the barriers to optimal risk allocation and throw light on the processes currently in place for risk allocation. In order to approach a balanced construction contract, the current article aims to investigate the existing risk distribution in mega industrial projects. Properly identifying, evaluating, and assigning risks in contracts can improve project performance. First, the study found 70 risk factors that were categorized into nine groups based on a thorough literature review and scientometric analysis. Estimates of the likelihood, impact, and method of control for these risk factors were requested from the respondents. The findings showed that the way risk is now allocated in construction projects is ineffective and has resulted in a number of other issues, including aggressive contractual relationships, claims, and conflicts. Strong organizations today work hard to maintain effective partnerships by enforcing policies that promote cooperation and aid in risk management. Contractual provisions used in mega industrial projects become less flexible and less able to accommodate the needs and interests of the parties involved in all potential situations as a result of standardization. One of the most prominent standard forms of contracts for mega industrial projects, the Conditions of Contract for Plant and Design Build (FIDIC form 2017 Yellow Book), was researched and reviewed to identify risky provisions and offer solutions for contractual issues. In order to reduce the project's major risk factors and partially reform the contract requirements into risk-balanced conditions that may improve the contract's utility as a project management tool, several modifications were made. These amendments concentrated on the particular needs of mega industrial projects and made a concerted effort to address a numberof issues, including the Employer and Contractor's responsibility matrix, liability limitations, resolving procurement-related issues, design errors and contradictions in documents, the

necessity of coordination between contractors and subcontractors, the significance of following the project schedule, and the relationship between delay damages and project milestones. Contract parties will benefit from the study's findings in terms of effective project management, risk reallocation, management, and reduction of claims, as well as preventing disputes.

Keywords: Mega Industrial Projects, Risk allocation, Relative Importance Index, Frequency-Adjusted Frequency Index, Risk identification,optimal risk, risk management, FIDIC-2017 Yellow Book, Delay Damages.

INTRODUCTION

Project management units face more obstacles and hurdles as a result of the pressing need to implement mega industrial projects in the MENA area. The complexity of mega industrial projects is growing, which causes hazards that are typical in these projects to become more severe and frequent (Youssef, A., et al., 2018; Abdelalim, A.M., et al., 2022, 2023). These complexities necessitate clear definitions of the rights and obligations of contracting parties. Since risk is a constant in industrial projects, effective management has the potential to boost earnings and provide businesses a competitive edge.

In the construction sector, a number of researchers carried out risk assessment studies in a variety of global locations, such as the US, Europe, and East Asia. Nevertheless, there is a dearth of such research in the Middle Eastern construction sector (Eskander, et al, 2018). It is unjust and irrational to transfer the unmitigated risks of construction project to one party; in the past, this has led to adversarial relationships between contractual parties and increased claims and disputes. Despite the fact that a large number of significant studies on construction risk in industrial projects have been carried out, a number of research gaps remain unfilled (Hanna, et al 2013). Every study that is now available offers a portion of the answer, but the construction sector still requires a fully accepted multiparty, non-unilateral risk allocation sustainable model. There is a broad consensus among academics and industry professionals in favor of an owner-contractor collaborative partnership. Over the past few decades, many studies have been conducted on the distribution of construction risks (Zhang, L., et al, 2017). Industry players continue to express anxiety about the risk associated with mega projects, despite the fact that the research that is currently available provides some helpful insights into the issue. A number of working relationships, communications, and contractual duties are not being carried out in good faith and in a transparent manner, which has led to a strain in contract relationships in the industrial projects of the MENA region in recent years (Abdelalim, A.M., et al., 2018, 2019, and 2020). M. Marzouk (2011 Researchers and practitioners are generally in favor of a cooperative connection between the owner and the contractor (Zhang, S., et al, 2016). Assaad et al. (2020b) found thatcertain risks can be appropriately managed by sharing them between the two contracting parties rather than allocating them to a single party. In this instance, the general terms of a contract between project parties usually contain various construction risk clauses. According to Hannaet al. (2013), there will always be risk involved in industrial projects, even with improved knowledge of those hazards and a sound risk distribution strategy. But by structuring construction contract language correctly, risk can be distributed and many of the unclear and illegal arguments can be minimized. However, contract standards are becoming more stringent with an increasing number of new contract types in an

effort to mitigate risks during project implementation. The important risk considerations for design-build projects in the constructionsector are discussed in this study. An ad hoc contract based on the design-build contract type can be used by owners and contractors with greater confidence if these risk elements are properly identified, allocated, and managed. Although contracts are essential business assets, construction projects are vulnerable to future uncertainties due to their inherent complexity, scope, and scale. According to Ramonu, JA, et al.'s (2018) research on conflict types in the construction sector, contractual disagreements rank as the most significant and common type of disputes in construction projects. The economic and administrative issues, however, were dealt with last. Thus, categorizing disputes has given rise to a basis for avoiding confrontations in construction projects. Contract conditions typically serve a crucial regulatory role in all project interactions between the various project parties, making them an important tool for managing construction risks. Numerous researches indicate that if contract terms are not appropriately taken into account, they could end up becoming one of the most significant sources of risks in construction projects. Since risk is a constant in the construction sector, effective risk management can boost earnings and strengthena company's competitive edge, Suprapto, M., Abdelalim, A.M. and others 2016 and 2017. It is crucial to concentrate on existing risk allocation practices and research the barriers to ideal risk allocation in Mega industrial projects given the growth in construction projects expected in the MENA area in the next years. In order to share the future loss of opportunities or project advantages proportionately, contractdrafting is therefore crucial to successful contract management, where balanced risk allocation specifies and distributes risk-related obligation. As a result, maintaining the balance of risk allocation has emerged as a critical component of successful project management which helps to ensure the balance of liabilities and gains among project parties.

The distribution of construction risk among the project's stakeholders (owner, designer, contractor, etc.) greatly affects the project's overall objective (see Figs. 1, 2). As a result, risk distribution has garnered a lot of attention in recent years as a crucial component of contractual governance for building projects (see Tables 1, 2). The main project participants—owners, engineers, contractors, and material suppliers are obligated by both direct and indirect contractual agreements; yet, their interests in the project may differ, and they may assess the risks and their allocations differently. According to some academics, this uneven distribution of risks will force the contractor to use defensive tactics, such as lowering the quality of their work or inflating their invoices (Nasirzadeh, F., et al., (2014). Inappropriate risk allocation has resulted in violent interactions between contract participants since it can have a substantial impact on the behavior of project participants. On the other hand, risk allocation in construction projects is typically not evenly distributed. Strong businesses today make the effort to ensure that they maintain fruitful partnerships by implementing policies that promote cooperation and aid in risk management. Nevertheless, the advantages of sound contracting are often overlooked because those who draft and negotiate them have a propensity to prioritize avoidance over appropriate risk allocation. This highlights how crucial it is to assess conventional contract terms, particularly those that address how incorrect risk distribution can lead to antagonistic interactions between contractual parties, T. Mellewigt et al. (2012).

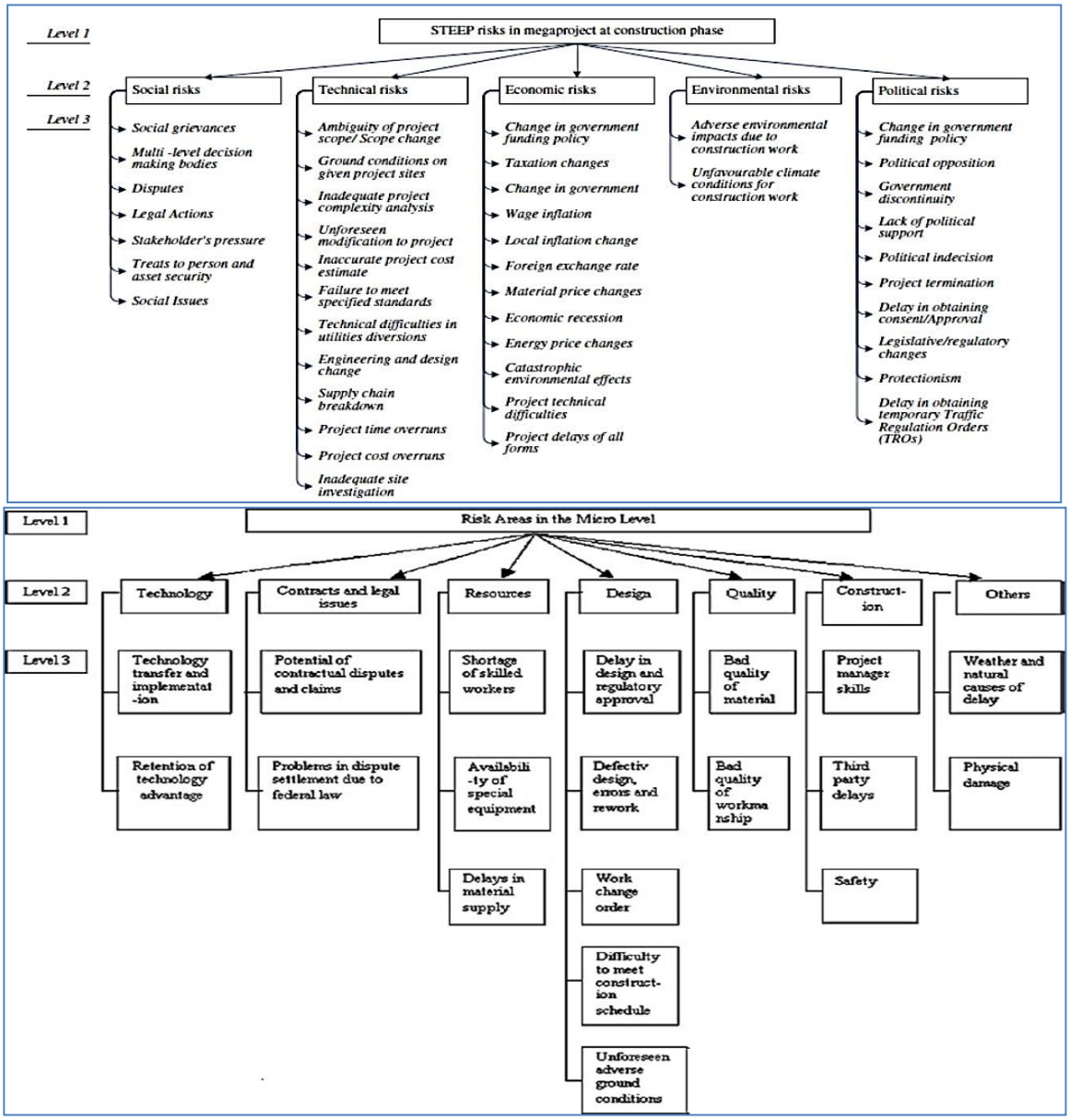


Fig.1: Hierarchy of Risk Classification (STEEP Risks of Megaprojects), in the micro level, *Boateng (2015), Zayed, (2008*).

Table.1: Risk Allocation on Different Parties.

Risk Allocation	Risk Description
Owner	site access/right of way differing site condition delayed payment on contract permits and ordinances unidentified utilities changes in work acts of God govt. acts and regulations and tax rate change

Shared between all Parties	contract-delay resolution indemnification and hold harmless financial failure-any party third- party delays change-order-negotiations
Design-Build contractor	defective materials actual quantities of work quality of work safety and accidents contractor competence establishment of a project costs labor disputes defective design defensive engineering
Undecided	weather conditions environmental risks inflation redesign if over-budgets

Table.2: Risk Categorization according to importance.

Level of Importance	Risk Description
Most important	defective design changes in work differing site condition delayed payment on contract unidentified utilities defective materials financial failure-any party
Medium important	actual quantities of work weather conditions safety and accidents site access/right of way defensive engineering establishment of a project costs redesign if over-budgets environmental risks quality of work change-order-negotiations permits and ordinances third- party delays indemnification and hold harmless contractor competence contract-delay resolution
Least important	inflation labor disputes govt. acts and regulations and tax rate change acts of God

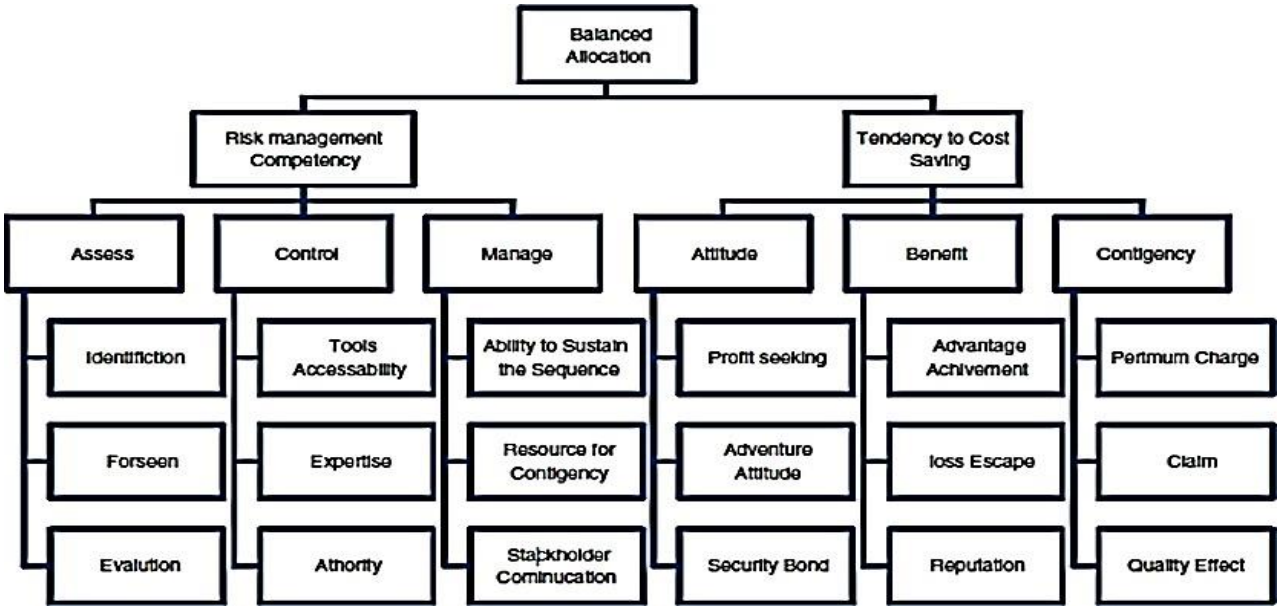


Fig.2: Hierarchical structure of criteria for the risk allocation

Although it's important to have different forms for construction contracts in order to standardize contractual stipulations related to large-scale industrial projects, it can also be helpful to offer revisions that improve the contract's risk-balance. Rather than winning a court battle, the goal of modifications to contracts is to make it easier for the parties to accomplish project goals, respect contracting partners, and avoid disagreements. According to a number of studies, contract terms can become major sources of risk in building projects if they are not adequately taken into account Rameezdeen, R. et al.)2014(. Both the public and commercial sectors in the MENA area have seen a notable increase in the use of design-build contracts as a project delivery method. Nonetheless, unless the risks are sufficiently identified, evaluated, and managed during the bidding and project execution stages, this project delivery method ends up being risky for all contractual parties. The impact of the selected contract type and risk management collaboration in construction projects was studied by Banik, G.C. (2008) and Osipova, E. (2007). They discovered that the design-build project showed high project performance and productive teamwork in risk management. From the contractor's point of view, risk management works better in design-build projects since it allows the contractor to have early project control.

Problem Statement

The investigation of the literature reveals that in significant industrial projects in the MENA region, contractors and owners do not share sufficiently of the risks. The present study aims to examine the risk variables associated with industrial projects in the Middle East and North Africa (MENA) region, as indicated by Table 3. Additionally, the research will identify, evaluate, and categorize the issues and roadblocks that impede the optimal allocation of risk in industrial projects. Next, the important risk considerations for design-build projects in the construction sector will be discussed in this article. Owners and contractors hoping to use the design-build contract will benefit from effective risk management of these aspects. Not only does the research help identify and assess risk factors in mega industrial projects but also to better

understand risk control techniques from the viewpoints of owners and contractors, in addition to distributing these risk factors across contractual parties through contract conditions. This study focuses on the primary risk factors for industrial design-build projects and offers ways to reduce those risks by modifying some conventional contract clauses.

Table.3: The 70 Investigated Risk Factors and their 9 Risk Categories in Mega/ Industrial Projects with codes

No.	Risk Factor	No.	Risk Factor
1st Category: Risks during Tender			
X1	Clarity of tender document	**X36**	Unfavorable weather conditions
X2	Insufficient technical specifications	**X37**	Suspension issues
X3	Concerns around skills of project team organization	**X38**	Lack of knowledge of existing facilities
X4	Poor design and documentation	**X39**	Buildability issues such as complex site details
X5	Change scope of work (leads to change contract price)	**X40**	Restricted working hour
X6	Unclear responsibility matrix	**X41**	Noncompliance between specifications and test results
X7	Insufficient FEED documents	**X42**	Social and cultural conditions
X8	Conflicting goals and objectives of project parties	**5th Category: Risks Related to the Subcontractors**	
		X43	Lack of coordination between subcontractors
X9	Strong competitors	**X44**	Lack of experiences of subcontractors
X10	Insufficient site investigation	**X45**	Subcontractor's failure to comply the schedule
2nd Category: Risks Related to the Owner			
X11	Unreasonable expectations of the client	**X46**	Improper type of project bidding
X12	Perceived risks of dealing with particular clients (statutory bodies)	**X47**	Noncompliance with professional ethics in construction
X13	Concerns around the financial viability of some clients	**X48**	Ineffective delay penalties
X14	Negative cash flow	**X49**	The ability of productivity of subcontractors
		6th Category: Risks Related Resources	
X15	Indecisive management	**X50**	Delay of utilities
X16	Lack of procedure to correct errors bet. owner/ contractor	**X51**	Material delivery doesn't comply with project schedule
X17	Frequent changes and/or variations by client	**X52**	Monopolistic practices of certain commodities
X18	Change execution methods from client to another	**X53**	Labor strikes due to revolutions
X19	Allocation of liability	**X54**	Limited list of suppliers
X20	Document approval cycle	**X55**	Procurement's problems
X21	Conflict management	**7th Category: Risks related to Management**	
		X56	Inability to interpret contract documents
		X57	Project manager isn't competent
3rd Category: Risks related to the Engineer			
X22	Non flexibility of Engineer		
X23	Concerns around engineer's experience	**X58**	Weak experience of the supervisor's level
X24	Concerns around availability of engineer	**X59**	Shortage of QC
X25	Unclear testing plan	**X60**	Poor communication between project parties

X26 **X27**	Engineer's satisfaction clauses Perceived risks of dealing with a particular engineer	**X61**	Miscommunication between the client & the contractor
		8th Category: Risks related to Finance and Commercial	
		X62 **X63**	Interest rate changes Limiting overdraft facilities
4th Category: Risks related to the Project			
X28	Defective materials		
X29	New constructive methods that are unfamiliar	**X64**	possible cash flow risks
X30	Availability of key inputs; labor, materials, equipment	**X65**	Lack of full knowledge of taxes and duties
X31	Compliance risks (H&SE)	**X66**	Client financial credentials
X32	Force majeure	**X67**	General market conditions
X33	Using an unstudied design and methods for the first time	**9th Category: Legislations Risks**	
		X68	Change in legislations/lows
X34	Design errors, omissions and contradiction in documents	**X69**	Late issuance of licenses
X35	False progress reports	**X70**	Delay due to statutory bodies

Research Objectives

Finding and analyzing important risk variables for large industrial projects in the MENA region is the primary goal of this research. Secondly, creating a balanced construction contract that aids in redistributing these risks to strengthen the bonds amongst the many project participants. To do this, the risk factors affecting the project life cycle will be identified, and the contract provisions pertaining to each risk will be examined and amended, or new clauses that can reduce or remove risk factors will be added.

