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Identification and Assessment of Major Risks in Syrian Construction Projects: Lattakia-Syria Case

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ABSTRACT

The Syrian construction industry is plagued with risks that can be challenging to the overall success of any construction project. To minimize a project's damage in terms of cost, time and quality, an authentic data-driven and expert-approved risk plan must be developed. This paper proposes a methodology to identify and assess major risks based on the personal evaluation of experienced civil engineers as a step in a comprehensive risk-management process. By combining a ranked risk magnitude index and an assigned risk zone, fifteen major risks were identified and assessed. Companies are advised to use the list to develop a resourceful general risk plan. Combining the two methods together makes the risk plan more representative and thus more reliable, as the two proposed methods can result in different rankings. The top fifteen risks in the Syrian construction industry were mainly management, financial and design risks. Locating in the zone of maximum risk came "an unprecedented increase in raw-material prices" and "the loss due to an increase in fuel prices" as number one and number two, respectively". "Unavailability of resources" was next in the zone of high risk. "Improper cost estimation" and "losing critical work forces at a critical time" scored high in the final ranking.

KEYWORDS: Risk identification, Risk assessment, Syria, Construction industry.

INTRODUCTION

The construction industry is undoubtedly famous for being one of the most dynamic, hazardous and challenging businesses. It is also widely known for having projects with increasing complexity. Nevertheless, the industry still has a very poor reputation for managing risks due to inadequate strategies that it uses to fulfill this purpose. As this is the bleak reality with construction projects, it is well-understood that no construction project is risk-free. What managers can do is trying to manage, decrease, transfer or even accept risks. It is, however, impossible under any circumstances to ignore risks (Burchett et al., 1999; Jayasudha & Vidivelli, 2016; Hayes et al., 1986). At First, the whole definition of a risk can be quite perplexing, as it is a multi-facet concept (Karimi Azari et al., 2011). As far as the construction industry is concerned, there could be the likelihood of the occurrence of one factor/event, as well as at least the combination of two factors/events which occur during the whole process of construction to the detriment of the project (Karimi Azari et al., 2011). A risk is the potential for complications and/or problems with respect to the completion of a project and the achievement of at least one of the project's objectives (i.e., scope, schedule, cost, quality, … etc.). Subsequently, it is an indecisive future event or condition with an occurrence rate ranging from 0% to 100% (Barnes, 1983). As for risk categorization, several different classifications for different purposes are found in the literature (Jayasudha & Vidivelli, 2016). The aim of this paper is to develop a methodology to identify and assess risks in Syrian construction projects. It is the very first basic and yet crucial step towards an integrated risk assessment, as the

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entire success of risk-management concept depends on it, including basically identifying the factors which could potentially impacts of project's cost, schedule or quality targets, quantifying the different impacts of the risks that were identified and finally executing managerial decisions to mitigate the outcomes of these risks. This paper identifies and assesses major risks in the Syrian construction industry by initially introducing risks at two levels. At the first level, six main groups (financial risks, legal risks, management risks, construction risks, risks associated with sub-contractors and finally design risks) were used. The second level included thirty of the most-influential risks in construction projects in Lattakia, Syria. This hierarchy was finalized after studying several projects executed by the General Firm for Construction in Lattakia and consultation with academics at Tishreen University. Next, this study developed linguistic terms to describe the likelihood and the severity or impact of the proposed risks. Those terms were expressed in detail in terms of cost, quality and time according to the experts and managers. Risks were then ranked using a combination of a ranked risk magnitude index and risk zones, as using one of them by itself may not represent the risks needed to be incorporated into a general risk plan. The results may also be used in further research as input data that would have summarized the major risks that are heavily affecting the Syrian construction industry and are in either the maximum-, high- or moderate-risk zones.

