

Identification Of Risk Sources In Construction Project Networks And The Efficient Means Of Managing Network Risks

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Abstract – The construction industry is a complex and dynamic sector that involves many interconnected project networks. Despite significant advancements in risk management practices, risks are inherent in construction project networks, and they can significantly impact the performance and success of these networks. This research aims to identify the risk sources commonly encountered in construction project networks and explore efficient ways to manage network risks. The study employed a literature review approach to gather data from existing literature and identify gaps in the current understanding of risk management practices in construction project networks. The findings demonstrate that risk management in construction projects is not solely about identifying and mitigating potential threats but also about creating positive relationships among stakeholders, such as clients, contractors, subcontractors, and suppliers.

Keywords – Risk Sources, Construction Project Networks, Managing Network Risks

I. INTRODUCTION

The construction industry is inherently complex and involves many interconnected activities and stakeholders. Each stakeholder has different goals, perspectives, and expectations, which could conflict with the interests of other parties. Therefore, all parties involved in a project certainly carry enormous risks (Razi, Ali, & Ramli, 2019). (Nawaz, Waqar, Shah, Sajid, & Khalid, 2019) Cited that with the increasing association of many contracting parties, such as contractors, subcontractors, suppliers, owners, and designers, the level of risk increases.

Clients can risk construction projects by changing requirements or specifications, delaying payments, or needing clarification about project goals. These risks can cause delays, cost overruns, or disputes between the client and contractor. Contractors can risk construction projects by not adhering to project schedules or specifications, providing low-quality work, or failing to meet safety and regulatory requirements. Subcontractors can risk construction projects by failing to deliver materials or services on time, providing low-quality work, or causing safety hazards. Suppliers can risk construction projects by providing low-quality materials or services, causing delivery delays, or failing to meet project specifications. Moreover, the competing contractors may have different organizational risk attitudes that have been developed over time (Taofeeq, Adeleke, & Ajibike, 2020). Local authorities can pose risks to construction projects by imposing regulations or requirements that are not in line with project plans or specifications.

All these risks can result in delays, additional costs, legal liabilities, or even project cancellation. Thus, The complex and dynamic nature of construction projects, due to intricate design and involvement of several direct and indirect stakeholders, expose them to various risks” (Ur Rehmana, Thaheem, Nasir, & Khan, 2020). Therefore, the project management team and the client

must recognize that establishing robust strategies for managing known and unknown risks exceeds setting up processes and governance models to include paradigm shifts in culture and mindsets (Wuni, Shen, & Saka, 2022).

On the other hand, relationship management is crucial in construction projects as it involves multiple stakeholders, such as clients, contractors, subcontractors, architects, engineers, suppliers, and local authorities. Effective relationship management ensures that all parties collaborate, communicate effectively, and achieve the project's goals within time, cost, and quality constraints. Relationship management helps identify and manage risks resulting from construction project networks. Therefore, policymakers and sponsoring agencies are more focused on stakeholder management to ensure smooth execution, high performance, and achieving desired outcomes (Khan, Waris, & Haron, 2019).

(Le, Chong, & Kashiwagi, 2020) They identified the factors that could address shared risks and improve project performance, including improving management capability, adequate pre-planning, stakeholders' management, and performance-based procurement. The author argued that these four factors emphasize the essential elements of Critical Success Factors (CSFs) for project risk management. Thus, in such an environment, identifying and managing risks is crucial for the success of a project. In addition, network analysis provides a valuable framework for understanding the interdependencies and relationships between various elements in a construction project.

This paper will review the literature on risk management in construction projects and networks. It will then describe the data collection methodology and analysis, followed by a discussion of the findings. Finally, the paper will propose an efficient means of managing network risks and conclude with recommendations for practitioners.

II. STUDY OBJECTIVES

This study aims to identify the risk sources in construction project networks and develop efficient means of managing network risks. In addition, this research will provide insights into how project managers can mitigate risks and improve project outcomes by Identifying and analyzing the risks arising from network structure and using appropriate management means.