Creating and validating modifications to conventional contracts that the construction project parties can utilize to more effectively allocate project risks is another important objective of this research, which aims to improve the current risk allocation procedures in mega industrial projects This study attempts to identify the risky contract clauses, as well as whether these clauses expressly state the risks or if the risks are implicit in the clause itself, based on the risk factors that were determined in the first section of a thorough investigation (see Table.3, Hassanen, M., and Abdelalim, 2023). An inductive approach is used in the research, and general contractual issues as well as the new standard FIDIC contract forms from 1999 and 2017 (Yellow Book) were studied.

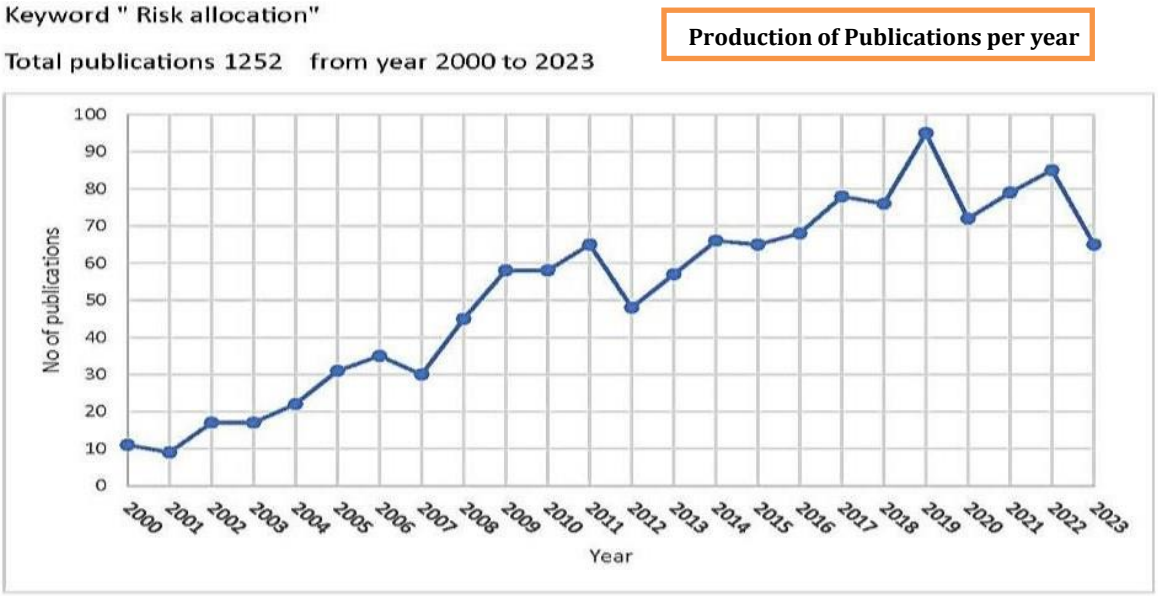
A comparison is shown in Table 4. We then looked into therationale behind the changes and recommendations made to this sample contract. Information is gathered for this using a questionnaire survey and semi-structured interviews. The experts' response was a great asset to the study because most of their risk-related solutions have already been developed and applied to the creation of balanced construction contracts, which aim to solve the issues preventing the best possible risk allocation within the specific construction sector. The findings will suggest a few modifications to the sections of mega industrial projects' clauses including the major risk elements.

Table.4: Comparison of Clauses and Sub-Clauses Relating to Claims in FIDIC Red-Book editions 1987, 1999 and 2017.

No.	Claim By	Claim Bases	FIDIC 1987	FIDIC 1999	FIDIC 2017
			Clause/Subclause	Clause /Subclause	Clause /Subclause
1.	Contactor	Delayed Drawing or Instructions	6-4	1-9	1-9
2.	Contactor	Unforeseeable Physical conditions	12-2	4-12	4-12
3.	Contactor/ Employer	Setting out	17-1	4-7	4-7
4	Contactor	Soil investigations done by the Contractor	18-1	13-1	1-13
5	Contactor	Costs incurred as a result of Employer's Risks	20-3	17-4	18-4, 20-2
6	Employer	Consequences of Force Majeure	22-3	19-4	18-4, 20-2
7	Employer	General Requirements for insurance	25-4	18-1	18-1
8	Contactor	Fossils	27-1	4-24	4-23
9	Employer	Access Routes	30-3	4.15	4.15
10	Contactor	Co-operation	31-2	4-6	4-6
11	Employer	Rejection	36-5	7-5	7-5
12	Employer	Inspection	38-2	7-3	7-3
13	Contactor	Consequences of suspension	40-2	8-9	8-9
14	Contactor	Right of access to the site	42-2	1-2	1-2
15	Contactor	Extension of Time for Completion	44-1	8-4	8-5
16	Contactor	Cost of Remedying Defects	49-3	11-2	11-2
17	Contactor	Contractor to Search	50-1	11-8	11-8
18	Contactor	Variation and Adjustments	51-1	13	13
19	Contactor	Variation Procedure 13-3 & Evaluation 12-3	52-1	12-3	12-3
20	Contactor	Evaluation	52-2	12-3	12-3
21	Contactor/ Employer	Evaluation	52-3	12-3	12-3
22	Contactor	Day work	52-4	13-6	13-5
23	Contactor	Provisional Sums	58-1	13-5	13-4
24	Employer	Payment to nominated Sub-Contractors	59-4	5-3	5-2
25	Contactor	Delayed Payment	60-10	14-8	14-8
26	Contactor	Payment after termination	63-3	15-4	15-4
27	Contactor	Consequences of Employer's Risks	65-3	17-4	18-4, 20-2
28	Contactor	Employer's Risks	65-5	17-3	20-2
29	Contactor	Optional Termination, Payment and Release	65-8	19-6	18-4, 20-2
30	Contactor	Release from Performance under the Law	66-1	19-7	20-2
31	Contactor	Payment on termination	69-3	16-4	16-4
32	Contactor	Contractor's Entitlement to suspend work	69-4	16-1	16-1
33	Contactor	Adjustments for Changes in Cost	70-1	13-8	13-7
34	Contactor	Adjustments for Changes in Legislation	70-2	13-7	13-6
35	Contactor	Currencies of Payment	71-1	14-15	14-15

Scientometric Analysis of Risk Allocation and Sharing in Mega Industrial Projects Research

The list of publications was extracted from the Web of Science Database (WoS). WoS was chosen as the primary data source for the current study due to its widespread availability and endorsement in extant literature, Zou, X., & Vu, H. L. (2019). The search strategy focused on "risk allocation," examining titles, abstracts, and author-generated keywords. Data collection concluded in 2023, covering the period from 2000 to mid-2023. After filtering non-English and irrelevant publications, the authors retrieved 1355 documents regarding "Risk Allocation", 4743 documents related to "Risk Identification", 1376 documents related to "Optimal Risks", 91 for "delay damages". *Despite that, the rarely found researches in contractual risks of Mega Industrial Projects were emphasized by finding ONLY 3 papers discussed Mega Industrial projects in light of FIDIC 2017, and Only 2 papers conducted in 2022 for claims and disputes according to FIDIC 2017*. The authors utilized keyword co-occurrence analysis to track the development of "Risk allocation" studies. This method effectively visualizes evolving scientific trends and subjects through graphical maps. Fig.3 visually represents these keywords, categorized into six clusters. These clusters are color-coded as follows: purple indicates "Risk Allocation", red represents "PPP- Risks", green corresponds to "Risk Identification", and blue signifies for "other mergers and acquisition processes that include risks", yellow denotes "Risk Management" and sky-blue stands. "Risk Allocation" serves as the central node, as shown in Fig. 3, with 507 links, and total link strength of 2221. The second rank was for Risk Identification and Assessment, with 271 links, and total link strength of 1582. "Risk management" was ranked the third of investigated researches with 202 links, and total link strength of 1232.



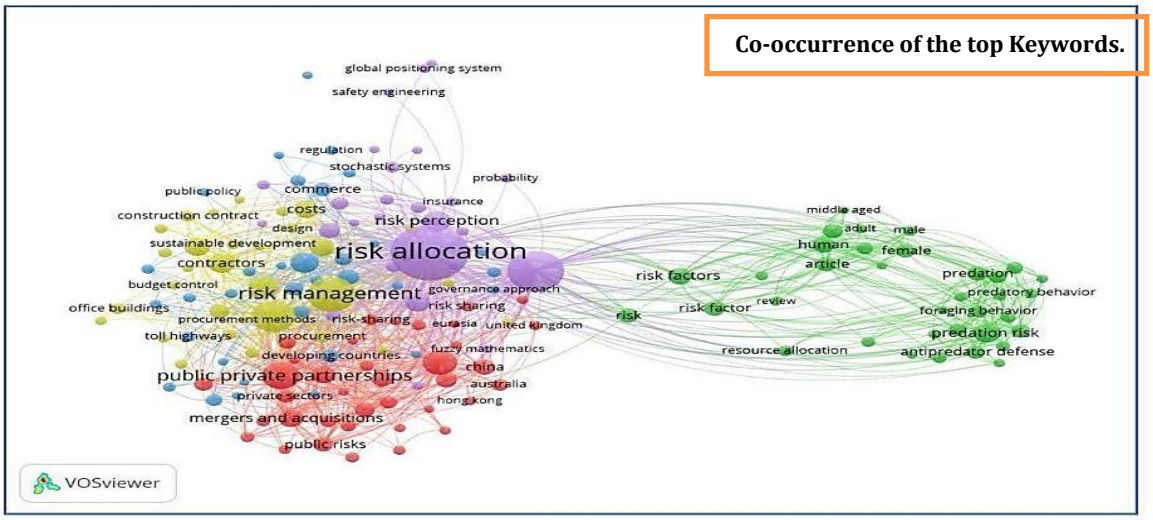


Fig.3: Scientometric Analysis.

LITERATURE REVIEW

The outcomes of mega projects are significantly impacted by the numerous risks that are present in mega industrial projects. Additionally, it has been observed that due of their complexity, distinctiveness, dynamic character, lengthy project duration, and competitive environment, megaprojects are riskier than those in many other industries (McCord, M., 2015). Additionally, Youssef, A. et al. (2018) noted that the complexity of mega industrial projects is growing, which raises the severity and frequency of hazards that are typical of these projects.

The study of equitable risk allocation between the project participants (owner, designer, contractor, etc.) has received a lot of attention over the past few years. Risk allocation has therefore been a popular research topic in recent years as a crucial component of contractual governance for building projects, according to Nasirzadeh, F. (2014). A successful planning strategy among project team members continues to use risk quantification and modeling as a means of promoting an effective risk response, according to Boateng, P. (2015), because of the growing complexities and dynamics of the risks involved in mega-projects and mission management approaches for these projects. In recent years, there has been an increase in the strain between contract parties in industrial projects. Sometimes, obligations under contracts and communications were not carried out in an honest and equitable way. On the other hand, Li, Y., et al. (2017) claimed that an unequal distribution of risk among contractual parties is a crucial choice that drives up project costs overall and affects the relationship between contracting parties as a whole. According to Peckiene, A. (2013), it is essential for parties to share risks fairly. An essential choice that raises a project's ultimate cost and damages the relationship between the contractual parties is the unequal distribution of risks among them. As a result, according to Khazaeni, G., et al. (2012), the parties' relative interests should be taken into consideration when allocating resources fairly. In construction projects, risks are rarely eliminated; instead, they are only transferred to a different party by a construction contract arrangement or shared according to particular contractual requirements. As a result, in addition to the four essential stages of the risk management process, Peckiene, A. (2013) proposed the existence of a fifth stage: risk allocation between the contracting parties.

Moreover, there is disagreement among those involved in construction projects over the best approach for allocating risks. According to some academics, this uneven distribution of risks will force the contractor to use defensive tactics, such as lowering the caliber of their work or inflating their invoices, The field of risk management has seen an increase in interest in recent years. Actually, risk management is crucial since it raises a company's profitability, and not doing so could have unfavorable effects, El-Adaway, I., 2020. Project risk management is actually a procedure that entails locating sources of uncertainty; (risk identification), estimating the likelihood and effects of uncertainties (risk analysis), developing strategies to react to the risks examined (risk response), and finally tracking such risks and repeating such steps across the project's life.

All construction projects must have a contract agreement since it outlines the parties' responsibilities and the manner in which project expenditures are allocated. R.K. Kumar, 2019. Construction contracts contain stipulations that help to reduce the inherent complexity of industrial projects by allocating rights, obligations, responsibilities, and risks among the parties. However, because contractual parties often prioritize risk avoidance above appropriate risk allocation, excellent contracting benefits are frequently lost. Despite having both direct and indirect contractual obligations, these parties might not share the same interest in the project and might see the related risks and their distribution differently Standard construction contracts (SFCs) are widely available, and their demonstrated benefits are one reason why utilizing them is beneficial. However, recent studies and present practice indicate that owners continue to rely on ad hoc (bespoke) or significantly amended SFCs. Youssef, A., and colleagues (2018). Strong firms today work hard to ensure long-lasting, successful relationships by incorporating clauses into contracts that promote cooperation and improve risk management. The field of construction research is not new to managing and allocating risks. Researchers from a variety of construction industry sectors have looked into the allocation and distribution of risk in specific contract forms (Abdelalim, A.M. et al., 2020, 2021People tend to think of terms like liability limitations, compensation, and the like when asked about contract terms that deal with or are essential in controlling risks. Another common response is to mention clauses that specifically refer to the word "risk," such as those that deal with the risks of the owner or contractor in construction contracts or the risks of loss or damage in sales contracts. The majority appear to believe that these are the sole clauses in the contract that address hazards. Such an outlook would be excessively limited. Risks associated with contracts can come in a variety of shapes and sizes. Studying past disputes and accusation experiences can help you comprehend problematic terminology and worries and reduce the likelihood that something will go wrong, Arditi, D. 2017. Risks associated with contracts can come in a variety of shapes and sizes. Studying past disputes and accusation experiences can help you comprehend problematic terminology and worries and reduce the likelihood that something will go wrong. In their study, Li, H., and Arditi, D. (2017) postulated that by making sure the design is as comprehensive as feasible; the owner can minimize project uncertainty and achieve good project efficiency by being ready to cope with complexity. Alongwith encouraging healthy competition between the contractor and subcontractors and the bidder, the owner should also make sure that these parties participate in the project as soon as possible.

Problems with Current Practice of Risk Allocation

Numerous construction projects fall short of their planned goals. Such a failure could be explained in terms of severe project delays, cost overruns, and inefficient work. A key contributing factor to such a failure is the existence of risks and uncertainties inherent in the planning and implementation of projects. PMI, 2017. A five-phase risk management approach, comprising risk identification, risk management strategy, qualitative and quantitative risk analysis, and risk response planning, can help lessen the negative effects of defined risks. This section looks at and assesses earlier studies to identify issues with current risk allocation procedures in the construction industry, based on the examined literature. Tension, disputes, and ineffective risk management appear to be related, Abdelalim, A.M, et.al 2016.

Time and Cost Overruns

Undervalued risks frequently result in monetary losses (Peckiene, A., 2013). Defensive risk measures lead to poor quality and time and expense overruns. Thus, it is essential to distribute risks fairly in order to achieve effective project performance protective tactics against risk.In many developed and developing countries, the construction industry frequently faces delays and cost overruns. Abdullah et al. (2018) discovered that the most important causes of delays are poor/insufficient planning and scheduling, lack of subcontractor ability, and delays in subcontractor work when identifying factors that lead to cost overruns and delays during refinery projects for palm oil. Studies by Pham, L.H. et al. (2014) indicated that some delays are caused by contractors, project owners, authorities, and external sources, (i.e., weather). Therefore, the contractors need to increase their project management abilities in order to extend the project's duration. In addition, the contractor's technical and managerial skills must be carefully considered by the project owner while selecting the contractors. The project owner must also establish a clear project scope, uphold the project requirements, and refrain from making design changes throughout the fundamental design, also known as front-end engineering design (FEED). (Adam, A., et al., 2015) came to the conclusion that the factors causing cost overruns and time delays frequently overlap based on the body of research on the causes of client cost overruns and delays in building projects. Consequently, two projects that have the same underlying cause for a schedule delay or cost overrun could be interpreted quite differently. Every explanation is distinct and depends on the research endeavour being conducted.

Claims

Construction contracts are essential for averting the legal and administrative hazards that give rise to claims, since the frequency of litigation involving construction projects has grown. According to Mohammadi, S. (2016), the study aims to increase construction professionals' awareness of these likely risks by identifying legal risk factors that could give rise to claims in sustainable construction and by evaluating the criticality of each risk factor based on the opinions of industry professionals and analysis using the relative importance index method. Common reasons for claims were altered owner needs, additional labour, delays or acceleration, different site circumstances, and unclear contracts, R. Komurlu et.al, 2017. According to Dastyar, B., et al. (2018), the most significant variables influencing claims include contractors' financial difficulties, shortage of materials, and high pricing when they provide a contractual price below the required tender price. In construction projects, risk management

is still largely ineffective. In their research, Haidar, A. (2011) provided a brief overview of this issue. Their analysis indicates that undervaluation and imbalanced bidding are common causes of claims. Many writers have researched the justifications for assertions. According to Mohammadi, S. and Birgonul, M.T. (2016), contract-related problems are exacerbated by irrational contract clauses as well as a lack of clarity in the contract agreements about payment, modifications, and a performance time. As a result, as the project moves forward, additional risks and unanticipated circumstances could surface, leading to potential disputes and a breakdown of the relationship practices such as the use of performance bonds to shift the risk of delays and cost overruns, dispute resolution processes to minimize litigation, and negotiation tactics to prepare for litigation in the event of an unforeseen circumstance. Time extensions, scope modifications, payment, administration, contractual duties, and other issues are also included in disputes. They claim that one of the causes of disagreements is that the party impacted did not acknowledge the risk as pertinent to the project. As a result, as the project develops, additional dangers and unanticipated circumstances could surface, raising the possibility of disagreements and a partnership breakdown. The most common sources of claims and disputes were covered by the International Association for Contract and Commercial Management (IACCM 2011) in its 10th Annual Survey, Top Terms in Negotiation. Table 5 summarizes the key findings. Generally speaking, the owner wishes to transfer as much risk as feasible to the contractor and take on as little risk as possible. In this instance, the contractor is only liable for any situations that may develop throughout the project; thus, he is free to raise the project tender price, A. Peckiene. (2013).

