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Risk Factors Identification from Contractors Perspective

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***Abstract*— Numerous studies on the distribution of buildingdangers have been conducted during the last few decades. Even though the current study gives significant insights into the matter, construction industry members are nonetheless concerned about the risks of contracting. A study product was developed to help contracting parties identify, quantify, and assign each construction risk to address this issue. To supplement the model worksheets, flowcharts were created to determine which party should carry which risk, legal research was conducted, and risk allocation guidelines were produced to generate acceptable contract language to address the identifiedrisks. This article focuses on the most significant risks to the project's timeliness, quality, and budget.**

***Keywords*— Risk categories, risk identification, contracting, legal risks**

I. INTRODUCTION

Every day construction industry faces risk, defined as"the probability of injury or loss, or something that creates or represents a risk." Due to the multiple contractual parties involved, technological obstacles, and tough working circumstances, construction enterprises are usually exposed to a significant level of risk [1]. As a result, risk allocation in the construction sector is frequently contentious, with both sides striving to transfer as much risk as possible through favorable contract provisions [2]. Due to a lack of risk-shiftingtraining and knowledge, contracting parties are encouraged to continue their risk-averse conduct. Inappropriate risk allocationis shifting risk to the contracting party with the weakest bargaining position [3] . Risk misallocation is "the process of shifting risk without first establishing who is best positioned to analyze, control, bearthe expense, or gain from the risk assumption." The risk is usually transferred from the owner to the major contractor, whothen passes it on to the lower-tier contractual players [4]. Identifying potential risk is a key step in risk management as it allows project participants to pinpoint instances of uncertainty, assess the potential impact, and devise appropriate tactics for overcoming their effects [5]. A well-organized and exact risk assessment also serves as a foundation for subsequentstages and ensures risk management success [6]. One of the most useful tools for identifying construction-related risks (both good and bad) is published literature [7]. Risk assessment, analysis, and modelling have already been done using numerous dangers that affect building projects that researchers have discovered. This article focuses on finding risks that directly impact a project's timeliness, budget, and/or quality [8].

II. LITERATURE REVIEW

The systematic and ongoing identification of risks and their potential implications on a project, the categorization of risks into categories, the identification of causes, and the documentation of the features of each risk, using various risk identification tools and procedures, is risk identification [9]. In rare situations, primary risk reactions may be found during the risk identification step [10]. Because subsequent phases may only be done on possible threats that have been recognized, the first important step in risk management is identifying risk [11]. The building research community isfamiliar with the concept of risk allocation and the risk concepts that go with it. Many research organizations have looked at thetopic of risk allocation, resulting in a plethora of valuable products [12]. Each of the studies available provides a piece of the solution, but the construction industry still lacks a universally acknowledged full, multiparty, no unilateral risk allocation model. Risk identification, as a discovery process, necessitates inventive thinking, imagination, and the application of project team experience and knowledge [13]. Depending on the type of project, stakeholders, project members, the risk management team (if assigned), non-project team subject matterexperts, and project managers from other projects may all be required to participate in risk identification [14].

III. RISK CATEGORIZATION AND IDENTIFICATION

Risk classification is an essential component of risk assessment. It aids the project team in organizing a variety of hazards that may arise throughout a building project [15] . Risk classification improves the quality and efficiency of risk identification by a better understanding of the nature of risks and their sources [16]. It isalso easier to manage risks later on when threats are classified logically and systemically during the risk identification stage [17]. Risks are classified using a three-level meta (micro, meso, and macro) classification technique [18] based on their origin, type, an occurrence at various project stages, impact on project goals, and the party that may be the risk's producer. External risks (those that are not project-related and do not ordinarily fall under the project management team's purview) and internal risks (those that do fall under the project management team's purview) were categorised (those that are outside the control of the project management team) [19].

IV. RESEARCH METHODOLOGY

Research study objectives were satisfied in our work by employing a technique that outlines data collection, analysis, andconclusion drawing.

Risk is "something that potentially affects goals positively or negatively." Risk management is one of the nine PMBOK emphasizes on recognizing, assessing, and responding to project risk. It "maximizes the possibilities and impact of good events while lowering the likelihood and implications of bad events" Due to the importance of risk and risk management in projects, the study will analyze the hazards building construction projects in Khyber Pakhtunkhwa face and the risk management methods utilised to control them. During the preliminary research phase, journals and books will be studiedto acquire information on the topic and aims. The questionnairewill be prepared after reviewing earlier studies. After the literature evaluation, the questionnaire will be created. During the test run, industry experts will make any necessary improvements before finalising and deploying it for data collecting. During data collection, only the questionnaire is available. Construction companies and consultants will receivethe questionnaire. All these firms will be visited to clarify any questionnaire misunderstandings. Completed questionnaires will be collected for analysis. Data analysis involves examining questionnaire responses. Data analysis involves examining questionnaire responses. Fuzzy analytic hierarchy is used to rank hazards and manage them. First-stage research. It's done to grasp the topic and learn about earlier research. Journals, periodicals, and books are studied for the necessary literature.