III. PROBLEM AND THE STUDY QUESTIONS

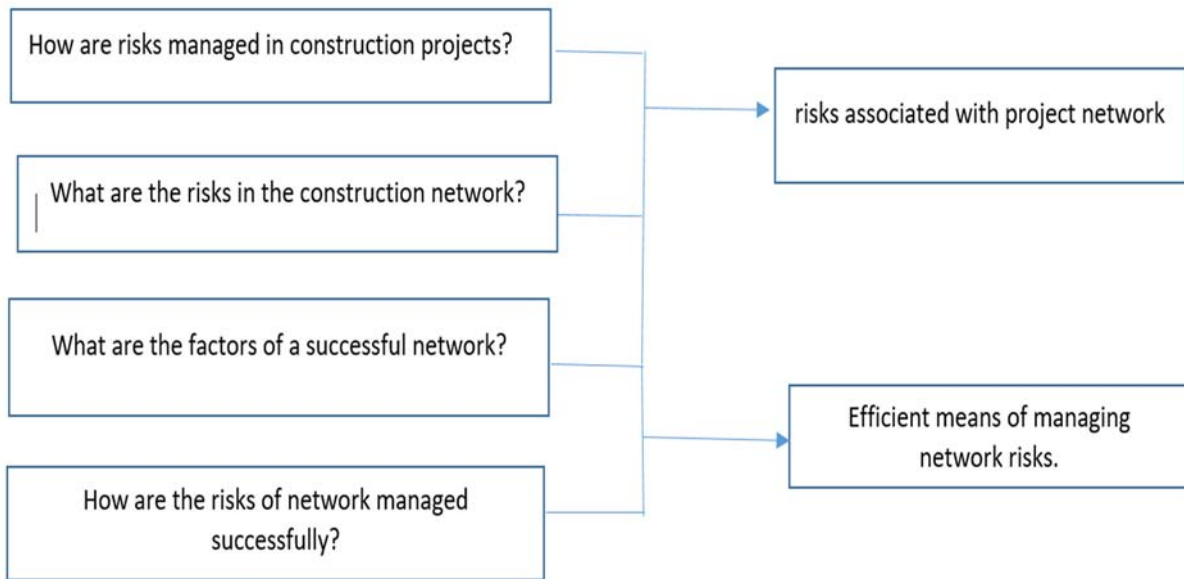
Research related to risk management in construction projects still needs studies concerning risks arising from project networks. Moreover, risk management in construction projects has been studied from a single perspective. Parties determine the threats individually, and each stakeholder works to add risks from the other party. (Mazher, et al., 2022) Argued that implementing risk management processes alone by each stakeholder may not maintain a well-shielded project from the effects of risks. Moreover, the lack of collaboration and trust among construction stakeholders affects the transparency and exchange of information, as well as the efficiency of the supply chain (Rompoti & Kitsios, 2020). Thus, considering the complexity and interdependency in construction projects, an appropriate decision-making methodology is needed to evaluate the interdependent risk factors (Karmoozian, Wu, Chen, & Luo, 2019).

Therefore, the following questions and figure 1 are structured to satisfy the objectives of the study.

- 1- How are the risks managed in construction projects?
- 2- What are the risks in the construction project network?
- 3- What are the factors of a successful network?
- 4- How are the risks of networks managed?

To answer the third and the fourth questions, the author developed the below hypotheses:

H1. Effective relationship management is the efficient mean of the management of network risks.



IV. METHODOLOGY AND DATA SOURCE

Project networks. In other words, the study examines the sources of the risks in project networks and explores the efficient risk management means to mitigate the network risks. Therefore, the study’s first objective is to identify the risks from the project network in construction projects. The second objective is to find efficient means of managing the risks of the networks.