Table 5: Most Sources of Claims and Disputes, IACCM 2011.

Issue	% Reported	Issue	% Reported
Delivery/acceptance	41	Price/charge/price changes	38
Change management	32	Invoices/late payment	30
Performance/guarantees/undertakings	27	Service levels and warranties	27
Payment	25	Responsibilities of the parties	22
Liquidated damages	22	Scope and goals	21
Warranty	16	Limitation of liability	16
Indemnification	14	Service withdrawal or termination	14
Intellectual property	12	Audits/benchmarking	10
Assignment/transfer	8	Dispute resolution	8
Data protection/security	7	Communications and reporting	7

Disputes

Conflicts in industrial projects have become routine in the MENA region. Such a phenomenon could impede the success of these projects inthe MENA area and slow down development if it is not controlled well. One of the primary causes of projects failing to meet their goals is the inherent risk and uncertainty associated with mega industrial undertakings. One of the most frequent reasons for disagreements and claims in the construction sector is the project parties' inability to understand their contractual duties. R. Khalef et al., 2021. In general, any country's economy depends heavily on the building industry. In 2019, ARCADIS reported that the average cost and duration to resolve construction disputes was $33.0 million, with 17 months being the average. Claims and disagreements were prevalent in 2016 across most industry sectors, but

they were particularly prevalent in public sector and social infrastructure projects. According to the ARCADIS 2017 report, the number of claims and disputes on oil and gas projects is increasing as the industry becomes more cautious in response to low oil prices. Particularly in building projects, the MENA area has witnessed a rise in the complexity of contract structures in recent years. Working relationships, correspondence, and contracts are still not being fulfilled in a good faith manner. Usually, conflicts arise from the opposing priorities of multiple parties. These disputes result in the need for more resources, which are wasted and used needlessly, llankoon et al., 2019. More than 220 claims have been presented for arbitration during the previous 20 years, according to the Cairo Regional Centre for International and Commercial Arbitration. Marzouk, M. (2011) developed a survey questionnaire that outlined forty-four reasons why disagreements arise in the construction industry. The most frequent reasons for disagreements will guide the owners, contractors, and consultants involved in the project in resolving these issues. According to Gandhi, M. et al. (2017), ambiguities in contracts, restricted access, scope modifications, poor documentation, and unforeseen site conditions are some of the things that lead to disagreements in their research, Hiyassat, M.A., et al., 2020 find 62 risk variables that fall into 14 categories in an effort to lower the overall cost of claims and disputes. Delays in client payments, incorrect contract forms, competitiveness, and permit approval delays were the top risk factors. Other risk factors were subcontractor default, poor specifications, fluctuating material prices, disparate construction standards, design changes, and inadequate implementation. The International Monetary Fund said that the base case for global growth in 2016 was a moderate 3.2%, mostly consistent with 2015 but down 0.2% from January 2016. It was anticipated that the recovery would strengthen in 2017 and beyond, mostly due to developing countries as those stressed markets' conditions progressively return to normal Global Construction Disputes Report 2016 states that there are significant risks associated with the forecasts, and some market volatility is anticipated. These factors could have an impact on the volume of construction disputes. This research states that inadequate contract management is the most frequent reason for disagreements, as shown in Table 6. According to the research, there has been a global proportionate growth in the usage of design and contract forms, and one new cause in the rankings is connected to incomplete design information, which is typically thought to be associated with poor design information quality. The use of EPC contract formats has caused issues in certain industries.

Table 6: The Most Common Causes of disputes, Global Construction Disputes Report 2016

2015 Rank	CAUSE	2014 Rank
1	Failure to properly administer the contract	1
2	Poorly drafted or incomplete and unsubstantiated claims	2
3	Errors and/or omissions in the contract document	3
4	Incomplete design information or employer requirements (for Design and Build)	New
5	Employer/contractor/subcontractor failing to understand and/or comply with its contractual obligations	4

Even with standard general conditions, contracts would require a significant amount of time to negotiate and sign if the specific contractual clauses were poorly written or poorly calibrated.

As a result, the original allotted time would be significantly reduced. Assaad and El- AdAway 2020c, in addition to inadequacies in contractual risk management, have seen a significant increase in volume and complexity in recent years, exposing numerous firms to previously unheard-of risk. Contracts frequently turn into a battleground where parties give up trying to find common ground or shared interests and instead concentrate on relative strength and capacity for risk allocation. In many partsof the world, the general perception of contracts is still centred on their legal intent. According to a 2015 study by P.J. Keane on the reasons behind claims in construction projects, a lot of contractual claims are brought about by changes and extra work. While unfair contract / unjustrisks' allocations, changes, complaints about delays, and contract terminations are all frequent grounds for a claim (Van Weele, A., 2014). According to John E. Miller (2014), construction disputes would result from faulty contract writing, unrealistic tendering, and disparities in contract interpretation among project participants. According to Suprapto, M. (2016), on average, if they tackled the issues that commonly undermine contract performance, companies could generate over 9 % improvement to their bottom line. In respect of owner-contractor co - operative relationships and contract type criteria. Improved relationships and higher-quality teamwork are the main reasons why partnering/alliance contracts are generally associated with greater project performance than lump-sum or reimbursable contracts. Accordingto the research, the most frequent causes of claims, disagreements, and strained relationships were a lack of clarity on the scope, inadequate communication, and unclear roles. During the talks, the terms and conditions pertaining to intellectual property, liabilities, reimbursements, liquidated damages, data protection, and pricing are the ones that garner the most attention (IACCM 2015). Sharing project outcomes is thought to be a crucial tool for coordinating contractors' interests with the owner's, Chang, C.Y., and S.M. Hosseinian (2013). Positive attributes that foster mutual understanding must counterbalance the negative incentives to perform in an unfavourable setting. Contracts that are defensive, risk-averse, and compliance-based compromise the outcomes. As a result, it is much more probable that the developing accords will provide guidelines for better governance and acknowledge the need for more flexibility. Consider the dangers that contractors confront and avoid the need to abuse mediated power against them in order to lessen entrepreneurial opportunism. L. Zhang, 2017. It hasbeen observed that the majority of business-to-business negotiations centre on topics related to risk allocation (liabilities, indemnities, data security, performance promises, and liquidated damages) and financial concerns (pricing and payment). Despite their importance, these problems do not result in the win-win solution that negotiators would like. Furthermore, the clauses emphasized in the contract discussion were not the reasons for the problems. But if the hazards aren't correctly detected, assessed, and managed throughout the bid preparation and project execution stages, this project delivery system turns to be a risky system for both owners and contractors. For every project, especially design-build projects, to be successful, project risks must be appropriately recognized, allocated, managed, and mitigated, G.C. Banik and F. Hannan. 2008. Contract conflicts may arise if the contractual terms and conditions are not adequately taken into account throughout project execution, meaning that the contracting parties may not fully comprehend what they have agreed upon. In terms of contracts, design-build provides the owner with a single point of contact for both construction and design services. From planning to conceptual and preliminary design, detailed design, procurement, building, and operation, the design-build contractor oversees every stage of the project. In terms of contracts, design-

build provides the owner with a single point of contact for both construction and design services. From planning to conceptual and preliminary design, detailed design, procurement, building, and operation, the design-build contractor is in charge of every stage of the project. In recent years, there has been a noticeable shift in the bargaining technique. The governance and performance standards that lead to successful solutions are more of a focus for negotiators. This shift in perspective in many industries is the result of a gradual realization that many agreements in the modern world need to be considerably more flexible and sustainable, as evidenced by the IACCM's yearly review of the terms that are most frequently negotiated. Indemnities and liabilities are the most frequently negotiated conditions. Focusing on securing assets and preventing losses produces an often-adversarial culture where risk management's wars weaken the ingenuity and transparency that encourage innovation and value Proper identification and management of these risk factors can instil confidence in owners and contractors who wish to use design-build contracts.; Nguyen, P.T. et al. 2020. Denied or exculpatory clauses are terms used to describe contract provisions that deal with risk allocation. Generally speaking, these clauses shift liability, loss, and injury risk from one contracting party to the other. Rather than examining how project parties distribute risks through contract terms and how their legal enforceability is determined, prior research has concentrated on the impact of exculpatory clauses on the cost premium associated with inherent risks in construction contracts Khalef, R., et al., 2021. Their investigation revealed how standard contract forms handled project risk and liabilities Since SFC modifications are typically initiated by the employer, A. Youssef et al. (2018). All aspects of the DB project's design and construction, including work completed by subcontractors, remain under the purview of the primary contractor, 2020; Nguyen, P.T. et al. Exculpatory clauses were included in construction contracts between owners and contractors in order to better divide risk among the parties and avoid or minimize the inclusion of excessive contingencies in bid pricing. Khalef, R., et al. (2021) provided a better understanding of how exculpatory clauses affect risk allocation. Comparing the reasons behind the disagreements that occurred throughout the course of the year 2014, according to the survey, conversations regarding financial matters (pricing and payment) and risk allocation (liabilities, indemnities, data security, performance obligations, and liquidated damages) typically take centre stage in business-to-business negotiations. While these issues are significant, they do not lead to the win-win strategy that negotiators prefer. Moreover, the causes of disputes weren't attributed to the clauses highlighted in the contract discussion. Although considering intellectual property to be a significantly higher priority, the Middle East agenda tends to be dominated by price, payment and guarantees issues. This was evident in the Global Construction Dispute Report 2016, where its annual report shows that the ambiguous conditions in the contract document are the main cause of disputes in the US, while those in the Middle East and ASIA have failed to manage the contract properly, incomplete design information or employer requirements (for Design and Build).

Five recommendations were made by Loosemore, M. et al. (2015) in order to attain the best possible risk allocation for the party taking the risks. These guidelines concern whether the party bearing the risk: 1) fully understands the risks; 2) has the best capacity and expertise to manage risk; 3) is capable of handling the consequences of the risk; 4) has the high skills necessary to take the risk; and 5) has received enough incentives.

Standard Forms of Contracts, FIDIC Forms

The International Federation of Consulting Engineers, or FIDIC, creates standard forms for contracts pertaining to civil engineering. It was founded in 1913 by three nations in Lausanne, Switzerland. FIDIC is well-known for creating Standard forms of contracts for mechanical and electrical plant, as well as civil engineering construction. Published in 1957, the "Red Book" refers to the initial version of the "Conditions of Contract for Works of Civil Engineering Construction". The group deals with several contract kinds that are widely used worldwide and have gained popularity, particularly in the Middle East. After being approved and endorsed by the international federations ofthe Asian and Western Pacific Contractors' Associations, the Red Book was published in its second edition in July 1969. A compilation of 'Notes on Documents for Civil Engineering Contracts' covering specific facets of the various clauses in the Red Book Third Edition was published by FIDIC in 1977. The 1987 package of FIDIC contracts has been replaced by the current suite, which is mostly recognized by its colors. FIDIC recognized the need for a design and construction contract from 1987 to 1999, and in 1995 they created what is now known as the Orange Book. The 1999 set eliminated the necessity for the Orange Book since a design and development contract could now be satisfied by either the Yellow or the Silver Book. The 1999 set includes the following four forms of contract: https://fidic.org/:

1. Conditions of Contract for Construction (First Edition, 1999) The Red Book;
2. Conditions of Contract for Plant and Design-Build (First Edition, 1999) The Yellow Book;
3. Conditions of Contract for EPC/Turnkey Projects (First Edition, 1999) The Silver Book;
4. Short Form of Contract (First Edition, 1999) The Green Book); and
5. Contractor partnership agreement (the White Book)

"FIDIC is the most commonly used contract form, "they have been used extensively for many years throughout the Middle East and North Africa. The success of FIDIC contract forms can be attributed to its adaptability to various legal systems, their familiarity among market participants, including financiers, and their proactive updates to better serve their target market. The FIDIC contract form has been widely used in the Middle East and North Africa (MENA) region, particularly in Egypt, for a number of significant projects. These projects include the construction of the new Cairo airport (Terminal Two), the Greater Cairo Wastewater project, the third phase of the Grand Egyptian Museum, the Cairo Metro Project, and currently the fourth phase of the Metro. FIDIC held multiple conferences in Egypt including the conference hosted by FIDIC with the International Chamber of Commerce in 2005, which discussed the settlement of disputes in international construction contracts. Since the 1999 editions of the FIDIC volumes were published, there has been a significant increase in the use of the FIDIC forms of contract over the past 20 years. The three new 2017 FIDIC types of contracts were unveiled during the FIDIC international Contract Users Conference, held in London on December 5 and 6, 2017. "The central objective of most of the adjustments to FIDIC 's 2017 contract updates is to improve clarity and certainty, reduce the possibility of disagreements over the definition of contract terms and thus increase the probability of effective projects, Peter Fogh, 2017. In line with the above, FIDIC has improved the contract provisions by making them more prescriptive and by introducing step-by - step project management and procedural mechanisms, by setting out exactly what is expected of the employer, the contractor and the engineer while the contract is being performed (CMS guide to

the FIDIC 2017 suite). The brochure offers recommendations for Particular Conditions for clauses that address issues that crop up regularly and call for alterations to the normal terms. FIDIC has now included its "Golden Principles" for the formulation of Particular Conditions. Among these is the rule that the risk/reward ratio set forth in the General Conditions cannot be altered by the Particular Conditions. The primary purpose of the new changes is to enhance the following areas: contract management techniques; dispute avoidance; reciprocity of rights and obligations; transparency, clarity, and certainty.

RESEARCH METHODOLOGY

A previous review of the literature on risk identification and sources of risk in megaprojects is part of the research methodology. After reviewing and analyzing the existing published material, a systematic survey questionnaire was created and disseminated. IBM-SPSS Ver.25 (Statistical Package for the Social Sciences) software was used to do a statistical analysis of all the acquired data in order to rank these factors according to their probability and influence. The reliability of the questionnaire was assessed between each field and the average ofall the fields, using the Pearson correlation coefficient and Cronbach's alpha coefficient, respectively, to assess the validity of the internal andstructural study. The characteristics of risk allocation in construction projects were graded and ranked using the Relative Importance Index (RII) and Adjusted Frequency Index (FAII) that can determine the importance of the attributes of the risk allocation. The following is a summary of the methodology as illustrated in Fig.4:

1. To inquire into the issues with the way risk allocation is currently carried out in the construction industry, a thorough assessment of related studies' literature was conducted.
2. In order to facilitate the inquiry, a systematic questionnaire comprising all risk factors influencing predetermined criteria for construction projects in the Middle East and North Africa (MENA) was created and given to construction practitioners.
3. After that, respondents were asked to rank these risk factors according to likelihood and impact on pre-established standards forconstruction projects.
4. To rank the risk factors, statistical analysis for the gathered data will be performed using IBM-SPSS Statistics' SPSS Ver.25 software.
5. In light of the findings of the questionnaire research, the terms of the FIDIC Yellow Book contract were reviewed.
6. The conditions of the FIDIC Yellow Book contract in the MENA region, the modifications being made to make it a balanced contract, andthe outcomes of these modifications have all been taken into consideration using an inductive approach.
7. Creating a straightforward, balanced contract that can be applied to the MENA region's construction project.

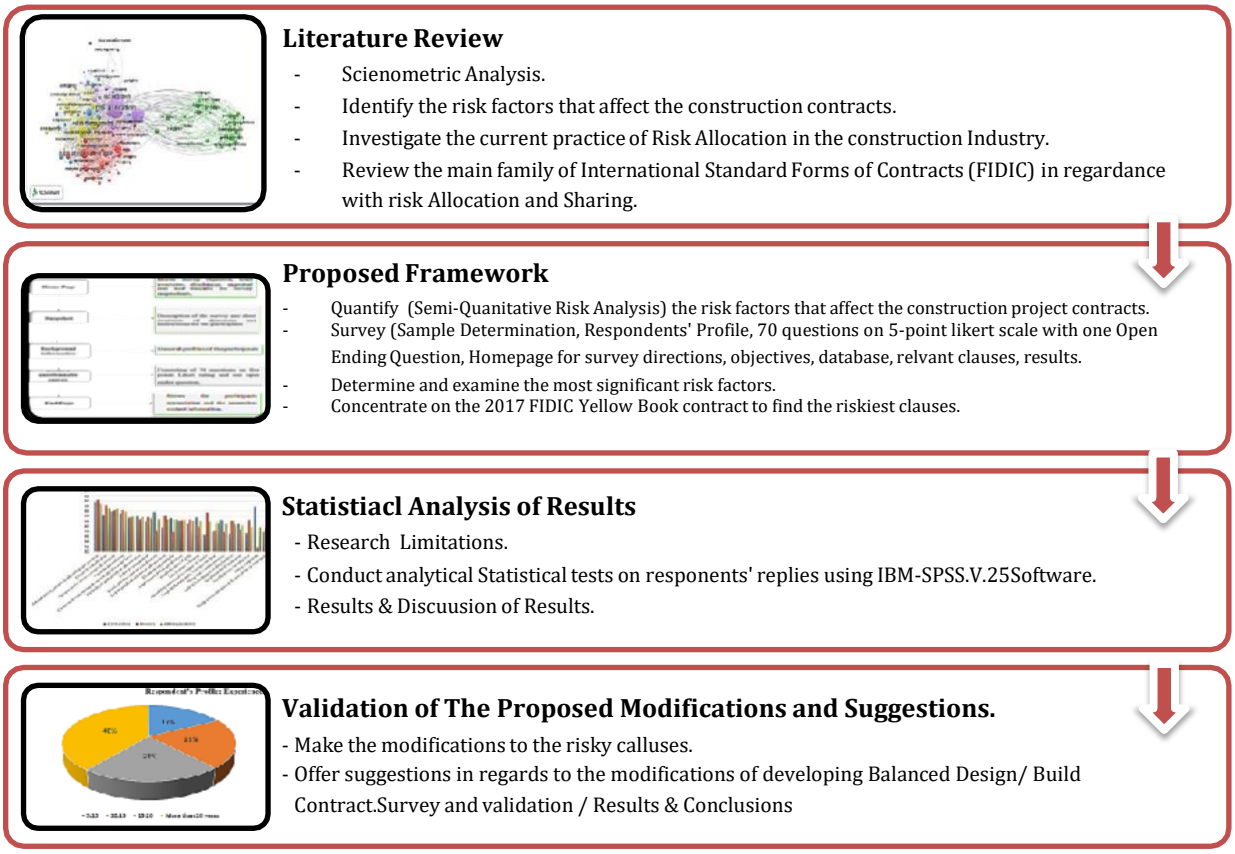


Fig.4: Research Methodology.