LITERATURE REVIEW

In the literature, authors have determined risks and used them to develop various models to predict and atomize the decision-making process in the construction industry, applying different approaches and mathematical models and for specific types of projects. However, very few approached risks in construction projects for the purpose of developing an overall risk plan for a company. In Syria, Jrad and Aldbs (2015) examined risks in dam projects. Risks were ranked according to the risk-criticality number that equals risk likelihood multiplied by risk impact on (quality, cost and time individually) and risk decidability. The paper presented a hybrid model of failure-mode and effect analysis (FMEA) and fuzzy set theory. The model was developed using C sharp, Microsoft access and OLDB (Jrad & Aldbs, 2015). Mustafa (2017) used "Bayesian theory" to model the cause-effect relationship between risks in road projects executed by the General Firm of Transportation and Roads in Damascus in Syria. Experts evaluated forty-seven risks in terms of occurrence likelihood and impact or severity of the risk (Mustafa, 2017). Khaddour (2022) assessed sustainability threats in mega-scale residential projects in Damascus, Syria. The research identified and assessed sustainability risks in private, public and private-public partnership companies (Khaddour, 2022). In concrete technology, Abdallah et al. (2022) determined the potential radiological risks of natural radioactivity in cement used in Jordan. The paper determined the factors impacting the natural radioactivity in cement, which are the activity concentrations for Ra226, Th232 and K40, dose rate, annual effective dose, radium equivalent, external hazard, activity concentration index and alpha index. The study performed flow-table tests for mortar workability, ambient-temperature measurements and high-temperature cupboard oven for each of the studied cement types. Results were then compared to the European and Jordanian specifications, which revealed that white Portland cement had the maximum value of compressive strength and all cement types were compliant with the Jordanian and European standard specifications (Abdallah et al., 2022). Alshboul et al. (2022) proposed seven robust models that can forecast liquidated damage in highway projects that could work with potentially different road projects arising in the future. Using modified multiple linear regression (MLR), the study examined 2486 different road projects in the USA over a six-year study period. The paper then determined the independent variables affecting liquidated-damage estimation for the road systems as follows (bid days, road-system type, total bid amount, auto liquidated damage indicator, funding indicator and total adjustment days) and one dependent variable, which is the response or the LD prediction. The models were able to predict new observations. The most important variable was the total bid amount, while the least important variable was the funding indicator (Alshboul et al., 2022). Alshboul et al. (2022) also introduced a hybrid mathematical and machine-learning model which can estimate green construction projects' costs based on external support impact. This was done using datasets for 3579 LEEF-certified green constructions from Europe and Northern America, as well as precision-assessment datasets which can eliminate the ambiguity associated with the cost prediction (Alshboul et al., 2022). Shehadeh et al. (2022) developed a model for risk assessment based on the gain-pain share ratio in real-world data for target cost contracts. The authors employed game-theory simulation to reach an optimal pain-gain ratio while considering all potential scenarios. Results showed that this ratio varies according to the difference between the construction-project cost variation and the contractor's effort fee (Shehadeh et al., 2022). Overall, researchers have tackled risks associated with specific types of construction projects and while that can be important and specific, a general risk list is needed to build a systematic risk plan for public companies. Nevertheless, this has had very little attention. This paper aims to identify and rank risks in the construction industry in Lattakia, Syria. This can be used to create a general risk plan and is a part of an integrated risk management which can lead – when properly applied – to minimum cost and time overruns in construction projects.