The research method used for data collection was the literature review. An extensive literature review is a critical research methodology, proficient in synthesizing the existing body of knowledge, creating new understanding in a broader sense, and resulting in new recommendations for future studies(Razi, Ali, & Ramli, 2019). Therefore, from a review of the literature, the research questions were answered by applying the below systematic procedures:

The first question explored the sources of risks in construction projects and provides the current status of risk management. The network risks were identified from the pool of construction project risks. Questions one and two satisfied the first objective of the study and provided the risks associated with the project network.

The third question was based on the assumption that the project network was the primary source of risks. Risks from each party in the network have an impact on other parties. Therefore, the successful management of the project network contributes positively to minimizing the likelihood of occurrence and the impact of risks. Thus, question three investigated the successful networks and the factors that led to efficient relationships in construction project networks. The third question was crucial because it answered the pros of an efficient project network and the influence of a successful network on risk management.

The fourth question was based on the assumption that the traditional risk management approach cannot manage network risks. Also, the second assumption was; that network risk management requires successful relationship management. Accordingly, the factors of successful relationship management are the mean of successful management of network risks. Thus, Questions three and four satisfied the second objective of the study and provided an efficient way to manage the risks of the construction project network.

V. LITERATURE REVIEW

Google Scholar (GS) and Research Gate were used as search engines to collect data from previous studies. The author used keywords such as risk management, risk assessment, and risk identification to collect data related to the study. The search focused only on the data published between 2019 and 2022. The first round of examinations revealed 16,700 topics on Google Scholar (GS). The selection criteria were: The publication should be in English, published between 2019 and 2022, consisting of identified risks in construction projects, and published in a scientific journal. After further checking, evaluating, and removing duplicate studies, 51 studies were identified.

Further reading of all 51 research revealed that 18 studies published from 2019 to 2022 were related to risk in construction projects, while 32 studies were excluded. Although the excluded studies were related to risk management in construction projects, risks were not identified in these studies. Therefore, these should have been excluded from the analysis. The 18 selected studies, Table 1, were classified according to the title, authors, year of publication, and outcomes.

VI. RESULTS AND FINDINGS

6.1 Risks Managed in Construction Projects

Risk management is an important issue of any construction project. It involves identifying, assessing, and mitigating risks that may arise during the project lifecycle. The following are key steps involved in risk management in construction projects:

- **Develop a Risk Management Plan:** A comprehensive risk management plan should be developed early in the project-planning phase. The plan should include a process for identifying, assessing, prioritizing, and mitigating risks throughout the project lifecycle.
- **Risk Identification:** The initial step in risk management is identifying all potential risks that could affect the project. This can be done by reviewing project plans, specifications, and contracts, and consulting with project stakeholders. (Tharanga, 2020) identified the five major categories of risk identification techniques from an extensive literature review with different data analysis methods. These five categories include documentation review, information gathering (brainstorming), diagram analysis, checklist analysis, and expert judgments.
- **Risk Assessment:** After identification of the risks, they should be assessed to determine their likelihood and potential impact. This step involves analyzing the likelihood of the risk occurring and the severity of its consequences. In addition, an accurate risk assessment approach can be achieved by collecting information from previous experiences, probabilities, brainstorming sessions, and individual knowledge (Issa, Mosaad, & Hassan, 2019).
- **Risk Prioritization:** Risks must be prioritized based on their likelihood and potential impact. Therefore, this step allows the project team to focus their resources on the risks that have a high probability of occurrence and have the most significant potential impact.
- **Risk Mitigation:** Once risks have been identified, assessed, and prioritized, mitigation strategies need to be developed to reduce their likelihood or impact. This stage may involve implementing contingency plans, changing project plans or timelines, or developing alternative solutions.
- **Risk Monitoring and controlling:** The project team needs to continually monitor the risks throughout the project lifecycle to ensure that the mitigation strategies are practical, efficient, and flexible for identifying any new risks that may arise.
- **Communicate Effectively:** Effective communication among all project stakeholders is essential for managing risks. Regular communication helps ensure that all stakeholders know the potential risks and mitigation strategies.
- **Review and Learn:** The project team should regularly review the risk management process to identify improvement areas and learn from experiences. This step helps ensure that the risk management process continually improves and adapts to the project's changing needs.