Questionnaire Design

The survey is divided into two components. The first part asks generic questions regarding professionals who represent their companies in the construction industry. The primary questions about identifying risk factors are covered in the second section. After the first round of survey and analysis, respondents were asked to rank the risk factors according to their likelihood and potential consequences. The same experts were then questioned about any suggested changes. The first step in processing the respondents' responses was to import the Google Forms questionnaire responses into a Microsoft Excel workbook. After that, the survey respondents' responses were coded using the following formulas: almost certain = 5, probable = 4, possible = 3, unlikely = 2, and unusual = 1 to modify the Likert scale of likelihood. As the survey respondents' responses were being coded to modify the severity of the consequences (Likert); the respondents were using the five- point rating scale, very high =5, high =4, moderate =3, very weak =2, or insignificant =1.

Sample Selection

Firstly, the sample size was determined, considering the scarcity of Claims & Disputes experts, as follows:

According to (Fouad al Bahi, 1979), when studying a particular population based on statistical evidence, the scholar uses information gathered from the survey to generalize findings from a

drawn sample back to a population. Accordingly, he divided the statistical samples in terms of size into two main types: A. Small samples: sample size 30 or fewer, B. Large samples: sample size greater than 30. Therefore, when the sample size exceeds 30, the statistical measures of the samples are very close to the populations which were drawn from it. Sample size determination for survey studies, from a population has been mentioned in many references, researches, e.g. (Hair et al. 1995) and (Cochran, 1977). The aim of the sample size calculation is to determine a precise sample size which can find results for the total population with a good accurate manner to generalize about the population from the sample data. (Hair, 1995) stated that "it is generally agreed that the minimum sample for appropriate use for statistical analysis is equal to or greater than 5 times of the independent variables, or not less than" 100", P ≥100 and P ≥ 5X (where X is equal to number of variables). Another approach (Cochran, 1977) developed a formula to calculate a representative sample and was used to calculate sample size for finite population (Naoum, 1998), (Odeh and Battaineh, 2002). To obtain a statistically representative sample size of the population, the number was calculated by formula as following equations

$$SS = \frac{Z^2 * (P) * (1-P)}{e^2} \quad \ldots\ldots(1)$$

SS: ($calculated\ sample\ size$)

- Z: value for the confidence level (e.g., 1.64 for 95% confidence level)
- p = percentage picking a choice out of five, expressed as decimal (0.2 used for sample size needed as chance of picking a choice out of 5available options)
- e = confidence interval, expressed as decimal, margin of error = (a percentage that describes how closely the answer your sample gave to the "true value" in your population), for this study it is considered 8 %. (e.g., o.08 = ±8%)

$$\text{SS } (\boldsymbol{sample\ size}) = \frac{1.64^2 * (0.2) * (1-0.2)}{0.08^2} = \mathbf{68} \quad \ldots\ldots\mathbf{(2)}$$

Pop: is the population which is considered for this research as the number of construction management consulting engineers in the construction industry in Egypt and Saudi Arabia as the existing booming construction market in MENA region, and as they could be reachedand thoroughly interviewed. The number of engineers in Egypt and Saudi Arabia are; 230,000 engineers working in Saudi Arabia according to Saudi Council of Engineers statics including 70,000 Egyptian engineers, 630,000 engineers working in Egypt according to the Egyptian Engineers Syndicate. The total number of engineers is 860,000 in all disciplines at all levels starting from fresh graduates, among these numbers to the best scenarios, 2- 3 % are contract experts with more than 10-15 years of experience. Then the number of populations was assumed as 5,000 based on the maximum number of claiming experts denoted by the Engineering Syndicates of Arab Countries, by using theequation:

$$\mathbf{SScorr} = \frac{68}{1+\frac{68-1}{5000}} = 68 \quad \ldots\ldots(3)$$

Within two months of the questionnaire being circulated to 200 engineers in the target sample, 100 insightful responses were obtained. Twenty-eight of them were disregarded because the data and answers were incomplete. Figure 5 depicts the respondents' experience. Project management experts were asked to respond to a questionnaire that included questions on current issues with risk allocation, sources of risk in construction projects, how these risks affect project objectives, and how likely it is that these risks will arise. Fig. 5 also displays the respondents' organization type. In order to conclude the research, the following parts provided an explanation and examples of the survey results:

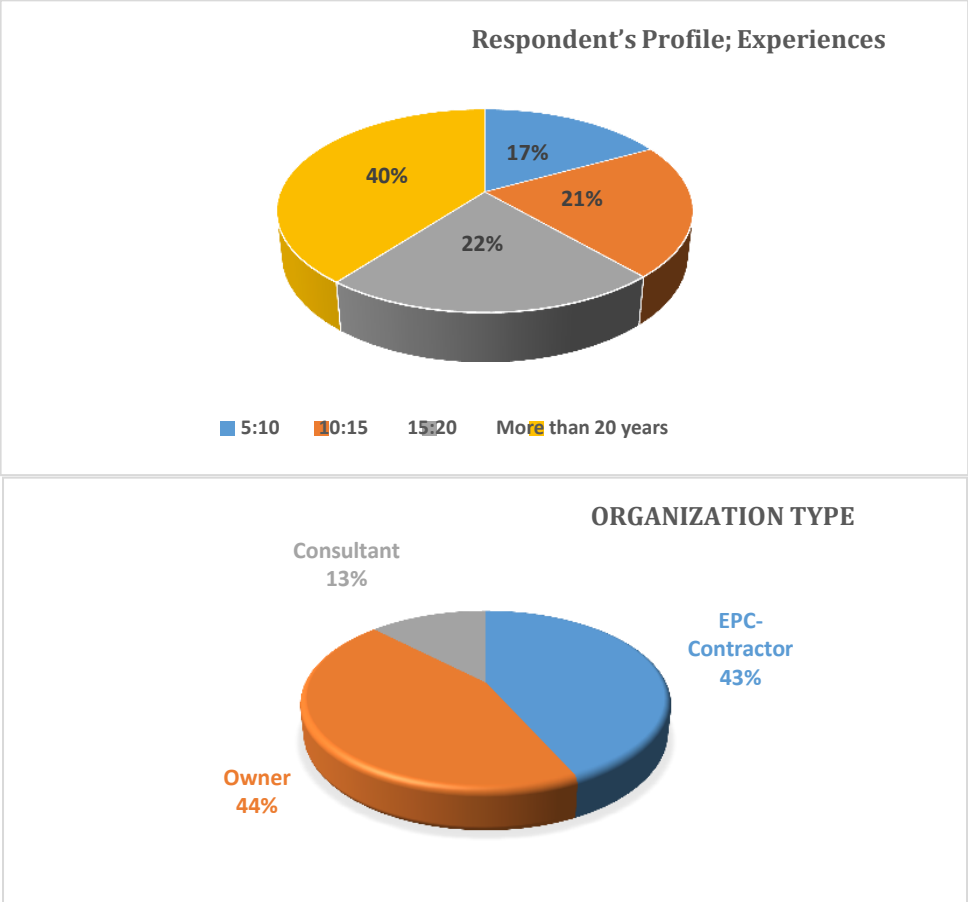


Fig. 5: Respondent's Profile; Experiences and Organization Type.

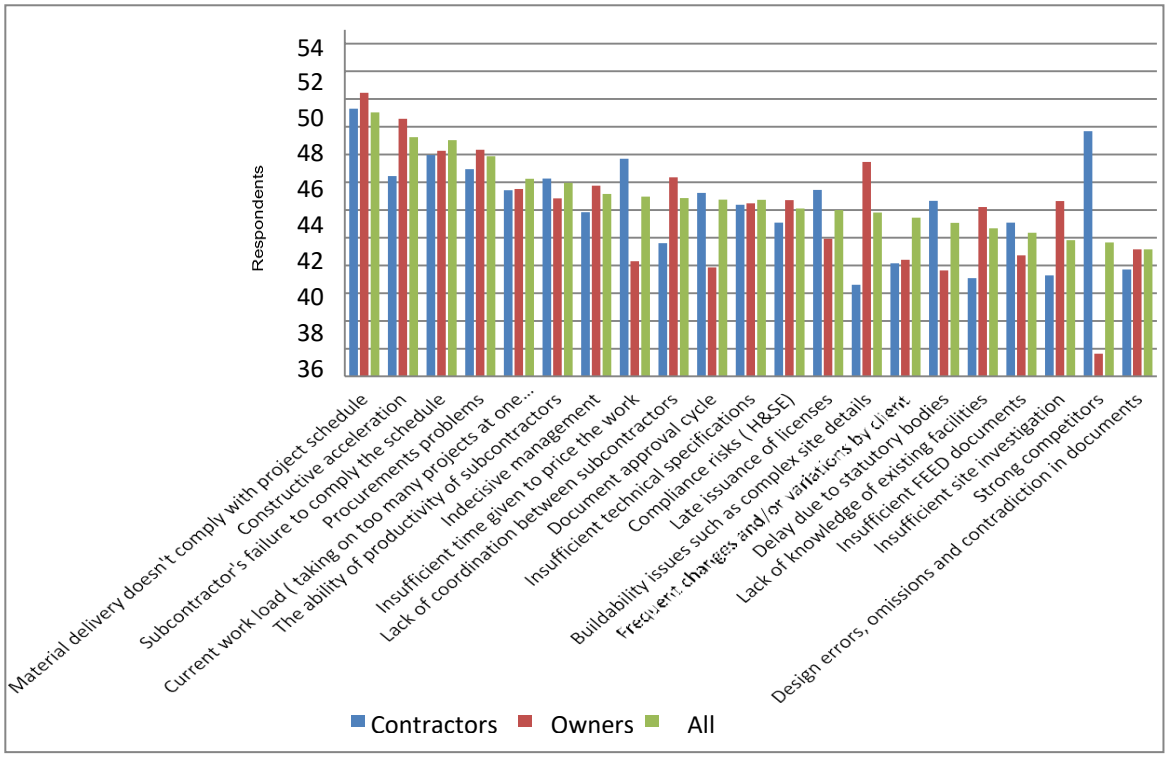


Fig. 6: Significant Risk Factors Related to Organization Type.

Fig. 6 displayed Important Risk Factors Associated with Organization Type. Figures 7, 8 showed probability and impact Rating of Risks during Tender Stage. Figures 9, 10 and 11 illustrated Impact Rating of Reason of Risks by the owner, the Engineer and subcontractors in sequent. And Finally, Figures 12, 13 and 14 11 illustrated Impact Rating of Reason of Risks related to resources, Management and Finance in sequent.

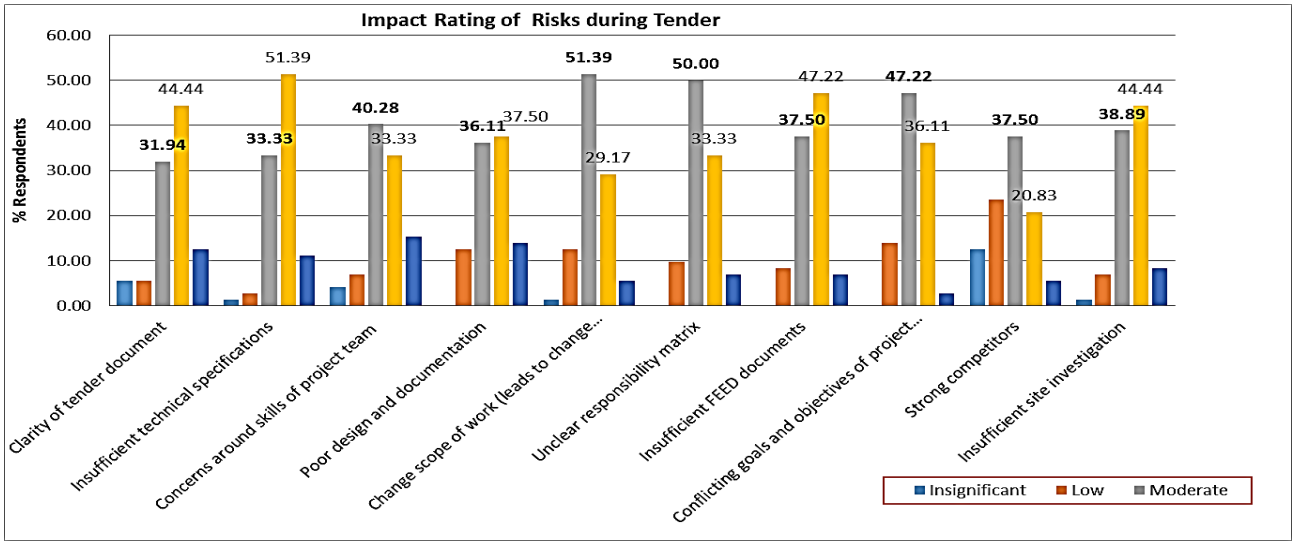


Fig.7: Impact Rating of Risks during Tender Stage.