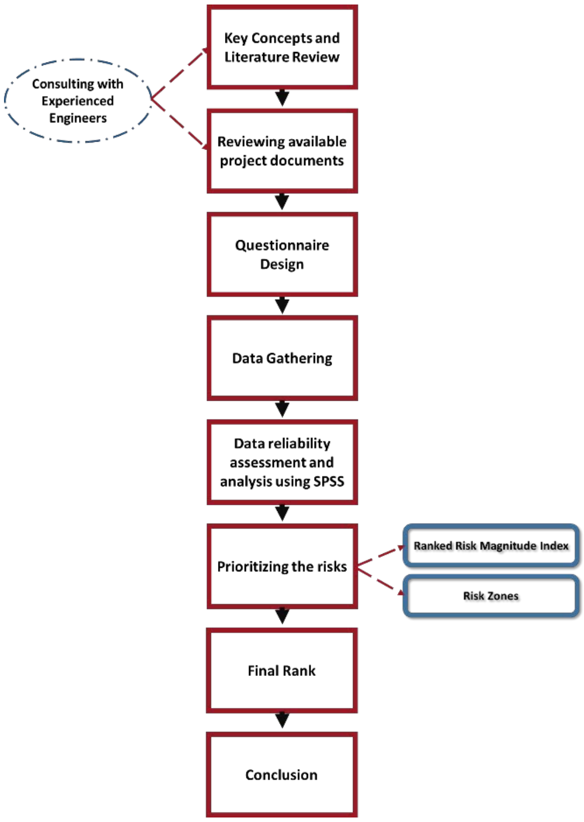

Figure (1): Research-methodology chart

EXPERIMENTAL METHODS

The main goal of this research is to identify major risks affecting the Syrian construction industry in general. This can be used by public companies in Lattakia to develop a risk plan which is especially useful in the first phases of any construction project, where little information is available. According to Porter, the number of risks needed to incorporate the majority of the risks is not substantial, as considering the top eight largest risks will cover approximately 90% of the total risks (Porter, 1981). By considering all of the major risks discussed in this research, a construction company would be able to develop a proper risk plan, which inevitably means that a project will be less likely to suffer disastrous cost and time overruns. Keep in mind that the assessment of a risk is filled with inevitable uncertainty, ambiguity and vagueness, because the risk magnitude is expressed using subjective opinion and imprecise linguistic expressions (Tah & Carr, 2000). The research proposes a methodology to assess major risks in the Syrian construction industry using historical data and reports to develop a questionnaire including the top major risks in the construction industry in Syria, particularly in Lattakia. Experienced civil engineers were asked to answer the questionnaire. A total of 30 sub-risks were ultimately chosen after a thorough study of the available literature and previous similar works. Some modifications have also been made to accommodate the Syrian construction-industry nature after consultation with academics at the university. The sub-risks are compiled into six major groups (financial risks, legal risks, management risks, construction risks, risks associated with sub-contractors and design risks). In the next step, a total of 50 samples have been distributed to several companies in Lattakia which execute and supervise construction projects in the city, which are (the General Company for Engineering Studies, the General Firm for Construction in Lattakia, Social Work and Insurance Company, the General Water and Irrigation Firm), along with some civil engineers working for an on-going series of residential buildings in Lattakia and are employed by those firms. The respondents were civil engineers supervising and designing several public construction projects with over 10 years of experience. 37 copies were answered and returned, which were used for analysis, as they were deemed valid and completed. The response rate is 74 percent, which is considered a considerably good rate given the nature of the construction industry. The results are then analyzed using the statistical package for social sciences (SPSS), the 25th edition. Risks are then ranked using a combination of a risk-magnitude index and risk zones. The chart in Figure 1 explains the research methodology.

Step 1: Questionnaire Design

The questionnaire used to gather data is divided into four sections. The first section includes general information about the respondents (years of experience, job title and the approximate number of construction projects that they had designed and/or supervised). The second section is designed to measure the awareness of risk allocation (owner, contractor and shared). The third section contains a total of the finalized risk hierarchy described in Table 1 and is dedicated to collecting the experienced opinions regarding each risk likelihood. To demonstrate the likelihood or the probability of a specific risk event happening, its frequency of occurrence during a year is used (Godfrey, 1996). The linguistic terms used to determine the risk likelihood are defined in Table 2.

Table 1. Risk hierarchy

Major Risk	Sub-risk	Symbol
Financial Risks	Loss due to interest fluctuation	Q1
	Loss due to an increase in fuel prices	Q2
	An increase in employees' payments	Q3
	An unprecedented increase in raw-material prices	Q4
Legal Risks	Contractual breaches	Q5
	Improper checking for contractual documents	Q6
Management Risks	Unavailability of past experience for this specific kind of projects	Q7
	Limited tender time	Q8
	Project-team deliberation about risks	Q9
	Losing critical work teams/forces at a critical time in the project schedule	Q10
	Incorrect feasibility study	Q11
	Poor relationships and disputes among contractual parties	Q12
	Time constraints	Q13
Construction Risks	Unavailability of resources	Q14
	Change in work quantities	Q15
	Getting approvals in accordance of project schedule	Q16
	Safety of the staff	Q17
	Labor and equipment shortage	Q18
	Labor accidents	Q19
	Unexpected structural elements collapsing	Q20
	Electric fuses	Q21
	Incorrect geotechnical studies and identification of underground and site investigation	Q22
	Work termination due to an outbreak (i.e., corona virus)	Q23
Risks Associated with Sub-contractors	Prices' review	Q24
	Sub-contractors delivering work post deadline	Q25
	Sub-contractors leaving or quitting	Q26
Designing Risks	Late design changes ordered by the client	Q27
	Improper and inadequate designs	Q28
	Improper specifications	Q29
	Improper cost estimation	Q30