The investigation's findings will determine the final objectives. A preliminary questionnaire will be created based on this study's goals. Many research papers show the risks building projects face around the world. After consulting with industry experts, the whole list of construction-related risks in Khyber Pakhtunkhwa will be reviewed. Respondents must rate these threats on a liker scale (1-9) from least to most severe. Respondents must specify the risk's client, contractor, or shared responsibility. After completing the questionnaire, research data might be collected. "Non-probability sampling approaches are crucial when resources are limited, population members cannot be identified, and a problem must be established." [17] Unrestricted non-probability samples are convenience samples. [18] Easy-to-access members of the population are chosen for non-probability sampling. The questionnaire will be delivered to clients, consultants, and contractors in Khyber Pakhtunkhwa. Companies will be visited to deliver questionnaires and answer questions. As there is insufficient risk knowledge at lower levels in Khyber Pakhtunkhwa Pakistan, the questionnaire must be completed by a CEO, project manager, or project engineer. Completed questionnaires will be returned promptly. When questionnaires are returned, data analysis can begin. This research will use MS Excel to collect and analyse data. All data will be entered into an Excel file and examined as appropriate.

Fuzzy-AHP steps:

Step 1:, create a project complexity hierarchy. First, a complex problem is deconstructed. The problem is graphically depicted with the aim at the top and criteria and choices at the bottom.

Step 2: Compare experts' opinions. F-AHP uses a scale to compare two things' relative preference 1 is evenly desired, 3 is moderately sought, 5 is strongly desired, 7 is extremely strongly desired, and 9 is exceedingly desired. Synthetizations are utilised to analyse each choice possibility in this step. The relative priority vector is determined by synthesizing a pair-wise comparison matrix.

Step 3 Convert expert opinion to fuzzy numbers. Fuzzy expert judgement matrices Because experts' inputs are linguistic, subjective, and unpredictable, they were translated from a fuzzy nine-point scale to triangle fuzzy numbers (l, m, u) using the following fuzzification factor:

(1, 1, 1) if relative complexity was judged as $\bar{1}$

(x-Δ, x, x+Δ) if relative complexity was judged as $\bar{x}$ ($\bar{x}$ = $\bar{2}$, $\bar{3}$,…,$\bar{8}$)

(1/x+Δ, 1/x, 1/x-Δ) if relative complexity was judged as 1/$\bar{x}$(1/$\bar{x}$ = 1/$\bar{2}$, 1/$\bar{3}$… 1/$\bar{8}$) (1)

Step 4 Aggregating Experts' Judgments into Fuzzy Judgment Matrices. The following are the equations used to combine experts' judgments (Büyüközkan and Feyzioğ l $\bar{J}$

ij = (lij, mij, uij) such that

lij ≤ mij ≤ uij and lij , mij , uij ∈ [1/9, 9] (2)

$$lij = \min (lijk) \quad (3)$$

$$mij = \sqrt[k]{\prod_{k=1}^{k} mijk} \quad (4)$$

$$uij = \max (uijk) \quad (5)$$

The pair wise comparison of criteria (or sub criteria) I and j evaluated by the kth expert from step 3 is (lijk, mijk, uijk), and K is the number of experts. In addition, geometric means can be utilized to calculate lij and uij. [19]

Step 5 Check for consistency.

The consistency of pair wise judgments is tested in this stage by computing the consistency ratio. If the consistency ratio is less than 0.1, the pair wise judgment is sufficient, however if the consistency ratio is greater than 0.1, the pair wise judgment is insufficient. The formula for calculating the consistency ratio is as follows:

$$\boldsymbol{CR = \frac{CI}{RI}} \quad (6)$$

Where CR = Consistency Ratio, CI= Consistency Index and RI is Random Index

$$\boldsymbol{while\ CI = \frac{max - n}{n-1}} \quad (7)$$

The random index value is obtained from Table I, whose value is dependent to the number of components being compared.