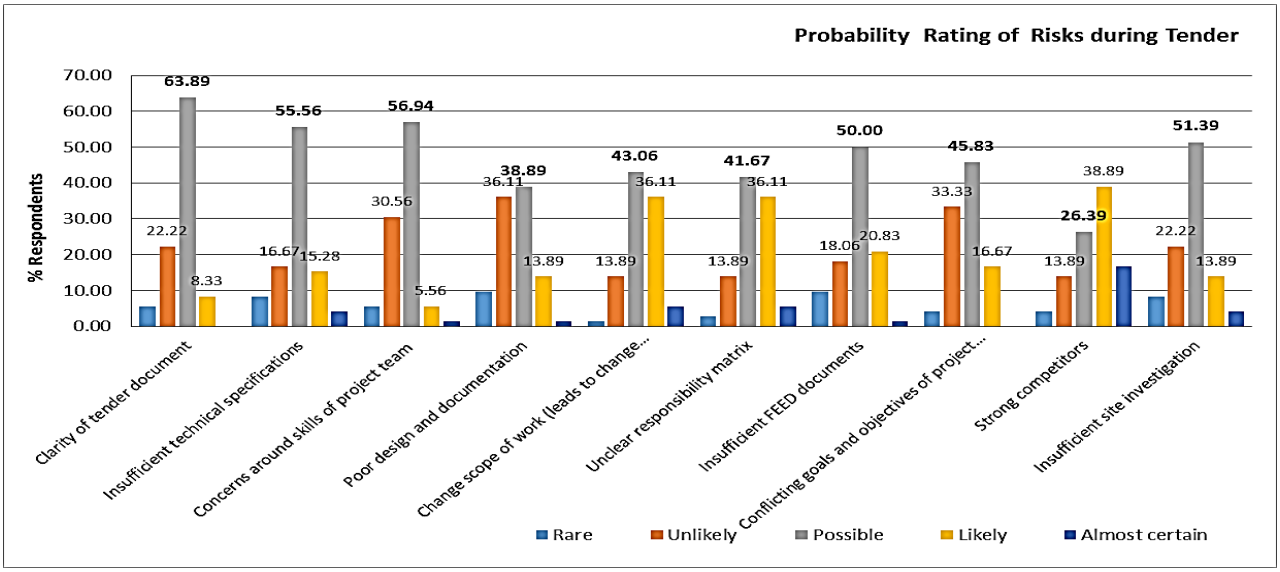


Fig.8: Probability Rating of Risks during Tender

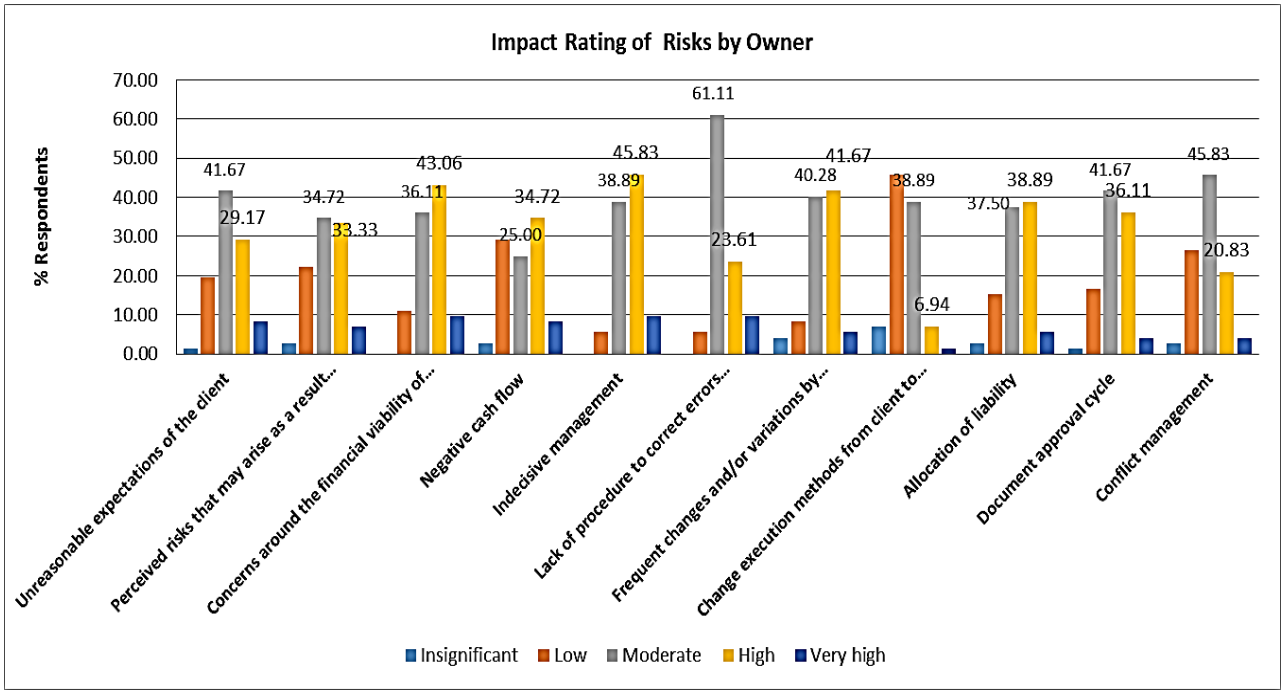


Fig. 9: Impact Rating of Reason of Risks by Owner

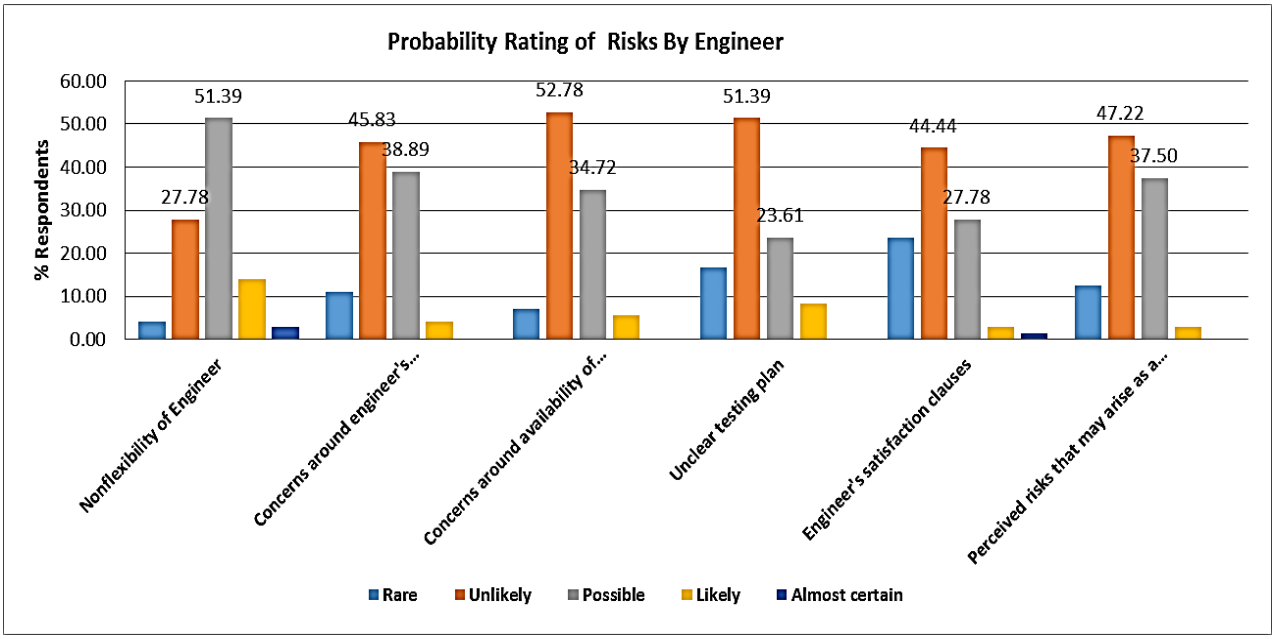


Fig. 10: Impact Rating of Reason of Risks by the Enginner

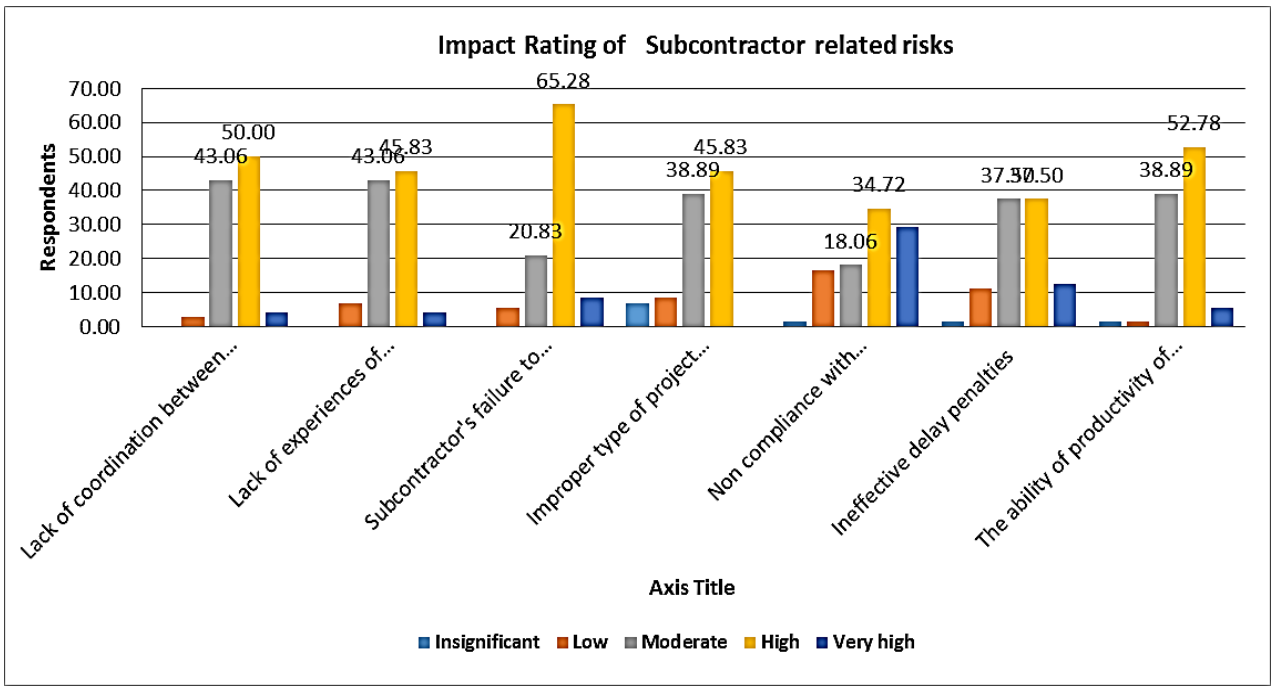


Fig. 11: Impact Rating of Reasons of Risks by the Subcontractors

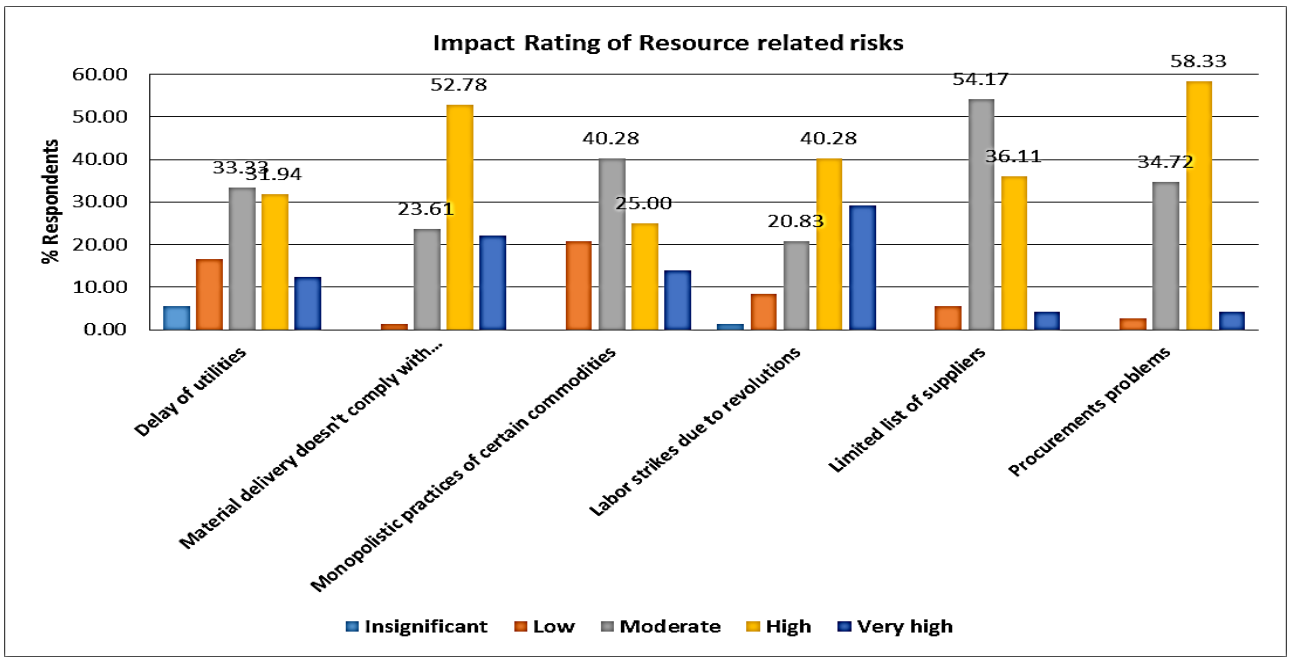


Fig. 12: Impact Rating of Reasons of Risks related to Resources.

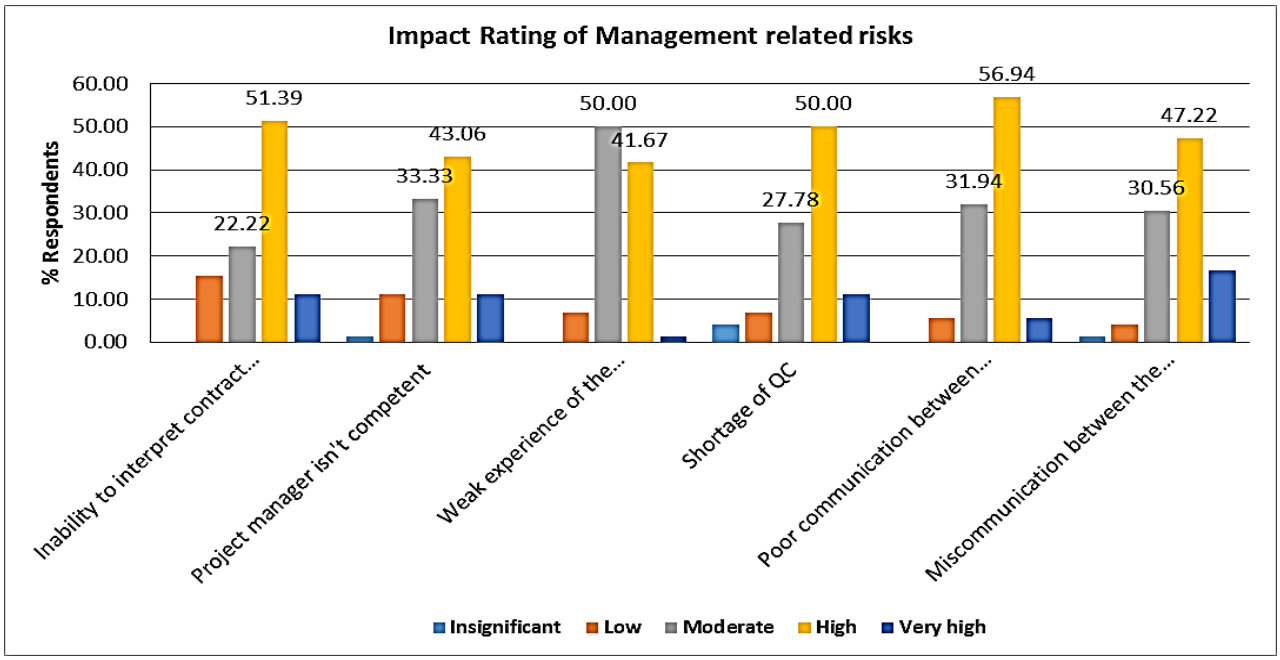


Fig. 13: Impact Rating of Reasons of Risks related to Management.

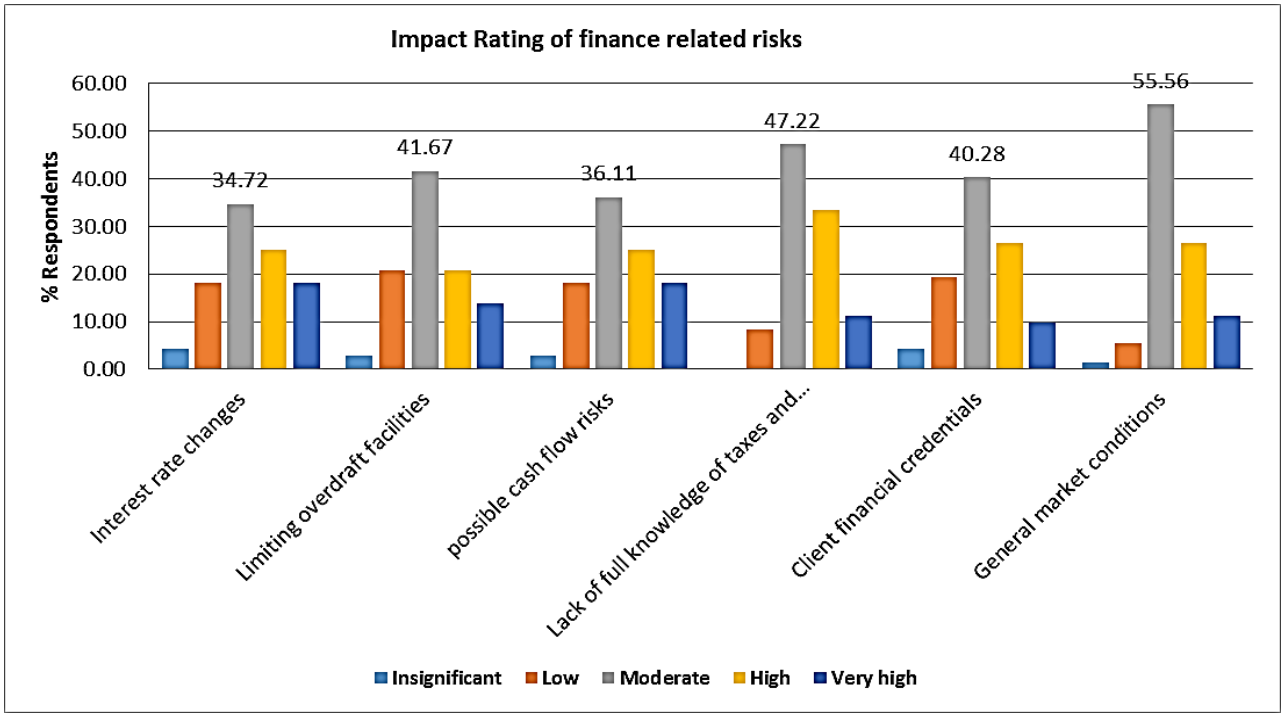


Fig. 14: Impact Rating of Reasons of Risks related to Finance.

Statistical Analysis of the Survey

For statistical analysis, both qualitative and quantitative data analysis techniques were applied. The following statistical tools will be used bythe author in her statistical analysis of all the data that has been gathered, which will be done using IBM's SPSS Ver.25 software (Statistical Package for the Social Sciences): Questionnaire reliability; Questionnaire structural validity; Factor ranking and Research-Based Validity ofSurvey.

Reliability of the Questionnaire:

The internal consistency of the factors that have been constructed is measured by reliability. Utilizing the Cronbach's Alpha Coefficient test within the SPSS software, a reliability analysis was performed in order to strengthen the validity of the study hypotheses. Any factor with a corrected item-total correlation value of less than 0.3 would be deemed rejected; Cronbach's alpha for adequate reliability is 0.8, Kien (2012).The research showed that the Cronbach's alpha value for all factors was (0.956), which was more than 0.8. Thus, it may be concluded that the survey was valid and reliable.

Structure Validity of Questionnaire:

The validity of the questionnaire structure, wherein the coefficient of correlation is generated between the primary fields and all questionnaire fields, will be tested using the Pearson correlation coefficient through the usage of the (SPSS) program. According to the data,there is a substantial correlation (Pearson correlation coefficient $r > 0.5$) and all relationships between the factors are positive. They are also statistically significant at $\alpha = 0.01$.

Rank the Factors:

The Relative Importance Index, Frequency Index, and Frequency Adjusted importance index were computed by assessing the riskdistribution's properties according to their probability and importance.

Relative Importance Index (RII):

The current risk allocation features were ranked for the whole questionnaire as well as for each category, according to the importance levelvalues provided by each participant. Equation 4 was used to calculate the RII value.

$$\mathbf{RII}=\Sigma(\boldsymbol{N}) \quad \textbf{Eq. 4}.$$

Where; W = weight given to each attribute by the respondent (1 to 5),A = the highest weight (in this case is 5),

- N = total number of respondents. The value of the RII varies between 0 and 1, while a higher value means that the attribute is more importantthan the other factors.

Frequency Index (FI):

The value of the frequency index (FI) will be determined, and the existing risk allocation attributes will be ranked based on their frequency scale values by responses from all respondents.

$$\mathbf{FI}\%=\Sigma(\boldsymbol{N})\ \boldsymbol{X}\ \mathbf{100} \quad \textbf{Eq. 5}.$$

And the frequency adjusted Importance/ significance index will be calculated as follows, based on both the FI percent and the RII equations:

$$\mathbf{FAII}=\mathbf{RII}*\mathbf{FI}\% \quad \textbf{Eq.6.}$$

Frequency Adjusted Importance Index (FAII):

To rank the risk and determine the important factors, FAII was carried out. Following the calculation of FAII for risk factors ranked fromgreatest to smallest index, the lowest RII = 23.95 and the highest FAII = 49.04. As a general guidance for factor classification, Difference (D) can be computed as follows: D = 49.04-23.95 = 5 02. Conversely, all levels are thought to have equal intervals, which equal D/5 = 0.06 4.8. After FAII is computed using previously established values to reflect the most significant risk variables affecting the building projects, Table 7 displayed the significant risk factors.

Table.7: Ranked FAII Values for Risk Factors

Rank	Factor	FAII	ID	Importance
1	Material delivery doesn't comply with a schedule	49.04	X51	Very High
2	False progress reports	47.26	X35	
3	Subcontractor's failure to comply with the schedule	47.05	X45	

4	Procurement's problems	45.89	X55	
5	Unclear responsibility matrix	44.25	X6	
6	The ability of productivity of subcontractors	43.97	X49	High
7	Indecisive management	43.17	X15	
8	Change scope of work (leads to change contract price)	42.97	X5	
9	Lack of coordination between subcontractors	42.86	X43	
10	Lack of procedure to correct errors	42.75	X16	

Comparison of Top-Ranked Risks between the Contractors and the Owners:

The comparison of the TOP 10 significant risk factors that affect the groups of contractors and owners separately is presented in Table 8, from which it can be inferred that both parties believe there is a problem with the way risk is currently allocated; their concerns are about the same risks, albeit to varying degrees.