Effective risk management in construction projects can minimize delays, cost overruns, and quality issues. It also helps to ensure that the project is delivered as required.

6.2 Risks in The Construction Project Network

Reviewed literature reveals several risks resulting from construction networks. Table 1 includes all risks in the selected studies published from 2019 to 2022. Therefore, network risks identified from the risk pool:

6.2.1 Lack of effective communication and coordination

Poor communication and coordination can lead to misunderstandings, disagreements, and conflicts that can increase project risk and potentially result in legal disputes. This risk factor, Table 1, raised in previous studies as one of the significant risks in construction projects. Lack of communication and coordination among the project network can occur due to various factors, including poor project planning: If the project plan was not well-defined or lacks details, it can create confusion and increase the

likelihood of miscommunication. Inadequate communication channels: If the communication channels between project parties were not well-established or were insufficient, it can lead to a lack of coordination and collaboration. Misaligned goals: If the project parties had different objectives or priorities, it could create conflicts and misunderstandings. Lack of trust: If the project parties do not trust each other, it can lead to reluctance to share information or work together effectively.

6.2.2 lack of management experience

The lack of management experience in construction projects, Table 1, can significantly negatively impact project outcomes. A lack of management experience can lead to delays in the project schedule, improperly estimated costs, lack of control over spending leading to budget overruns, and suffering in quality control. Moreover, Construction projects are subject to numerous legal and regulatory requirements, and inexperienced managers may not be aware of these requirements, leading to non-compliance and legal issues. Therefore, Inexperienced managers may struggle to communicate effectively with stakeholders, leading to dissatisfaction and negative project outcomes.

6.2.3 Inadequate design and design errors

Design errors in drawings and specifications can result in construction errors, misunderstandings, and rework. Inadequate site investigation, analysis, and failure to meet regulatory codes and standards can lead to design errors, safety hazards, and construction delays. Therefore, risks resulted from design problems mentioned intensively in the previous studies. “High costs of projects design” (Akomea-Frimpong, Xiaohua, & Robert, 2021) and (Taofeeq & Adeleke, 2019), Incomplete design data and design errors (Taofeeq & Adeleke, 2019), (Sharma & Gupta, 2019) and (Abd El-Karim, El Nawawy, & Abdel-Alim, 2017), change due to poor design (Zhao, Ma, & Bu, 2020) and (Lin & Chen, 2021), design changes by the owner during construction (Ur Rehmana, Thaheem, Nasir, & Khan, 2020), Insufficient design time, Insufficient design information, Insufficient number of designers, and lack of a design standard (Lin & Chen, 2021), Insufficient consultant’s experience and delays review and approval of design (A. Kassem, Khoiry, & Hamzah, 2019).

6.2.4 Delay in supplying materials

Delays in supplying critical materials, Table 1, significantly impact construction projects where a delay in the supply can cause delays in the project's completion. This delay can result in financial losses due to missed deadlines and penalties for delays. Delays in material supply can be due to rush orders, expedited shipping costs, and increased labor costs. Rushing to complete a project due to material delays can also lead to poor-quality work. Sometimes, the need for more necessary materials can force workers to use alternatives, lower-quality materials, resulting in a substandard final product. Thus, a delay in material supply can damage a company's reputation with clients and customers. Therefore, this can result in lost business and negatively impact future projects.

6.2.5 Delay in decision-making

Delays in decision-making can significantly impact effective management, and when decisions that were not made on time can lead to missed opportunities, increased costs, and decreased productivity. Delays in decision-making can affect a company's profitability and competitiveness. Late decisions lead to decreased productivity, as employees might be unable to move forward with their tasks until a decision is made. This delay can lead to frustration and a lack of motivation among employees. Delayed decisions can lead to a lack of confidence in leadership and management. Employees may begin to question the ability of their leaders to make sound decisions, which can lead to a decrease in morale. Delayed decisions can also reduce an organization's agility, making it difficult to respond to changing market conditions or customer needs. Therefore, this can put an organization at a competitive disadvantage. Thus, previous studies, Table 1, revealed that the delay in decision-making causes risks and affects project outcomes.