TABLE I: RANDOM INDEX VALUE

n	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

Step 6 De fuzzified judgment matrices

Defuzzification is the process of converting fuzzy values in pair wise comparison matrices to crisp integers. The level of confidence (α -cut) and risk attitude (λ) of the decision maker are used. Both α-cut and λ are in the range of 0 to 1. A higher α-cut or λ indicates that the decision maker is more confident or hopeful, respectively.

$$zijl\alpha = (mij - lij)+lij \quad (8)$$

$$zijr\alpha = uij - (uij - mij)\alpha \quad (9)$$

$zij, \alpha = zijr\alpha + (1 -)zijl\alpha$ (10)

Step 7 Weight criteria and sub-criteria in accordance with their geographical context

$$i = \frac{1}{n} \sum_{j=1}^{n} \frac{zij}{\sum_{k=1}^{n} zkj} \quad (11)$$

Zij and zkj are components of the defuzzed judgement matrix..
Step 8 Determine the overall weights for each sub-weights.
criterion's
Sub-criterion weights (wij) with a -cut of 0.5 and a -cut of 0.5 are calculated using (12).

$$i = ci \times cij \quad (12)$$

V. RESULTS & DISCUSSION

The respondents' completed questionnaires are returned, and the data is entered into an excel spreadsheet for future analysis. There were a total of 50 questionnaires collected in their entirety. In addition, the responders had varying levels of experience as shown in Fig. 1.

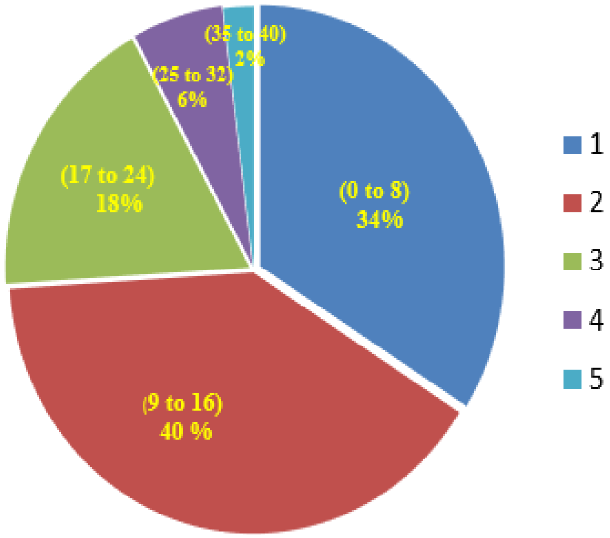
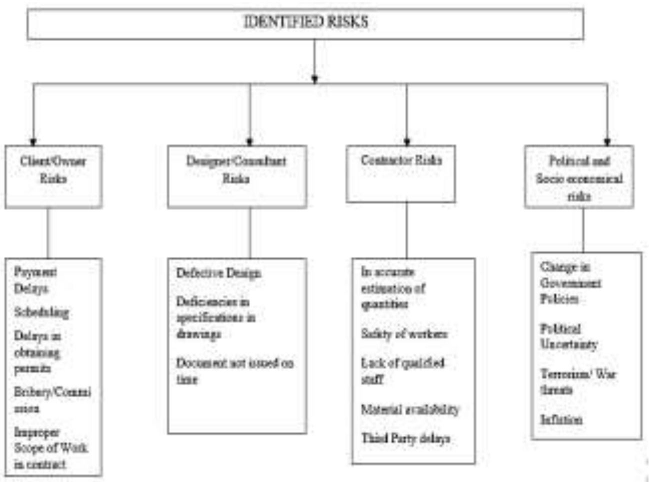


FIGURE 1: Categories of Firms based on Experience (years)

Identified Risks

A hierarchical structure of identified risks is given in Table II.

Table II: HIERARCHY OF IDENTIFIED RISKS



Reliability Test of the Data

Source of Variation	SS	df	MS	F	P-value	F Crit
Rows	127.728	49	2.6066694	4.69572	2.85	1.361687
Columns	3980.539	34	117.0747	210.8993	0	1.436596
Error	924.832	1666	0.555121			
Total	5033.099	1749				

Cronbach's Alpha

$$1 - (Ms\ Error / \text{Ms Rows})$$

=1- (0.55/2.60) = 0.78	
interpretation	konting et al.
.01 - .60	Unacceptable
.61 - .70	Acceptable
.71 - .80	good and acceptable
.81 - .90	good
.91 - .1.00	excellent

Criterion Weight

Risk Ranking	Criterion	Weight
1	CLIENT/OWNER	0.55
2	DESIGNER/CONSULTANT	0.24
3	CONTRACTOR	0.13
4	POLITICAL AND SOCIOECONOMIC	0.04

Sub criterion weight

Ranking	Sub Criterion	Global Weights
1	Payment delays	0.242
2	Defective design	0.163

3	Scheduling	0.121
4	Delays in obtaining permits	0.077
5	Bribery/ commission	0.060
6	In accurate estimation of quantities	0.057
7	Deficiencies in specifications in drawing	0.052
8	Improper scope	0.033
9	Safety of workers	0.026
10	Change in Government policies	0.022
11	Lack of qualified staff	0.02
12	Documents not issued in time	0.016
13	Material availability	0.013
14	Inflation	0.01
15	Political uncertainty	0.008
16	Terrorism/ war threats	0.006
17	Third party delays	0.006