Table.8: Comparison of Top 20 Ranked Risks between the Contractors and the Owners

FAII Rank		Contractors		Owners
1	X51	Material delivery doesn't comply with project schedule	X51	Material delivery doesn't comply with schedule
2	X9	Strong competitors	X35	False progress reports
3	X45	Subcontractor's failure to comply the schedule	X55	Procurement's problems
4	X5	Change scope of work (leads to change contract price)	X45	Subcontractor's failure to comply the schedule
5	X55	Procurement's problems	X28	Defective Materials
6	X35	False progress reports	X43	Lack of coordination between subcontractors
7	X49	The ability of productivity of subcontractors	X15	Indecisive management
8	X69	Late issuance of licenses	X6	Unclear responsibility matrix
9	X6	Unclear responsibility matrix	X11	Unreasonable expectations of the client
10	X16	Lack of procedure to correct errors: owner and contractor	X49	The ability of productivity of subcontractors
11	X70	Delay due to statutory bodies	X31	Compliance risks (H&SE)
12	X2	Insufficient technical specifications	X10	Insufficient site investigation
13	X15	Indecisive management	X2	Insufficient technical specifications
14	X7	Insufficient FEED documents	X60	Poor communication between project parties
15	X31	Compliance risks (H&SE)	X38	Lack of knowledge of existing facilities
16	X17	Frequent changes and/or variations by client	X69	Late issuance of licenses
17	X43	Lack of coordination between subcontractors	X1	Clarity of tender document
18	X67	General market conditions	X34	Design errors, omissions, contradiction in documents
19	X54	Limited list of suppliers	X7	Insufficient FEED documents
20	X44	Lack of experiences of subcontractors	X36	Unfavorable weather conditions

Pearson Correlation of Significant Factors:

The analysis identified twenty-one Significant variables, and the author will take into consideration that the risk variables affecting building projects are those categorized as extremely high and high. Table 9 shows which components have a strong relationship to other elements that affect the construction project. These factors were used to calculate Pearson

correlation coefficient values to configure the correlation between these factors. The following is demonstrated by the correlation analysis results:

- The risk variables "Subcontractor's failure to comply with the schedule," "Procurement's problems and the ability/ productivity ofsubcontractors" are highly correlated with "Material delivery doesn't comply with the project."
- There is a significant link between the risk factors "False progress reports" and "Regular changes and/or variations by client."
- The risk factors "The ability of productivity of subcontractors" and "Frequent changes and/or client's variations" are highly correlated withthe risk factor "Subcontractor's failure to comply with the schedule."
- There is a significant association between the risk factors "Defective materials" and "Procurement's problems."
- There is a substantial association between the risk factors "Change scope of work (leads to change contract price)" and "Insufficient siteinvestigation" and the risk element "Unclear responsibility matrix."
- The risk factor "Indecisive management" exhibits a high link with the risk factor "Lack of procedure to correct errors."
- There is a significant relationship between risk and the risk factor "Insufficient site investigation."

Table 9: Pearson Correlation Value of the Significant 21 Factors (Very high/ highly significant)

ID	Attributes		Pearson Correlation	P-Value (Sig.)
X51	Material delivery doesn't comply with project schedule	Impact	.711**	0.000
		Probability	.699**	0.000
X35	False progress reports	Impact	.726**	0.000
		Probability	.487**	0.000
X45	Subcontractor's failure to comply the schedule	Impact	.633**	0.000
		Probability	.698**	0.000
X55	Procurement's problems	Impact	.382**	0.001
		Probability	.600**	0.000
X6	Unclear responsibility matrix	Impact	.642**	0.000
		Probability	.603**	0.000
X49	The ability of productivity of subcontractors	Impact	.547**	0.000
		Probability	.530**	0.000
X15	Indecisive management	Impact	.577**	0.000
		Probability	.499**	0.000
X5	Change scope of work (leads to change contract price)	Impact	.632**	0.000
		Probability	.594**	0.000
X43	Lack of coordination between subcontractors	Impact	.517**	0.000
		Probability	.663**	0.000
X16	Lack of procedure to correct errors between owner and contractor	Impact Probability	.615** .492**	0.000 0.000
X2	Insufficient technical specifications	Impact	.607**	0.000
		Probability	.513**	0.000

X31	Compliance risks (H&SE)	Impact	.662**	0.000
		Probability	.380**	0.000
X69	Late issuance of licenses	Impact	.766**	0.000
		Probability	.792**	0.000
X28	Defective Materials	Impact	.564**	0.000
		Probability	.627**	0.000
X17	Frequent changes and/or variations by client	Impact	.545**	0.000
		Probability	.566**	0.000
X70	Delay due to statutory bodies	Impact	.868**	0.000
		Probability	.867**	0.000
X38	Lack of knowledge of existing facilities	Impact	.399**	0.001
		Probability	.598**	0.000
X7	Insufficient FEED documents	Impact	.392**	0.001
		Probability	.753**	0.000
X10	Insufficient site investigation	Impact	.318**	0.006
		Probability	.616**	0.000
X9	Strong competitors	Impact	.439**	0.000
		Probability	.447**	0.000
X34	Design errors, omissions and contradiction in documents	Impact	.312**	0.008
		Probability	.534**	0.000

Risk Control Strategy:

This research concludes with a comparison of the owners' and contractors' suggested answers to the response plan for the 21 most significant (very high and high) risk factors influencing project performance. Based on the survey data results, the methods by which each project partner has addressed each possible risk are examined and analysed. Table 10 indicates that the two primary stakeholders in the building project view risk mitigation essentially from the same point of view.

Table 10: Risk Control Strategy of the most Significant Factors from the perspective of Contractors/ Owners

Risk Factor	ID	Control risk Strategy	
		Contractor	Owner
Material delivery doesn't comply with the project schedule	X51	Mitigate	Mitigate
False progress reports	X35	Avoid	Avoid
Subcontractor's failure to comply with the schedule	X45	Mitigate	Mitigate
Procurement’s problems	X55	Mitigate	Mitigate
Unclear responsibility matrix	X6	Avoid	Avoid
The ability of productivity of subcontractors	X49	Mitigate	Mitigate
Indecisive management	X15	Mitigate	Mitigate
Change scope of work (leads to change contract price)	X5	Mitigate	Mitigate
Lack of coordination between subcontractors	X43	Mitigate	Mitigate
Lack of procedure to correct errors	X16	Mitigate	Mitigate
Insufficient technical specifications	X2	Avoid	Avoid
Compliance risks (H&SE)	X31	Mitigate	Mitigate
Late issuance of licenses	X69	Share	Share
Defective materials	X28	Mitigate	Mitigate
Frequent changes and/or variations by the client	X17	Share	Mitigate

Delay due to statutory bodies	X70	Share	Share
Lack of knowledge of existing facilities	X38	Share	Share
Insufficient FEED documents	X7	Mitigate	Avoid
Insufficient site investigation	X10	Mitigate	Avoid
Strong competitors	X9	Share	Share
Design errors, omissions, and contradiction	X34	Mitigate	Mitigate

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-taile).

Significant Risk Factors and Related Contract Clause/Sub-Clause:

Several Sub-clauses listed in the FIDIC form 2017 Yellow Book should be included in each balanced contract that is drafted. Suggestions for FIDIC forms are frequently made with the intention of improving the contract's risk balance. In light of this, the writers will examine a few driving selective sub-clauses using the data from the earlier research. This paragraph offers a list of driving selective sub-clauses that the two contracting parties can change based on semi-structured interviews with several project management experts (the second round of conducted survey) in order to attain risk-related sub-clauses. Any modifications will be assessed in light of the FIDIC yellow book and the numerical sequence of pertinent sub-clauses. The significant risk variables and their corresponding modified. Tables 11, 12 show the important risk factors and the corresponding modified contract clauses. Moreover, table.13 Showed Spearman's Rank Correlation Factor for RII vs FAII Rankings for all Risk Factors within their Groups**.** Table 14 also showed Person Correlation of Significant Factors in 2-dimensional matrix.

Table.11: Significant Risk Factors and the Corresponding Contract Clauses in FIDIC 2017, the Yellow Book.

ID	Risk Factor	Clause/Sub-Clause
X51	Material delivery doesn't comply with project schedule	Sub-Clause 8.3, Sub-Clause 8.8
X35	False progress reports	Sub-Clause 8.7
X45	Subcontractor's failure to comply the schedule	Sub-Clause 8.3, Sub-Clause 6.9
X55	Procurement problems	Sub-Clause 8.8, Sub-Clause 7.7
X6	Unclear responsibility matrix	Sub-Clause 4.1, Sub-Clause 1.15
X49	The ability of productivity of subcontractors	Sub-Clause 8.3, Sub-Clause 6.9
X15	Indecisive management	Sub-Clause 8.3
X5	Change scope of work	Sub-Clause 14.1
X43	Lack of coordination between subcontractors	Sub-Clause4.4, Sub-Clause 4.5
X16	Lack of procedure to correct errors between owner and contractor	Sub-Clause 11.1, Sub-Clause 11.4
X2	Insufficient Technical Specifications	Sub-Clause 4.1
X31	Compliance Risk (HSE)	Sub-Clause 4.8
X69	Late issuance of licenses	Sub-Clause 1.13, Sub-Clause 2.2
X28	Defective Materials	Sub-Clause 11.5, Sub-Clause 11.9
X17	Frequent changes and/or variations by client.	Sub-Clause 4.1
X70	Delay due to statutory bodies	Sub-Clause 2.2, Sub-Clause 8.6
X38	Lack of knowledge of existing facilities	Sub-Clause 4.1, Sub-Clause 4.6
X7	Insufficient FEED documents	Sub-Clause 4.1
X10	Insufficient site investigation	Sub-Clause 4.1, Sub-Clause 4.6

X9	Strong competitors	NA
X34	Design errors, omissions and contradiction in documents	Sub-Clause 5.1, Sub-Clause 5.3, Sub-clause 5.4
X31	Compliance risks (H&SE)	Sub-Clause 1.15 Limitation of Liability

Table 12: Important Risk Factors and Corresponding Modified Clauses as suggestions for FIDIC 2017(the Yellow Book).

No.	Clause/Sub-Clause	Risk Factor
1	Standard Sub-Clause 1.13: Compliance with Laws	• Late issuance of licenses • Delay due to statutory bodies
2	Standard Sub-Clause 1.15: Limitation of Liability	• Unclear responsibility matrix
3	Standard Sub-Clause 4.1: Contractor's General Obligations	• Unclear responsibility matrix • Insufficient site investigation • Insufficient FEED documents • Insufficient technical specifications
4	Sub-Clause4.4: Subcontractors	• Lack of coordination between subcontractors
5	Standard Sub-Clauses 5.1: General Design Obligations	• Design errors, and contradiction in documents
6	Sub-Clause 8.3: Programme	• Indecisive management • Subcontractor's failure to comply the schedule • Material delivery doesn't comply with the program
7	Standard Sub-Clause 8.7: Rate of Progress	• False progress reports
8	Standard Sub-Clause 8.8: Delay Damage	• Material delivery doesn't comply with the program Procurement problems
9	Standard Sub-Clause 11.3	• Lack of procedure to correct errors between the employer and the Contractor
10	Extension of Defects Notification Period Standard Sub-Clause 11.4: Failure to Remedy Defects	• Defective Materials
11	Standard Sub-Clause 11.10: Unfulfilled Obligations	• Lack of procedure to correct errors between owner and contractor Defective Materials
12	Standard Sub-Clause 14.1: The Contract Price	• Change scope of work
13	Standard Sub-Clause 1.13: Compliance with Laws	• Late issuance of licenses • Delay due to statutory bodies
14	Standard Sub-Clause 1.15: Limitation of Liability	• Unclear responsibility matrix
15	Standard Sub-Clause 4.1: Contractor's General Obligations	• Unclear responsibility matrix • Insufficient site investigation • Insufficient FEED documents • Insufficient technical specifications
16	Sub-Clause4.4: Subcontractors	• Lack of coordination between subcontractors
17	Standard Sub-Clauses 5.1: General Design Obligations	• Design errors, and contradiction in documents
18	Sub-Clause 8.3: Programme	• Indecisive management • Subcontractor's failure to comply the schedule
19	Standard Sub-Clause 8.7: Rate of Progress	• Material delivery doesn't comply with the program False progress reports

20	Standard Sub-Clause 8.8: Delay Damage	• Material delivery doesn't comply with the program Procurement problems
21	Standard Sub-Clause 11.3 Extension of Defects Notification Period	• Lack of procedure to correct errors between the employer and the Contractor
22	Standard Sub-Clause 11.4: Failure to Remedy Defects	• Defective Materials
23	Standard Sub-Clause 11.10: Unfulfilled Obligations	• Lack of procedure to correct errors between owner and contractor Defective Materials
24	Standard Sub-Clause 14.1: The Contract Price	• Change scope of work

Table.13: Spearman's Rank Correlation Factor for RII vs FAII Rankings for all Risk Factors within their Groups.

ID	Factors	RII	Rank	Rank / Group	FI	Rank	Rank by Group	FAII	FAII Rank	FAII Rank / Group
Risks during Tender										
X1	Clarity of tender document	0.71 0.74	21 8 28	2 1	55.00 58.06	26 16	7 4	38.81 42.74	22 11	7 3
X2	Insufficient technical specifications	0.70 0.71	21 52	6 2	53.33 52.22	33 37	9 10	37.19 36.85	28 31	
X3	Concerns around skills of project team	0.65 0.68	37 21	9 7	66.11 65.56	3 4	2 3	42.97 44.25	8 5	8 9
X4	Poor design and documentation	0.71 0.66	49 67	2 8	57.22 55.00	18 26	5 7	40.37 36.06	18 32	
X5	Change scope of work	0.57 0.57	67 24	10 10	70.00 70.00	1 1	1 1	39.67 39.67	20 20	2 1
X6	Unclear responsibility matrix	0.70		5	56.67	19	6	39.82	19	
X7	Insufficient FEED documents									4 10
X8	Conflicting objectives of project parties									
X9	Strong competitors									6
X9	Strong competitors									6
X10	Insufficient site investigation									5
Risks Related to the Owner										
X11	Unreasonable expectations of the client	0.65 0.64 0.70	54 57 24	7 8 2	58.61 55.00 50.83	15 26 42	4 6 9	37.93 35.14 35.72	26 36 33	4
X12	Perceived risks of (statutory bodies)	0.63 0.72	59 14	9 1	51.39 60.00	39 12	8 3	32.55 43.17	45 7 10	6 5
X13	Concerns around the financial viability of clients	0.68 0.67 0.50	37 41 70	3 4 11	63.33 61.67 56.39	5 9 21	1 2 5	42.75 41.45 28.19	15 65 52	
X14	Negative cash flow	0.66	47	5	48.33	48	10 7	31.82	39	8
X15	Indecisive management	0.65 0.59	52 64	6 10	51.67 48.33	38 48	10	33.58 28.73	64	1

X16	Lack of procedure to (owner / contractor)									2
X17	Frequent changes/ variations by client									3 11
X18	Change execution methods from clients									
X19	Allocation of liability									9
X20	Document approval cycle									7
X21	Conflict management									10
Risks related to the Engineer										
X22	Non flexibility of Engineer	0.63 0.61	61 63	2 4	35.57 28.86	34 63	1 4	35.57 28.86	34 63	1
X23	Concerns around engineer's experience	0.61 0.65 0.58	62 51 66	3 1 5 6	29.33 29.19 24.95	59 61 69	2 3 5 6	29.33 29.19 24.95	59 61 69 70	4
X24	Concerns around availability of engineer	0.52	69		23.95	70		23.95		2
X25	Unclear testing plan									3
X26	Engineer's satisfaction clauses									5
X27	Perceived risks that may arise as a result of dealing with a particular engineer									6
Risks related to the project										
X28	Defective materials	0.63	59	13	60.00	12	2	41.83	14	3
X29	New constructive methods / unfamiliar	0.66 0.71 0.81	46 20 1	11 5 1	52.50 48.33 59.44	36 48 14	7 10 3	33.25 31.95 42.11	42 50 12	7 9
X30	Availability of key inputs such as labor, materials, or equipment	0.71 0.73 0.68 0.67	17 9 34 41	4 2 8 9	35.83 39.17 53.61 69.44	68 67 32 2	15 14 6 1	28.87 27.96 39.17 47.26	62 66 21 2	
X31	Compliance risks (H&SE)	0.68 0.73	33 12	7 3	51.39 47.78	39 53	8 11 4	34.54 32.65	38 44	2
X32	Force majeure	0.66	49	12	56.11	22	11 5	40.68	17	14
X33	Using an unstudied design and methods for the first time	0.57 0.66 0.59	67 44 65	15 10 14	47.78 55.00 44.17	53 26 64	13 9	31.32 31.17 29.32	54 55 60	15
X34	Design errors, omissions and contradiction in documents	0.70	28	6	49.72	45		29.42	58	5 1 6 8
X35	False progress reports									
X36	Unfavorable weather conditions									
X37	Suspension issues									

X38	Lack of knowledge of existing facilities									4
X39	Buildability issues such as complex site									10
X40	Restricted working hour									11
X41	Noncompliance: specs and test results									13
X42	Social and cultural condition									12
Risks Related to subcontractors										
X43	Lack of coordination for subcontractors	0.71 0.69	19 31 5	4 6	0.71 0.69	19 31 5	4 6	42.86 38.39	9 24 3	3 4
X44	Lack of experiences of subcontractors	0.75 0.65	54 6	1 7	0.75 0.65	54 6	1 7	47.05 32.54	46 68	
X45	Subcontractor's failure to comply schedule	0.75		2	0.75		2	25.74 30.79 43.97		1 5
X46	Improper type of project bidding									
X47	Noncompliance with professional ethics									7
X48	Ineffective delay penalties	0.70 0.72	28 14	5 3	0.70 0.72	28 14	5 3		56 6	6
Risks Related Resources										
X50	Delay of utilities	0.66	47 2	6	46.11	59 8	5	30.36	57 1	5
X51	Material delivery doesn't comply with schedule	0.79 0.66 0.78	44 3 36 11	1 5 2	61.94 48.06 34.72	52 69 30	2 4 6	49.04 31.90 26.91	51 67 30	1
X52	Monopolistic practices of certain commodities	0.68 0.73		4 3	54.72 63.06	6	3 1	37.09 45.89	4	4
X53	Labor strikes due to revolutions									6
X54	Limited list of suppliers									3
X55	Procurement's problems									2
Risks related to Management										
X56	Inability to interpret contract documents	0.72 0.70	16 24	3 5	44.72 45.00	62 61	6 5	32.05 31.63	48 53	5
X57	Project manager isn't competent	0.68	37[32]	6	51.39	39	2	34.69	37	6 3
X58	Weak experience of the supervisor's level									
X59	Shortage of QC	0.71	17	4	46.39	58	4	33.12	43	4
X60	Poor communication between parties	0.73 0.75	12 6	2 1	53.06 49.72	34 45	1 3	38.47 37.15	23 29	1
X61	Miscommunication: client & the contractor									2

Risks related to Finance and Commercial											
X62	Interest rate changes	52.78 49.72	35 45	3 5	35.33 32.04	35 49	3 6	35.33 32.04	35 49		3 6
X63	Limiting overdraft facilities	55.28 48.33	24 48	2 6	37.31 33.56	27 41	2 4	37.31 33.56	27 41		
X64	possible cash flow risks	50.83 56.11	42 22	4 1	32.34 38.19	47 25	5 1	32.34 38.19	47 25		2 4
X65	Lack of full knowledge of taxes/duties										
X66	Client financial credentials										5
X67	General market conditions										1
Legislations Risks											
X68	Change in legislations/lows	0.70 0.73	24 9	3 2	47.78 57.50	53 17	3 1	33.58 42.01	40 13		3
X69	Late issuance of licenses	0.76	4	1	54.17	31	2	41.08	16		1
X70	Delay due to statutory bodies										2
Spearman's correlation (SPSS)		Correlation Coefficient (FI &FAII) Sig. (2-tailed) Correlation Coefficient (RII &FAII) Sig. (2-tailed)					0.887** 0.000 0.448** 0.000				

Table.14: Person Correlation of Significant Factors

Risk ID	X51	X35	X45	X55	X6	X49	X15	X5	X43	X16	X2	X69	X28	X17	X70	X38	X7	X10	X34
X51	**1**																		
X35	0.38	**1**																	
X45	0.53	0.40	**1**																
X55	0.50	0.35		**1**															
X6	0.43	0.37			**1**														
X49	0.53		0.81			**1**													
X15	0.31						**1**			0.61									
X5	0.45	0.35		0.33	0.71	0.32	0.31	**1**											
X43	0.57	0.41	0.41	0.47		0.41	0.40	0.30	**1**										
X16	0.37			0.30			0.35	0.30		**1**									
X2		0.33		0.35						0.31	**1**								
X69		0.33					0.34		0.40			**1**							
X28	0.34	0.38	0.38	0.60	0.43	0.39		0.34	0.35				**1**						
X17	0.49	0.50	0.51	0.39	0.31	0.38			0.38	0.38			0.31	**1**					
X70	0.39	0.31	0.36				0.39	0.30	0.35					0.44	**1**				
X38		0.37							0.41							**1**			
X7		0.42	0.34		0.45			0.41	0.32	0.33				0.36	0.48		**1**		
X10	0.41	0.47			0.57			0.45					0.31	0.38			0.47	**1**	
X34	0.32	0.17	0.22	0.23	0.47	0.25	0.24	0.34	0.24	0.10	0.10	0.22	0.27	0.12	0.08	0.18	0.37	0.58	**1**

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

*. Correlation is significant at the 0.05 level (2-tailed).