6.2.6 Change during the construction process

Change is an inherent part of the construction process, and it can refer to modifications made to the original plan, design, materials, or specifications of a project. While changes can sometimes be necessary to improve a project's quality, safety, or functionality, they can also pose significant risks if not managed properly. Changes to the original plan can result in unexpected costs, such as the need for additional materials, labor, or time. These can add up quickly and result in cost overruns that can put the project budget at risk. Changes can also impact the project timeline, leading to delays in completion. These delays can be costly

and cause disruptions to other parts of the project or the overall construction schedule. Changes can also lead to communication breakdowns between the project team members. If changes are not communicated effectively, it can result in confusion, errors, and misunderstandings that can negatively impact the project outcome. Changes can lead to disputes and claims if not adequately documented and managed. For example, if the owner and contractor disagree on the need for a change or the associated costs, it can lead to legal disputes that can delay the project or result in financial losses.

Change during the construction process took several aspects in the previous studies. Change in project scope, laws and regulations changes, and change in the inflation rate (Sharma & Gupta, 2019), New stakeholders with the changed request, changing government funding policy, and unforeseen multiple modifications to project scope (Chattapadhyay, Putta, & Rao P, 2021), change in regulations and law (A. Kassem, Khoiry, & Hamzah, 2019), (Bahamid, Doh, & Al-Sharaf, 2019) owner demand changes & intervention (Bahamid, Doh, & Al-Sharaf, 2019), change in decisions (Lin & Chen, 2021), and change due to poor design (Zhao, Ma, & Bu, 2020).

6.2.7 Delay in payment

Delays in the payment, whether from client to main contractor or from contractor to suppliers and subcontractors, were considered a significant risk factor that caused the failure of the construction projects (A. Kassem, Khoiry, & Hamzah, 2019), (Luo, Shen, Xu, Liu, & Wang, 2019), (Lin & Chen, 2021), (Zhao, Ma, & Bu, 2020), and (Taofeeq & Adeleke, 2019). Payment delays are a significant issue in the construction industry and can substantially influence construction projects. Delayed payments can cause financial instability for contractors and subcontractors, leading to a cascade of adverse effects that can affect the entire project. When contractors and subcontractors are not paid on time, they may cut corners or use lower-quality materials to save costs. Therefore, payment delays can compromise the quality of the construction work, leading to safety hazards, structural issues, and decreased project value. Delayed payments can lead to disputes and claims between contractors, subcontractors, and owners. This can cause delays and disruptions to the construction process, as well as additional legal costs. Delayed payments can also reduce the productivity of workers on the construction site. If workers are not paid on time, they may become demotivated, which can affect their performance and productivity. Thus, delayed payments can damage the reputation of the owner or contractor, leading to difficulty in attracting new projects or finding subcontractors willing to work with them in the future.

6.2.8 Other risks in the construction project networks

Other risks in the construction project network identified from the 18 studies published between 2019 and 2022 include a lack of contractors' experience (A. Kassem, Khoiry, & Hamzah, 2019), (Bahamid, Doh, & Al-Sharaf, 2019), (Gavrysh & Melnykova, 2019), (Lin & Chen, 2021), (Zhao, Ma, & Bu, 2020), and (A. Kassem, Khoiry, & Hamzah, 2019), inaccurate initial time and resources estimation (Luo, Shen, Xu, Liu, & Wang, 2019), (Wuni, Shen, & Saka, 2022), and (Mahmoudi, Abbas, Deng, Ikram, & Yeganeh, 2020), issues in obtaining permits and licenses (Gavrysh & Melnykova, 2019) and (Chattapadhyay, Putta, & Rao P, 2021) and (Jiang, Martek, & Hosseini, 2019). Table1 includes all risks identified in previous studies