Payment Delays

Payment delays were at the top of the list, with a global significance of 0.242. This demonstrates that the most common cause of delays on construction projects in Khyber Pakhtunkhwa is the client's failure to pay the contractor on time. This is a chain activity; if the contractor's bills are not paid, he will run out of operating funds and be unable to complete the task at the necessary pace. Another difficulty is that he cannot pay the subcontractors participating in most operations. Thus their work is halted due to the contractor's failure to pay them. As a result, necessary efforts should be made to ensure prompt payment to contractors and subcontractors so that project work does not come to a standstill and schedule and cost overruns are avoided. Payment delays occur due to funding issues on many construction projects, causing payment delays that lead to time and cost overruns. This is because Pakistan, particularly Khyber Pakhtunkhwa, is a developing country that frequently has financial issues for projects due to the unequal allocation of the annual developmental program (ADP).

Defective *Design*

According to this analysis, defective design is also a considerable risk factor, ranking second with a global weight of 0.163. As a result, to have the right design and avoid issues during project execution, the client and consultant should take steps to work closely and involve the contractor if the contract allows. These designs also have a lot of concerns with buildability. Suppose the contractor is involved in the project design phase. In that case, the design will be better since the suggestions of the party that will implement the project will be incorporated into the design, preventing later issues. Another important fact is that contractors do not thoroughly analyze the design during the bidding stage. Therefore, disagreements do not arise. While the client is liable for any design defects, it is also the contractor's job to thoroughly analyze the design early on to remedy any flaws and avoid delays later on.

Scheduling

With a global weight of 0.121, Inaccurate Schedule is likewise among the top lists. As a result, the contractor must thoroughly examine the project and contract documents, taking into account various risk variables to prepare an accurate timetable that can be met to avoid time and cost overruns later. Although this may not be achievable, contractors aim to squeeze the timetable as much as possible during the bidding stage to gain a faster project completion time. While the contractor is liable for any inaccuracies in the schedule he provides, the client should also assume full responsibility for validating the contractor's plan and making it as practicable as possible so that it can be fulfilled with the help of a consultant.

Delays in Obtaining Permits

Global weight of 0.077 delays in obtaining permits are also a key risk to consider. The client is responsible for providing the permits that have not been provided to the contractor on time, which is also the reason for the overrun and time bard. Obtain updated project information to create a proper timetable. When the most up-to-date project information is gathered, and the schedule is created, it will create the most optimum schedule that can be achieved with minimal variation because it is based on the most up-to-date project data and will not be subjected to any substantial changes. As a result, required efforts should be taken to collect current project data with all essential major modifications included and use it as the foundation for schedule planning to avoid problems in the future. After studying similar projects that have already been completed and those that are currently in the execution phase, necessary information about the issues that are likely to occur on this project can be gathered, allowing proactive management to avoid or reduce their effects, thereby minimizing the project's negative effects. There is a strong possibility that the project will be completed on time once all risk variables have been reviewed. Although risk management techniques used on mega projects around the world are not widely used in Pakistan, except for a few projects, making the necessary efforts to apply them to building projects in Khyber Pakhtunkhwa can be a real benefit, allowing us to create the most optimal schedule incorporating all risk factors that may arise during the execution phase and preparing us to manage them. As a result, it can significantly reduce deviations from the anticipated timetable, hence preventing time and expense overruns. As is clear, all risks cannot be addressed during the planning phase, and risks will inevitably arise during the implementation phase, necessitating using risk management tools to mitigate them. As a result, if strict supervision and coordination are used, and all stakeholders operate as one team, the project is unlikely to fall behind schedule.

VI. CONCLUSION

This paper offers a systematic examination and in-depth content analysis of earlier research on risk identification in the construction sector to suggest study areas that deserve future exploration. This study's findings suggest that the selected publications typically used a combination of two or more risk assessment approaches or procedures to identify potential issues. Literature reviews, questionnaire surveys, and expert interviews were the most often utilized approaches for finding dangers in the articles studied, while diagramming and analysis was rarely used. According to a review of existing classification systems, there is no standard or agreement on the classification of dangers in the construction industry. For risk classification, nature and source of risks were the most common approaches employed in selected papers. Economic, political, construction, financial and management were the top five categories utilized to group risks according to their type in most of the papers selected for inclusion in the review. Eleven categories of hazards found in the selected papers have been examined in this study; these are the following, management/technical/construction/resource related/site conditions/contractual/legal/economic/financial/social/political sudden rises or falls in inflation; design defects and poor engineering; changes in governmental regulations and policies; and unexpected adverse weather conditions were among the most commonly mentioned hazards (constant rain, snow, temperature, and wind). Comparing risk categories reveals that economic and financial risk was the most commonly identified, whereas social, health, and safety risk were the least frequently encountered.

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CONFLICTS OF INTEREST

The authors declare they have no conflicts of interest to report regarding the present study.

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