Standard Sub-Clause 1.13: Compliance with Laws:

In multi-partner projects, governments and regulatory bodies are the secondary partners; they have complex contractual relationships with one another both directly and indirectly. Their goals and approaches are varied, and they are involved in the project at different phases and

stages. They also each have a different perspective on risks. The complexity of contracts and the competitive attitudes of the different project participants may hinder the best risk allocation. In traditional contracts, this risk is usually assumed by the owner. This clause in the contract must be carefully read to guarantee that both parties will support one another in acquiring licenses and permits. The FIDIC 2017 Yellow Book is proactive in maintaining a fair and impartial risk allocation strategy. As a result, there are now more rights and obligations that is reciprocal. This is made abundantly evident by Sub-clause 1.13, which mandates that the Employer and the Contractor abide by all relevant laws. (Sub-Clause 1.13(c)) The Contractor is now also obligated to assist the Employer in obtaining permits and other approvals. To do this, the author suggest to add the following sentence after (Sub-Clause 1.13(d))

- Suggested Modification: The Contractor shall submit, in good time, the details of Goods to the Employer, who shall then promptly obtain all import permits or licences required for these Goods. The Employer shall also obtain or grant all consents including permits-to-work, rights-of-way, and approvals required for the Works.

The modification makes it clear that the contractor must notify the employer of any procurements they will make as soon as possible so that the employer can help the contractor obtain the required licenses and authorization from the relevant authorities.

Standard Sub-Clause 1.15: Limitation of Liability:

The 1999 FIDIC Yellow Book's Sub-clause 17.6 on limitation of liability has been modified to Sub-clause 1.15 to emphasize the significance of this provision while also making it clear that it covers a wider range of situations and is not just restricted to indemnities or payments made after termination. In FIDIC 2017, the exclusion of liability for loss of profit and indirect and consequential harm was modified to include delay damages, variations, claims under intellectual and industrial property rights, and indemnities by the contractor or the employer. The author suggests that the following to include in the carve-outs from the exclusion from Limitation of Liability:

- Sub-Clause 1.7 (Assignment);
- Sub-Clause 1.12 (Confidentiality);
- Sub-Clause 1.13 (Compliance with Law);
- Sub-Clause 4.18 (Protection of the Environment); and
- Sub-Clauses 6.7 (Health and Safety).

These carve-outs were added because:

- If the Contractor fails to perform any obligation under the Contract and if the Company terminates the work because this failure, whereas, the company may engage third parties to complete the Work and for this purpose so the Contractor shall: assignment to the Company of all Sub-Contracts for Contractor Provided Items to be delivered as the Company may request.
- Because of the nature of industrial projects, especially petrochemical, oil and gas projects, the Contractor shall treat all documents forming the Contract as confidential, and the Employer and the Engineer shall treat all information provided by the Contractor and marked “confidential”, as confidential.

- The Contractor shall in relation to all persons affected or likely to be affected by the performance of the Work take such steps as are reasonably practicable to ensure their health, safety and security. The Contractor shall take adequate and effective precautions in order to protect the Work, the Contractor's Personnel, the general public, all other persons, the environment, the property of the Company and the property of third parties and to avoid or reduce to a minimum any inconvenience to the public.

Standard Sub-Clause 4.1: Contractor's General Obligations:

The main reason for the modifications is to make the term "fit for purpose" clearer. This is because there are risks associated with the contractor's design, implementation strategies, and supply of materials that meet project specifications. As a result, the purpose of the modification needs to be made clear in the Employer's Requirements rather than anywhere in the Contract. The addendum includes affirmation that the design is the contractor's responsibility, that it conforms to the criteria and guidelines that have been accepted, and that it is free from flaws that are inherent. The modification also covers the contractor's adherence to environmental, occupational health, and safety regulations and safeguards the employer against any hazards related to the project's operational designs. The modification also serves to protect the employer from any mistakes or unclear design elements that could compromise the project's outcome. An additional issue with this subsection is that, in the absence of a set period for document approval, the employer's delay could impact the schedule for material supply. The author suggests that the modifications will be written in Italic as follow:

1. The Contractor shall execute and complete the Works in accordance with the requirements of Contract and with all due skill, care, and safety measures as should be exercised by a fully qualified, competent and first-class Contractor, fully skilled and experienced in the design and carrying out of work similar in nature and extent to the Work. When completed, the Works (or Section or Part or major item of Plant, if any) shall be fit for the purpose(s) for which they are intended, as defined and described in the Employer's Requirements and the standards set out in the Contract (or, where no purpose(s) are so defined and described, fit for their ordinary purpose(s)).
2. The Contractor shall at its own cost provide
   - the Plant all Contractor Provided Items and Equipment (and spare parts, if any)
   - the Contractor's Documents specified in the Employer's Requirements,
   - All Contractor's Personnel, Goods, consumables and other things and services, whether of a temporary or permanent nature, required to fulfil the Contractor's obligations under the Contract.
3. The Works shall include any work which is necessary to satisfy the Employer's Requirements, Contractor's Proposal and Schedules, or is implied by the Contract, and all works which (although not mentioned in the Contract) are necessary for stability or for the completion, or safe and proper operation, of the Works.
4. The Contractor shall be responsible for:
   - the adequacy; stability and safety of all the Contractor's operations and activities, of all methods of construction and of all the Works;
   - the engagement and management of Sub-Contractors in connection with the Work;
   - the timely provision of all items referred to in the Contract including the timely

ordering and delivery of all Contractor Provided Items and Equipment to be provided by the Contractor in order to ensure that commencement, performance and completion of the Work is in accordance with the Programme;
- obeying all local rules and regulations in importing and exporting Contractor items and shall indemnify, defend and hold the Company harmless against any claims suffered through the Contractor's breach of these requirements;

5. The Contractor shall be ensuring that all Contractor Provided Items and Equipment supplied by or on behalf of the Contractor for incorporation in the Facilities shall, unless specifically stated in the Contract to the contrary, be new and suitable for the purpose for which they are specified;
6. The Contractor shall, whenever required by the Engineer,
   - Submit details of the arrangements and methods which the Contractor proposes to adopt for the execution of the Works.
   - Give all notices and comply with all other obligations under the Contract promptly and with due diligence, no significant alterationto these arrangements and methods shall be made without this alteration having been submitted to the Engineer.

The aforementioned amendments also contain details of the arrangements and methods of implementation that the Contractor proposes to adopt to carry out the works, since it is necessary to discover and notify the Engineer and the Employer of any error, omission or error before carrying out the corresponding construction works that would significantly reduce the risks associated with the feasibility of the project. Contract document must include human resource schedule; plant and equipment schedule; quality assurance plan, and work schedule.

Standard Sub-Clause 4.4: Subcontractors:

To mitigate the risks resulting from the lack of coordination between subcontractors, the author suggests adding paragraph © after (Sub-clause 4.4 (b)). The modification will be written in Italic words as follows:

The Contractor shall not subcontract or assign or otherwise transfer:

a. works with a total accumulated value greater than the percentage of the Accepted Contract Amount stated in the Contract Data (if not stated, the whole of the Works); or
b. Any part of the Works for which subcontracting is not permitted as stated in the Contract Data.
c. The whole of the Work, except that the Contractor shall assign all or any Sub-Contracts to the Employer upon receipt of the Engineer’s direction in writing to do so.

The Contractor shall ensure that every Sub-Contract shall:

- provide that the Contractor may from time to time assign or otherwise transfer the Sub-Contract to the Employer;
- contain a confidentiality undertaking imposing on any Sub-Contractor obligations similar to that undertaken by the Contractor;
- contain restrictions on and provisions relating to Sub-Contracting to the same effect as in this contract;

- contain suspension and termination provisions consistent with those contained in this contract;
- contain defects correction provisions consistent with those contained in this contract;
- include terms and conditions which are consistent with the Contract; and
- Contains obligations to comply with the quality assurance, control procedures and requirements set out in this contract.
- Contain provisions which entitle the Employer to require the subcontract to be assigned to the Employer under sub-paragraph (a) ofSub-Clause 15.2.3 [After Termination]."

The sub-clause 4.4 had been modified in [©FIDIC 2017 Second Edition] and their writing has been expanded in order to mitigate the risks resulting from the lack of coordination between subcontractors, and their low productivity. The aforementioned amendments give the business owner the right to review the subcontracts, while preserving the contractor's right to withhold prices. The amendments also emphasize that the contractor may pay all subcontractors dues in order to maintain the rate of progress of the works. Where the main reason for the adjustment is that the success or failure of creating effective contracts that are just and equitable in the most efficient and productive manner is directly related to the profitability of general contractors and subcontractors. As the majority of project implementation work is carried out by subcontractors, it is clear that careful evaluation of subcontracts is essential to the success of the project. If only one of the subcontractor links fails, and a dispute arises, causing project delay or a cost claim or both, this sub contractual dispute will not only affect the principal parties to the subcontract, but the primary contract parties may be affected, and may be down Project due to delays and cost overruns.

Standard Sub-Clauses 5.1: General Design Obligations:

One of the biggest hazards influencing industrial projects is design risk. Design risks can come from a variety of sources, such as an inexperienced design team or an inappropriate design, and they can cause delays in the procurement process and the availability of materials. The Yellow Book states that if "an experienced contractor exercising due care" could not have found the error, fault, or defect before to submitting their tender, then contractors are not accountable for any error, fault, or other defect found in the employers' specifications. In contrast, the contractor-who is also the project's weakest participant-usually bears the brunt of complex design. Sub-clause 5.1 states that the Works shall be suitable for their intended uses upon completion; hence, if the Contractor takes on the responsibility for the design or for partsof the design, he should be careful in dealing with this Sub-Clause. The modification will be written in red and Italic words as follow:

The Contractor shall at its own cost carry out, and be responsible for, the design of the Works, so that the Work complies with the requirements of the standards, codes of practice, and all other requirements of the Contract provided. Design shall be prepared by designers who:

a. are engineers or other professionals, qualified, experienced and competent in the disciplines of the design for which they areresponsible;
b. comply with the criteria (if any) stated in the Employer's Requirements; and
c. Are qualified and entitled under applicable Laws to design the Works, and
   - Unless otherwise specified in the Employer's Requirements, the Contractor must

provide the name, address, full details, and pertinent expertise of each prospective designer or design subcontractor to the Engineer for approval.

- The Contractor warrants that the Contractor, the Contractor's designers and design Subcontractors are adequately financed, competent, qualified and fully experienced in the design, procurement, fabrication, construction, testing, pre-commissioning and commissioning of projects of a similar scope, complexity, size and technical sophistication as the Work and that it possesses the high level of skill and expertise commensurate with that experience.
- The Contractor covenants that the Work shall be free from inherent or Latent Defects whether in design, engineering, workmanshipor materials and shall be free of errors and omissions in design and engineering.
- The Employer is relying upon the skill, judgement and expertise of the Contractor in the performance of the Work and the co- ordination and planning thereof including without limitation the preparation and execution of the Programme.
- The Contractor undertakes that the designers and design Subcontractors shall be available to attend discussions with the Engineer and/or the Employer at all reasonable times (on or off the Site), until the issue of the Performance Certificate.
- Promptly after receiving a Notice under Sub-Clause 8.1 [Commencement of Works], the Contractor shall scrutinise the Employer's Requirements (including design criteria and calculations, if any). If the Contractor discovers any error, fault or other defect in the Employer's Requirements, Sub-Clause 1.9 [Errors in the Employer's Requirements] shall apply (unless it is an error in the items of reference specified in the Employer's Requirements, in which case Sub-Clause 4.7 [Setting Out] shall apply).

Regretfully, it frequently happens that the intended objectives are unclear or may never be determined. While most Contractors will find this unsettling, some Employers and consulting engineers are unable to fully benefit from Sub-clause 5.1. One of the most significant problems that both the employer and the contractor are likely to face at the same time is risk management. As a result, it's critical to take a proactive approach to reducing these risks by establishing stringent guidelines that require the contractor to exercise extreme caution when choosing the team responsible for design preparation, being aware of the project's primary goal and the nature of the work, and examining the underlying principles that will guide the creation of the designs. These terms could shield the contractor directly by establishing.

CONCLUSION

This study finds that a cooperative connection between the two parties to the contract can ensure more satisfied project results by keeping aneye out for key risk factors and putting risk mitigation measures into place through the provisions of the contract. The literature analysis andrecommendations from experts were used to identify the main risk factors for industrial projects. To ascertain the most important risk factors influencing the project objectives, a questionnaire was created and sent to a number of project management specialists. The findings demonstrated that there is an issue with how risks in large-scale industrial undertakings are divided up among different stakeholders. According to the study, risk during tender accounted for 29% of important risk variables. This suggests that these risks may be prevented bysuitably modifying the contract clauses to ensure that the risks are allocated in a

transparent manner. Although design flaws, faulty material, and compliance risks (H&SE) accounted for 25% of significant risk factors, these risks can be reduced by making the necessary changes to contract terms for procurement, design review, and quality control, which permit the sharing of these kinds of risks. The remaining risk factors were caused by subcontractor issues and indecisive management; these threats can be reduced by including provisions for the owner to monitor the project's implementation progress in order to develop solutions for any obstacles that arise on the fly. FIDIC forms undoubtedly offer a comprehensive starting point for the writing of industrial project contracts, but they also include a number of clauses that employers and contractors should carefully review for the significant consequences that may develop later. In summary, the parties should work to reach a compromise that meets their needs for both reasonable flexibility on the part of the employers and a balance of risks for the contractors. This will allow the contractors to adjust their compensation to the level of presumed risk, and the employers to modify their contractual obligations to reflect changes in project conditions over time. This equilibrium will most likely benefit the project asa whole, positively affecting both the parties' contractual relationship and the project's completion.

Data Availability Statement

All data, models, and code generated or used during the study appear in the submitted article.

References

Abdullah, M.S., Alaloul, W.S., Liew, M.S. and Mohammed, B.S., 2018. Delays and cost overruns cause during construction of palm oil refineryprojects. In MATEC Web of Conferences (Vol. 203, p. 02004). EDP Sciences.

Adam, A., Josephson, P.E. and Lindahl, G., 2015. Implications of cost overruns and time delays on major public construction projects. In Proceedings of the 19th International Symposium on Advancement of Construction Management and Real Estate (pp. 747-758). Springer, Berlin,Heidelberg.

ARCADIS, 2017, 2019, Construction disputes in the Middle East being resolved quicker than before.

Assaad, R., A. Elsayegh, G. Ali, M. Abdul Nabi, and I. H. El-adaway. 2020b. “Back-to-back relationship under standard subcontract agreements:Comparative study.” J. Leg. Aff. Dispute Resolut. Eng. Constr. 12 (3): 04520020. https://doi.org/10.1061/(ASCE)LA.1943-4170 .0000406.

Assaad, R., and I. H. El-adaway. 2020c. “Enhancing the knowledge of construction business failure: A social network analysis approach.” J. Constr.

Eng. Manage. 146 (6): 04020052. https://doi.org/10.1061/(ASCE)CO.1943-7862.0001831.

Bidua, A.K., 2018, November. Use of FIDIC 2017 as Standard Form of Contract for EPC Projects in Oil and Gas Industry. In Abu Dhabi International Petroleum Exhibition & Conference. Society of Petroleum Engineers.

Boateng, P., Chen, Z. and Ogunlana, S.O., 2015. An Analytical Network Process model for risks prioritization in megaprojects. International Journal of Project Management, 33(8), pp.1795-1811.

Chang, C.Y., 2014. Principal-agent model of risk allocation in construction contracts and its critique. Journal of Construction Engineering andManagement, 140(1), p.04013032.

Cummins, T., 2015. Strategic contracting as a source of organizational success. Journal of Strategic Contracting and Negotiation, 1(1), pp.7-14. Dastyar, B., Esfahani, A.F., Askarifard, M. and Abbasi, A.M., 2018. Identification,

Prioritization and Management of Construction Project Claims. Journal of Engineering, Project & Production Management, 8(2).

Eskander, R.F.A., 2018. Risk assessment influencing factors for Arabian construction projects using analytic hierarchy process. Alexandriaengineering journal, 57(4), pp.4207-4218.

Gamal El-Din Nassar. Claims, Disputes and Arbitration. According to FIDIC Conditions of Contract for Civil, Mechanical, Electrical, Construction,Design/Build & Turkey, EPC & Short Form. Published by FIDIC (From 1953 up to 1999)

Gandhi, M. and Dey, A., 2017. Avoiding an arbitration dispute. International Journal of Innovative Research in Advanced Engineering, (09).Haapio, H. and Siedel, G.J., 2017. A short guide to contract risk. Routledge.