Table 1 – Risks in Construction Projects

No	Study	Author	Identified Risks
1	A holistic review of research studies on financial risk management in Public Private Partnership project	(Akomea-Frimpong, Xiaohua, & Robert, 2021)	High costs of design of projects, Increased consulting and professional fees, Unfair share of profits, High financial compensations against force majeure, Costly legal settlements, Bankruptcy and insolvency of the supplier/Subcontractor, High bidding and tendering costs.
2	A novel model for risk management of outsourced construction projects using decision-making methods: a case study	(Mahmoudi, Abbas, Deng, Ikram, & Yeganeh, 2020)	Rework and scrap in project deliverables, Failure to fulfill the defined objectives of the project, Lack of client authority, lack of control, Supplier risks include delays in deliveries and/or improper quality, poor time management, initial estimates by the employer are not properly executed, Choosing the type of contract.
3	Factor's Influencing Contractors Risk Attitude in the Malaysian Construction Industry	(Taofeeq & Adeleke, 2019)	Incomplete design data, Late information from planners, Design errors, Financial Failure of the owner, Change order, Delay in delivery, Late payments by the owner, Productivity and efficiency, Arguments, upskill laborers.
4	Assessment of Barriers to Risk Management (RM) Implementation in Small Construction Projects in NIGERIA	(Mahmud, Muawiya, & Abdullahi, 2019)	Lack of experience, Lack of joint management, Lack of knowledge, Poor understanding, Lack of time, Lack of budget, Low profit margin, Competition among small and Medium Companies, Lack of available risk managers
5	Computing the severities of critical onsite assembly risk factors for modular integrated construction projects	(Wuni, Shen, & Saka, 2022)	Poor cooperation among critical onsite stakeholders, Site-fit rework due to discrepancies in drawings, Inadequate advanced planning.
6	Constructing a Risk-Sharing Framework for Sponge City PPP Projects from the Perspective of the Individual Participant	(Zhao, Ma, & Bu, 2020)	government intervention, immature laws, and regulations, government inaction, lack of management experience, lack of an effective payment mechanism, insufficient

			operating income, project financing failure.
7	Investigating the Relationship Between Active Leadership and Construction Risk Management Among Contractors in the Kingdom of Saudia Arabia	(Abdul Rehman & Ishak, 2022)	Administrative and Management Risk, Design Risk, Equipment and Labor Risk, Material Supply Risk, Rules and Regulations
8	Political risk management of foreign direct investment in infrastructure projects: Bibliometric-qualitative analyses of research in developing countries	(Jiang, Martek, & Hosseini, 2019)	Project approvals and permits delays, Poor public/political decision-making process, Land acquisition problems, Termination of project, Conflicting or imperfect contract, Non-transparent procurement system
9	Project risk management of the construction industry enterprises based on fuzzy set theory	(Gavrysh & Melnykova, 2019)	Obtaining permits and licenses, Availability and conditions for land use, Technology disadvantages, Cost overruns, Delay in completion, Contractor inability, Supplies and inputs, The solvency of suppliers, Staff turnover,
10	Project schedule risk management through building information modelling	(Ur Rehmana, Thaheem, Nasir, & Khan, 2020)	design changes by the owner during construction, financing problems by contractor, availability of material (suppliers, transporters),
11	Ranking of human factors affecting contractors' risk attitudes in the Malaysian construction industry	(Moshood, Adeleke, Nawanir, & Mahmud, 2020)	Work Experience, Professional Competence, Physical Health of workers, Emotional Intelligence, Educational Background.
12	Research for Risk Management of Construction Projects in Taiwan	(Lin & Chen, 2021)	Unclear definition of requirement, Lack of personnel, Change in decisions, Poor departmental communication, Delayed schedule and late payment, Complex contracting procedures, Difficulties in design–construction coordination, Difficulties in quality control with low budget, Late submission of re-modified or approved documents, Late completion due to design–construction interface problems, Insufficient information on health and safety facilities, Insufficient design time, Insufficient design information, Insufficient number of designers, Lack of experience and