Table 2. Linguistic terms for risk likelihood

Linguistic term for risk likelihood	Unlikely (0-35)%	Moderate (25-65)%	Very likely (50-100)%
Description	Risk might happen each 10 to 100 years	Risk might happen several times a year	Risk night happen at least one time a week

The fourth and final section includes the same sub-risks, but it is designed to measure risk severity. A set of terms to describe the severity of risks was chosen, after deliberation with several experts and academics about the possible used terms and their interpretation in terms of cost, time, safety and quality, as shown in Table 3.

Table 3. Linguistic terms for risk severity

Linguistic term for risk severity/ intensity/ impact	Low (0-35)%	Moderate (25-65)%	Very high (50-100)%
Description	Limited time and cost variations while maintaining an acceptable level of safety and quality standards.	Considerable time and cost variations while maintaining a medium level of safety and quality standards.	Very large time and cost variations with poor-quality standards and several incidents causing injuries.

Step 2: Data Gathering

A total of 50 samples have been dispensed for civil engineers working for governmental departments in Lattakia governance, 37 of which were valid and duly completed and returned. These were used for analysis purposes. The response rate equals 74 percent, which is considered a somewhat good rate given the nature of the construction industry in Lattakia, Syria. The questionnaire was dispatched in hand to every respondent after briefly explaining its objective, how to answer and what to expect when it is used later for analysis.

Step 3: Data-reliability Assessment and Analysis Using SPSS

Cronbach’s Alpha has been calculated to evaluate the internal consistency of answers using SPSS the 25th edition and the results are shown in the following Table 4:

Table 4. Reliability statistics

Cronbach's alpha	Cronbach's alpha based on standardized items	Number of items
0.948	0.946	60

The Cronbach’s alpha value is calculated using SPSS and is equal to 0.948. A value higher than 0.9 indicates that response values for each participant across a set of questions are consistent and thus no changes were needed to be made to the questionnaire. This consistency indicates that the measurements are reliable and the items might measure the same characteristics. This means that the results may be used as a future reference.

Demographic findings of the current study are explained here to help the reader gain further insight:

- 27.30% of the respondents have accumulated experience over 10 years and up to 30 years.
- 35.14% of the respondents were mainly engineers in charge of supervising multiple construction projects and 43.24% of them were designing engineers. The rest of the respondents are either department managers, department vice-mangers or in charge of managing a specific project.
- 37.84% of the respondents have worked in at least five major construction projects.

Step 4: Prioritizing the Risks

In the literature, there have been several methods used for this purpose. Researchers would sometimes use a risk magnitude index to rank risks. This is equal to the arithmetic mean of the risk impact on the project’s cost, time and quality, respectively, multiplied by its probability of occurrence, according to the experts (Khusravi et al., 2020; Jrad & Aldbs, 2015). In some cases, an additional factor, “risk detectability” is added (Jrad & Aldbs, 2015). Others used mathematical models as well as machine-learning approaches or a combination of both to calculate the relative importance of factors impacting a phenomenon (Alshboul et al., 2022; Alshboul et al., 2022). This paper aims to determine and assess major risks according to the industry's experts. Thus, a combination of a linguistic-based ranked risk magnitude index and the zone to which each risk is assigned based on the majority of experts' opinions. This will be used to get the final risk rank which will be later used to develop the company's general risk plan. Risk magnitude is calculated by multiplying its impact (severity/intensity) on the project's performance measures by its likelihood of occurrence. The linguistic terms describing the likelihood and the impact are described in Table 1 and Table 2, respectively. Equation (1) exhibits the formula used to calculate the magnitude.

$$\mathrm{RM} = \mathrm{Ri} \times \mathrm{Rl} \qquad (1)$$

where: RM is the risk magnitude.

Ri is the risk intensity.

Rl is the risk likelihood.

1. Linguistic-based Ranked Risk Magnitude Index

This index is calculated using the arithmetic average of the total experts' opinions or answers according to the values which were assigned to them. Equation (2) is used for this purpose.

$$\mathrm{RRMI} = \frac{\sum_{i=1}^{37}(\mathrm{RM})}{\mathrm{N}} \qquad (2)$$

where: RRMI is the ranked risk magnitude index.