Haidar, A., 2011. Global claims in construction. Springer Science & Business Media.

Hiyassat, M.A., Alkasagi, F., El-Mashaleh, M. and Sweis, G.J., 2020. Risk allocation in public construction projects: the case of Jordan. InternationalJournal of Construction Management, pp.1-11.

Hosseinian, S.M. and Carmichael, D.G., 2013. Optimal incentive contract with risk-neutral contractor. Journal of Construction Engineering andManagement, 139(8), pp.899-909.

Hui, S. and Bai-zhou, H., 2013, November. Revision of the construction project contract model text in China. In 2013 6th International Conference on Information Management, Innovation Management and Industrial Engineering (Vol. 2, pp. 595-599). IEEE.

IACCM 2014 International Association for Contract and Commercial Management. Commercial Excellence: Ten Pitfalls to Avoid in Contracting.www.iaccm.com

IACCM 2014 International Association for Contract and Commercial Management. Commercial Excellence: Ten Pitfalls to Avoid in Contracting.www.iaccm.com

Illankoon, I.M.C.S., Tam, V.W., Le, K.N. and Ranadewa, K.A.T.O., 2019. Causes of disputes, factors affecting dispute resolution and effectivealternative dispute resolution for Sri Lankan construction industry. International Journal of Construction Management, pp.1-11.

John E Miller, 2014. Managing contractual risk issues in commercial contracts. Contract Management, January 2014, pp.26-39Keane, P.J. and Caletka, A.F., 2015. Delay analysis in construction contracts. Wiley Blackwell.

Khalef, R., El-adaway, I.H., Assaad, R. and Kieta, N., 2021. Contract risk management: A comparative study of risk allocation in exculpatory clausesand their legal treatment. Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 13(1), p.04520036.

Khazaeni, G., Khanzadi, M. and Afshar, A., 2012. Fuzzy adaptive decision-making model for selection balanced risk allocation. International Journalof Project Management, 30(4), pp.511-522.

Komurlu, R. and Arditi, D., 2017. The role of general conditions relative to claims and disputes in building construction contracts. New Arch-International Journal of Contemporary Architecture, 4(2), pp.27-36.

Kumar, R.K. and Jegan, G.S., 2019. Risk Management of Contracts in Construction Projects. Risk Management, 6(04).

Li, Y., Wang, X. and Wang, Y., 2017. Using bargaining game theory for risk allocation of public-private partnership projects: Insights from different alternating offer sequences of participants. Journal of Construction Engineering and Management, 143(3), p.04016102.

Li, Y., Wang, X. and Wang, Y., 2017. Using bargaining game theory for risk allocation of public-private partnership projects: Insights from different alternating offer sequences of participants. Journal of Construction Engineering and Management, 143(3), p.04016102.

Lim, B.T. and Loosemore, M., 2017. The effect of inter-organizational justice perceptions on organizational citizenship behaviors in constructionprojects. International Journal of Project Management, 35(2), pp.95-106.

Lu, W., Zhang, L. and Pan, J., 2015. Identification and analyses of hidden transaction costs in project dispute resolutions. International journal ofproject management, 33(3), pp.711-718.

Mahamid, I., 2013. Contributors to schedule delays in public construction projects in Saudi Arabia: owners' perspective. Journal of ConstructionProject Management and Innovation, 3(2), pp.608-619.

McCord, M., Davis, P. T., Haran, M., & Rodgers, W. J. (2015). Understanding delays in housing construction: Evidence from Northern Ireland. Journal of Financial Management of Property and Construction, 20(3), 286–319.

Melese, Y., Lumbreras, S., Ramos, A., Stikkelman, R. and Herder, P., 2017. Cooperation under uncertainty: Assessing the value of risk sharing anddetermining the optimal risk-sharing rule for agents with pre-existing business and diverging risk attitudes. International Journal of Project Management, 35(3), pp.530-540.

Mentis, M., 2015. Managing project risks and uncertainties. Forest ecosystems, 2(1), p.2.

Mohammadi, S. and Birgonul, M.T., 2016. Preventing claims in green construction projects through investigating the components of contractual andlegal risks. Journal of cleaner production, 139, pp.1078-1084.

Mona Abdel Hamid Hassanen, Ahmed Mohammed Abdelalim. Risk Identification and Assessment of Mega Industrial Projects in Egypt.

International Journal of Management and Commerce Innovation (IJMCI). Vol 10 Issue 1 April 2022-September 2022

Nasirzadeh, F., Khanzadi, M., and Rezaie, M. (2014). “Dynamic modeling of the quantitative risk allocation in construction projects.” Int. J. ProjectManagement. 32(3), 442–451.

Nasirzadeh, F., Mazandaran Zadeh, H. and Rouhparvar, M., 2016. Quantitative risk allocation in construction projects using cooperative-bargaininggame theory. International Journal of Civil Engineering, 14(3), pp.161-170.

Nguyen, D.A., Garvin, M.J. and Gonzalez, E.E., 2018. Risk allocation in US public-private partnership highway project contracts. Journal ofConstruction Engineering and Management, 144(5), p.04018017.

Nguyen, P.T. and Nguyen, P.C., 2020. Risk Management in Engineering and Construction. Engineering, Technology & Applied Science Research,10(1), pp.5237-5241.

Peckiene, A., Komarovska, A. and Ustinovicius, L., 2013. Overview of risk allocation between construction parties. Procedia Engineering, 57,pp.889-894.

Peter Fogh, Niklas Korsgaard Christensen, Anne-Sophie Truelsen, 2017. Major Changes in FIDIC Red, Yellow and Silver Book. PP.1-6 Pham, L.H. and Hadikusumo, H., 2014. Schedule delays in engineering, procurement, and construction petrochemical projects in Vietnam: A qualitative research study. International Journal of energy sector management.

Prasad, K.V., Vasugi, V., Venkatesan, R. and Bhat, N.S., 2019. Critical causes of time overrun in Indian construction projects and mitigationmeasures. International Journal of Construction Education and Research, 15(3), pp.216-238.

Project Management Institute PMI. (2017). A Guide to The Project Management Body of Knowledge (PMBOK-Guide) - Sixth version,Pennsylvania, USA: Project Management Institute, Inc.

Project Management Institute, A guide to the project management

Rameezdeen, R. and Rodrigo, A., 2014. Modifications to standard forms of contract: The impact on readability. Australasian Journal of Construction Economics and Building, The, 14(2), pp.31-40.

Saaidin, S., Endut, I.R., Samah, S.A.A. and Ridzuan, A.R.M., 2017. Stakeholder's Perspective on Risks Allocation in Design and Build Projects inMalaysia. In MATEC Web of Conferences (Vol. 103, p. 03009). EDP Sciences.

Sadek, S. and Kulatunga, U., 2013. An overview of standard contractual forms modifications in the construction industry-the Middle East. Shafik, N., Qodsi, S., Serag, E. and Helmi, M., 2016. Application of FIDIC contracts under the Egyptian civil code. Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 8(3), p.04516004.

Solimene, F., 2014. Use of FIDIC forms in the oil and gas construction sector and possible amendments to the Yellow and Silver Books. The Journalof World Energy Law & Business, 7(6), pp.558-571.

Subcommittee TI of the International Bar Association, 2013, Standard form of construction contracts

Suprapto, M., Bakker, H.L., Mooi, H.G. and Hertogh, M.J., 2016. How do contract types and incentives matter to project performance? InternationalJournal of Project Management, 34(6), pp.1071-1087.

Tang, Y., Chen, Y., Hua, Y. and Fu, Y., 2020. Impacts of risk allocation on conflict negotiation costs in construction projects: Does managerialcontrol matter? International Journal of Project Management, 38(3), pp.188-199.

Tataretaghi, F. (2011). An Overview of Comparison between Parties of Construction Contracts in Malaysia. European Journal of Scientific Research,49 (30): 415-420.

Tembo-Silungwe, C.K. and Khatleli, N., 2020. Development of risk misallocation causal networks using interpretive judgement in the constructionindustry. International Journal of Construction Management, pp.1-15.

Van Weele, A., 2014. International contracting: Contract management in complex construction projects. World Scientific.

Walsh, K.P., 2017. Identifying and mitigating the risks created by problematic clauses in construction contracts. Journal of Legal Affairs and DisputeResolution in Engineering and Construction, 9(3), p.03717001.

Wan, S., Ding, G., Runeson, G., Er, M. and Liu, Y., 2019, June. A Dynamic Model of Risk Allocation of Energy Efficiency Retrofits under Energy Performance Contract for Office Buildings in China. In Abstract Proceedings of 2019 International Conference on Resource Sustainability-Cities(acres Cities).

Wang, Y., Chen, Y., Wang, W. and Tang, Y., 2019. Differentiating two types of learning in contract design: Evidence from the construction industry.

Scandinavian Journal of Management, 35(1), pp.1-11.

Youssef, A., Osman, H., Georgy, M. and Yehia, N., 2018. Semantic risk assessment for ad hoc and amended standard forms of constructioncontracts. Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 10(2), p.04518002.

Zavadskas, E.K., Turskis, Z. and Tamošaitiene, J., 2010. Risk assessment of construction projects. Journal of civil engineering and management,16(1), pp.33-46.

Zhang, L. and Qian, Q., 2017. How mediated power affects opportunism in owner–contractor relationships: The role of risk perceptions. InternationalJournal of Project Management, 35(3), pp.516-529.

Zhang, L. and Qian, Q., 2017. How mediated power affects opportunism in owner–contractor relationships: The role of risk perceptions. InternationalJournal of Project Management, 35(3), pp.516-529.

Abdelalim, A.M., 2019. “Risks Affecting the Delivery of Construction Projects in Egypt: Identifying, Assessing and Response”. In Project Management and BIM for Sustainable Modern Cities: Proceedings of the 2nd GeoMEast International Congress and Exhibition on SustainableCivil Infrastructures, Egypt 2018–The Official International Congress of the Soil-Structure Interaction Group in Egypt (SSIGE) (pp. 125-154).Springer International Publishing.

Abd El-Karim, M.S.B.A., Mosa El Nawawy, O.A. and Abdelalim, A.M., 2017. Identification and assessment of risk factors affecting constructionprojects. HBRC journal, 13(2), pp.202-216.

Medhat, W., Abdelkhalek, H. and Abdelalim, A.M., 2023. “A Comparative Study of the International Construction Contract (FIDIC Red Book 1999)and the Domestic Contract in Egypt (the Administrative Law 182 for the year 2018)”, International Journal of Management and Commerce Innovations, Vol.11, Issue.1, pp.10-23.

Abd El-Hamid, M.S, Farag, S., Abdelalim, A.M., 2023, “Construction Contracts’ Pricing according to Contractual Provisions and Risk Allocation”,International Journal of Civil and Structural Engineering Research ISSN 2348-7607, Vol.11, Issue.1, pp.11-38.

Yousri, Elhosin, Ahmed El Badawy Sayed, Moataz A. M. Farag, and Ahmed Mohammed Abdelalim. 2023. "Risk Identification of BuildingConstruction Projects in Egypt" Buildings 13, no. 4: 1084. https://doi.org/10.3390/buildings13041084.

Sherif Awad, Samir Gad, Abdelalim, A.M, 2023, “Critical Failure of Construction Projects and Their Remedial Actions from the Perspective of Applying Total Quality Management”, International Journal of Engineering, Management and Humanities (IJEMH), Vol.4, Issue.1, 147-167.

Khedr, R. and Abdelalim, A.M., 2021, “The Impact of Strategic Management on Projects Performance of Construction Firms in Egypt”, InternationalJournal of Management and Commerce Innovations ISSN 2348-7585, Vol. 9, Issue 2, pp.: (202-211).

Khedr, R. and Abdelalim, A.M., 2021, “Predictors for the Success and Survival of Construction Firms in Egypt”, International Journal ofManagement and Commerce Innovations ISSN 2348-7585 (Online), Vol. 9, Issue 2, pp.: (192-201).

Zou, X., & Vu, H. L. (2019). Mapping the knowledge domain of road safety studies: A scientometric analysis. Accident Analysis and Prevention 132(2019) 1052.

Cochran, W.G., 1977. Sampling techniques. John Wiley & Sons.

Naoum, S., Mustapha, F. H., "Factors influencing the effectiveness of construction site managers." International journal of project management 16, no. 1 (1998): 1-8. Mustapha, F. H., and S. Naoum. "Factors influencing the effectiveness of construction site managers." International journal ofproject management 16, no. 1 (1998): 1-8.

Odeh, A.M. and Battaineh, H.T., 2002. Causes of construction delay: traditional contracts. International journal of project management, 20(1), pp.67-73

Al-Bahi, M.F., 1979. Statistical Psychology. Measuring the Human Mind, Cairo: Dar Al-Fikr Al-Arabi.

Abd El-Hamid, S., Abdelalim, A.M, 2021, "A Proposed System for Prequalification of Construction Companies & Subcontractors for Projects inEgypt", International Journal of Management and Commerce Innovations ISSN 2348-7585, Vol. 9, Issue 2, pp.: 290-304.

Abdelalim, A.M., Elbeltagi, E. and Mekky, A.A., 2019. Factors affecting productivity and improvement in building construction sites, International Journal of Productivity and Quality Management, 27(4), pp.464-494.

Abdelalim, A.M., 2018, "IRVQM, Integrated Approach for Risk, Value and Quality Management in Construction Projects; Methodology and Practice", the 2nd International Conference of Sustainable Construction and Project Management, Sustainable Infrastructure and Transportationfor Future cities, ICSCPM-18, 16-18 December, 2018, Aswan, Egypt.

Amr Afifi, El. Samadony, A and Abdelalim, A.M., 2020, "Risk Response Planning for Top Risks Affecting Schedule and Cost of Mega ConstructionProjects in Egypt", International Journal of Civil and Structural Engineering Research ISSN 2348-7607 (Online) Vol. 8, Issue 1, pp.: 79-93.

Amr Afifi, El. Samadony, A and Abdelalim, A.M., 2020, "A Proposed Methodology for Managing Risks in Construction Industry in EGYPT",International Journal of Civil and Structural Engineering Research ISSN 2348-7607, Vol. 8, Issue 1, pp.: 63-78.

Abdelalim, A.M., El Nawawy, O.A. and Bassiony, M.S., 2016. 'Decision Supporting System for Risk Assessment in Construction Projects: AHP-Simulation Based. IPASJ International Journal of Computer Science (IIJCS), 4(5), pp.22-36.

Abdelalim, A.M., Mahmoud Eldesouky, 2021, "Evaluating Contracting Companies According to Quality Management System Requirements inConstruction Projects", International Journal of Engineering, Management and Humanities (IJEMH), Vol. 2, Issue 3, pp.: 158-169.

Abdelalim, A.M., Khalil, E.B. and Saif, A.A., 2021, "The Effect of Using the Value Engineering Approach in Enhancing the Role of Consulting Firms in the Construction Industry in Egypt". International Journal of Advanced Research in Science, Engineering and Technology, ISSN: 2350-0328 Vol. 8, Issue 2, pp. 16531-16539.

Ahmed Mohammed Abdelalim, Rizk Elimam A. Youni, Hesham Abdelkhalek, 2022, "Project Risk Management during Construction Stage According to International contract (FIDIC)", Al-azhar University Research Magazine, Civil Engineering (CERM), Vol.10, Issue.2, pp.76-93.

Abd-Elhamed, A., Amin, H.E. and Abdelalim, A.M.,2020, "Integration of Design Optimality and Design Quality of RC buildings from the perspective of Value Engineering", International Journal of Civil and Structural Engineering Research ISSN 2348-7607 (Online) Vol. 8, Issue 1,pp.:105-116

Zena A. Fadhel, El. Samadony and Abdelalim, A.M, 2020, "Studying the Applicability of Public Private Sector Partnership in the Reconstruction Projects in Iraq "International Journal of Civil and Structural Engineering Research ISSN 2348-7607, Vol. 8, Issue 1, pp.: 137-150.

Khaled Al-Barghouth, El. Samadony, A. And Abdelalim, A.M, 2016, "The Applicability of Public Private Sector Partnership (PPP) in the futuristic Reconstruction in Syria", The Engineering Sciences Magazine- Faculty of Engineering at Mataria- Helwan University, Vol.148, Issue.1.

Abdel-Alim, A.M. and Said, S.O.M., 2021, "Dynamic Labour Tracking System in Construction Project Using BIM Technology", InternationalJournal of Civil and Structural Engineering Research ISSN 2348-7607 (Online) Vol. 9, Issue 1, pp.: 10-20.

Abd-Elhamed, A., Amin, H.E. and Abdelalim, A.M.,2020, "Integration of Design Optimality and Design Quality of RC buildings from the perspective of Value Engineering", International Journal of Civil and Structural Engineering Research ISSN 2348-7607 (Online) Vol. 8, Issue 1,pp.:105-116.

Abdelalim, A.M., El. Samadony, A. and Alaa Al-Harouny, 2016, "Risk Assessment and Mitigation for Construction Projects in Egypt", the International Conference of Sustainable Construction and Project Management, ICSCPM-16, 29-31March, 2016, Aswan, Egypt.

Abdelalim, A.M. and Said, S.O.M., 2021." Theoretical Understanding of Indoor/Outdoor Tracking Systems in the Construction Industry", International Journal of Civil and Structural Engineering Research ISSN 2348-7607 (Online) Vol. 9, Issue 1, pp: (30-36), Month: April 2021.

Abdelalim, A.M. and Said, S.O.M., 2021. "Dynamic labour tracking system in construction project using BIM technology", International Journal of Civil and Structural Engineering Research ISSN 2348-7607 (Online), Vol. 9, Issue 1, pp: (10-20), Month: April 2021 - September 2021.

Abdelalim, A.M. and Abo. elsaud, Y., 2019. Integrating BIM-based simulation technique for sustainable building design. In Project Management andBIM for Sustainable Modern Cities: Proceedings of the 2nd GeoMEast International Congress and Exhibition on Sustainable Civil

Infrastructures, Egypt 2018–The Official International Congress of the Soil-Structure Interaction Group in Egypt (SSIGE) (pp. 209-238).Springer International Publishing.

Abdelalim, A.M., El-Kholy, A., 2016. A comparative study for fuzzy ranking methods in determining economic life of equipment. International Journal of Construction Engineering and Management, 5(2), pp.42-54.

Abdelalim, A.M., El Nawawy, O.A. and Bassiony, M.S., 2016. 'Decision Supporting System for Risk Assessment in Construction Projects: AHP-Simulation Based. IPASJ International Journal of Computer Science (IIJCS), 4(5), pp.22-36.