			<p>knowledge, Insufficient understanding of the actual construction Procedures, Lack of a design standard, Lack of communication and coordination in the design–construction interface, Incomprehensive coordination in the design–construction Interface, Insufficient budget, Interference from commissioned designers, Lack of specialized labor, Lack of on-site workers, Lack of correct concepts of health and safety, Poor communication and coordination with contractors, Late payment requests, Work correction due to incorrect construction operations, Lack of educational training for operators, Ignorance of construction work ethics, Poor on-site management, Construction operations conducted according to personal experience and in violation of relevant regulations</p>
13	<p>Risk factors affecting the construction projects in the developing countries</p>	<p>(Bahamid, Doh, & Al-Sharaf, 2019)</p>	<p>Requirement or delay for permits & approval, Client’s financial failure, Changes in laws and regulations, Labor & equipment productivity, Insufficient resource availability, Owner demand changes & intervention, Inadequate specifications, Contractor competence, Incomplete design scope, Change order negotiations, culture difference, Delayed dispute resolutions, Conflict of the document, Lower work quality in the existence of time constraints, Design complexity, Public relationship, Government acts and intervention, Defective materials, Poor site management and supervision, Contractors competition in bids</p>
14	<p>Risk factors in oil and gas construction projects in developing countries: a case study</p>	<p>(A. Kassem, Khoiry, & Hamzah, 2019)</p>	<p>Government delay in decision-making, Government interference in projects, Changes during the construction process, Delay payment of contractor’s dues, Lack of contractors’ experience, Execution errors, Inadequate coordination among contractors,</p>

			Inadequate tendering, The terms of the contract are unclear, Delay in delivery of materials to the site, Ineffective management, Lack of effective communication and coordination, Change regulations and law.
15	Risk Identification, Assessments, and Prediction for Mega Construction Projects: A Risk Prediction Paradigm Based on Cross-Analytical-Machine Learning Model	(Chattapadhyay, Putta, & Rao P, 2021)	Permits and licenses, Delayed supply of material and equipment, Delay in obtaining working drawings/reports/designs, Low skilled/incompetent workforce, Unavailability of materials, equipment, and labor, Poor site coordination/work organization, Construction failure, Construction and implementation error from faulty design, Changes in the material during construction, Deviations between specification and implementation, Supply chain breakdown, Improper equipment, and material quality, Incompetency of designers, Design changes, Inadequate design, and design errors, Modification to drawing/design, Unforeseen multiple modifications to project scope, Revision in design standard, Inadequate project complexity analysis, Demands of local people, Public objections, New stakeholders with a changed request, Multilevel decision-making bodies, Changing government regulations/funding policy, Legal disputes, Multilevel decision-making by government bodies for consent and approvals,
16	Risk Identification and Management in Construction Projects: Literature Review	(Sharma & Gupta, 2019)	Unavailability of funds, Design errors and poor engineering, Poor site management, Contractual risks, Laws and regulations changes, Inadequate safety measures, Changes in project scope, Severe environmental conditions , Changes in the inflation rate, Natural disasters.
17	Stakeholder-Associated Supply Chain Risks and Their Interactions in a	(Luo, Shen, Xu, Liu, & Wang, 2019)	Design change, Design errors, Inefficient design approval, Delayed payment, Poor communication with

	Prefabricated Building Project in Hong Kong		other project participants, Inaccurate initial time and resources estimation, Slow response to design change.
18	Using probability impact matrix (PIM) in analyzing risk factors affecting the success of oil and gas construction projects in Yemen	(A. Kassem, Khoiry, & Hamzah, 2019)	Delay in decision-making, Client interventions, Government interference, Change during the construction process, Delay in payment of contractor's dues, Lack of contractors' experience, Execution errors, Inadequate coordination among contractors, Insufficient consultant's experience, Delays in review and approval of the design, Poor contract management, Frequent change of designs, The terms of the contract are unclear, Delay in delivery of materials to Site, Lack of effective communication and coordination.

6.3 Relationships management in construction projects

The critical aspects of effective relationship management in construction projects are:

- **Communication:** Communication is critical and effective communication can prevent misunderstandings and conflicts. Therefore, decision-makers should establish clear communication channels and ensure all stakeholders are aware of the progress of the project, changes, risks, and issues.
- **Trust:** Trust is the backbone of a successful business as well as any construction project, and it requires all parties to act with integrity and transparency. Project managers should build trust with all stakeholders by being honest, transparent, and accountable for their actions.
- **Collaboration:** Collaboration is essential for effective relationship management in construction projects. All parties should promote teamwork, encourage input from other stakeholders, and ensure that everyone has a shared understanding of project objectives.
- **Conflict resolution:** Conflicts are inevitable in construction projects, and project managers should have strategies to manage conflicts effectively. They should encourage open communication, listen to all parties involved, and find solutions that are in the best interests of the project.
- **Continuous improvement:** Continuous improvement is critical for successful relationship management in construction projects. Project leaders should continuously evaluate the progress of the project, seek stakeholders' feedback, and identify improvement opportunities.

In order to foster collaboration and trust among construction parties, literature revealed several strategies to overcome this dilemma. (Rompoti & Kitsios, 2020) Identified the problems in the construction networks and proposed solutions strategies that can reduce the risks including; contracting, collaboration, relationship management, partnering, integration, procurement methods, and proactive management. The authors argued that collaboration problems and barriers could be overcome through better integration, partnering, and contractual governance. (Mazher, et al., 2022) They have mentioned six-factor groups for effective risk management in private public partnership projects. Factor five comprised; a flexible and collaboration-supportive contracts, the effectiveness of dispute resolution, Increased confidence, trust, and cooperation among parties, the availability of reliable risk mitigation tools/instruments, and collaborative risk management. The authors argued, increased confidence, trust and cooperation among parties may go a long way towards enabling effective project risk management. Moreover, (Zheng, Song, Zhang, & Gao, 2017) developed the theory of trust repair in the construction industry. Their study revealed strategies for contractors and subcontractors to repair the trust when it was violated. After subcontractors violate competence-based trust, their trust-repair

strategies include showing of positive attitude, immediate action, and self-justification. After subcontractors violate integrity-based trust, their trust-repair strategies include denial and excuses, correction and penance, and apology. After contractors violate competence-based trust, their trust-repair strategies include promise, paying part of the progress payment, and paying off the progress payment in arrears. Therefore, the widely-accepted three-dimensional operationalization of relational quality was trust, commitment, and relationship satisfaction (Levin, Quach, & Thaichon, 2018).

VII. CONCLUSION AND RECOMMENDATIONS

In conclusion, this research has highlighted the significant risks inherent in construction projects network and the importance of effective relationship management in mitigating these risks. Furthermore, the findings demonstrate that risk management in construction projects is not solely about identifying and mitigating potential threats but also about creating positive relationships among stakeholders, such as clients, contractors, subcontractors, and suppliers. By developing effective communication, encouraging collaboration and trust, and managing stakeholder conflicts, project managers can reduce the potential for conflicts, delays, and cost overruns.

Furthermore, this research underscores the value of adopting risk management, which involves identifying potential risks early in the project lifecycle, assessing their impact, and mitigating them. By doing so, project managers can minimize the likelihood of adverse outcomes, increase the likelihood of successful project completion, and enhance the reputation of the project team.

Overall, this research suggests that effective relationship management plays a crucial role in managing risk in construction projects. Therefore, it is essential for project managers to prioritize building and to maintain positive relationships with stakeholders, alongside other risk management strategies, to ensure project success.

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