RM is the risk magnitude.

N is the total number of experts used in this survey.

Table 5 shows the ranking of the risks.

Table 5. Risk ranking according to the ranked risk magnitude index

Symbol	Description	∑RM	RRMI	Ranked Risks
Q4	An unprecedented increase in raw-material prices	249	6.730	1
Q2	Loss due to an increase in fuel prices	198	5.351	2
Q12	Poor relationships and disputes among contractual parties	163	4.405	3
Q30	Improper cost estimation	160	4.324	4
Q10	Losing critical work teams/forces at a critical time in the project schedule	158	4.270	5
Q5	Contractual breaches	151	4.081	6
Q11	Incorrect feasibility study	151	4.081	7
Q29	Improper specifications	151	4.081	8
Q26	Sub-contractors leaving or quitting	148	4.000	9
Q25	Sub-contractors delivering work post deadline	147	3.973	10
Q28	Improper and inadequate designs	143	3.865	11
Q27	Late design changes ordered by the client	141	3.811	12
Q15	Changes in work quantities	134	3.622	13
Q14	Unavailability of resources	130	3.514	14
Q13	Time constraints	125	3.378	15
Q1	Loss due to interest fluctuation	124	3.351	16
Q8	Limited tender time	124	3.351	17
Q24	Prices' review	124	3.351	18
Q3	An increase in employees' payments	122	3.297	19
Q22	Incorrect geotechnical studies and identification of underground and site investigation	118	3.189	20
Q21	Electric fuses	117	3.162	21
Q19	Labor accidents	114	3.081	22
Q18	Labor and equipment shortage	112	3.027	23
Q17	Safety of the staff	111	3.000	24
Q20	Unexpected structural elements collapsing	106	2.865	25

Symbol	Description	∑RM	RRMI	Ranked Risks
Q7	Unavailability of past experience for this specific kind of projects	105	2.838	26
Q16	Getting approvals in accordance of project schedule	104	2.811	27
Q6	Improper checking for contractual documents	103	2.784	28
Q9	Project-team deliberation about risks	103	2.784	29
Q23	Work termination due to an outbreak (i.e., corona virus)	96	2.595	30

2. Assigned Risk Zone

Each risk will be assigned to a risk zone according to its magnitude. By plotting a graph between probability and the impact of a risk, we would get five possible zones for risks. It is possible to plot a graph between probability and the impact of the risk (Jayasudha & Vidivelli, 2016). Figure 2 explains the four zones of risk severity that are out there.

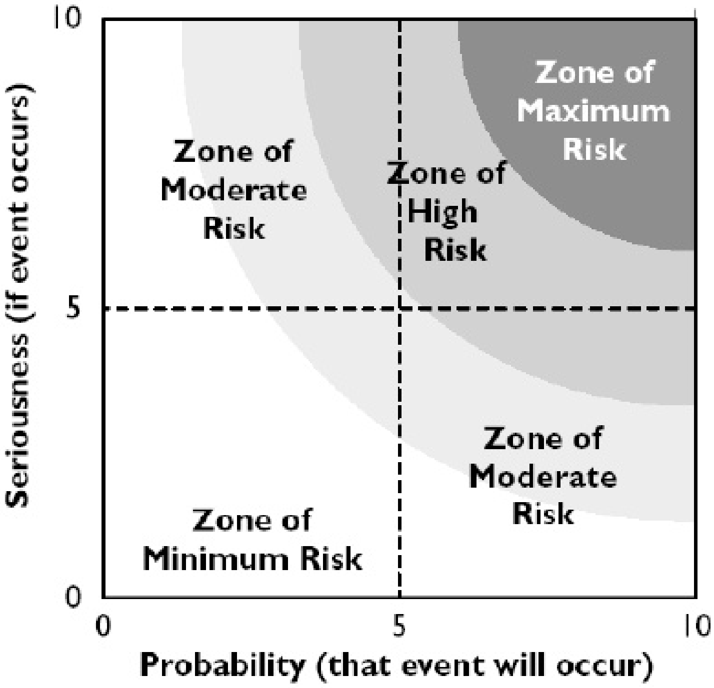

Figure (2): Zones of risks according to the relationship between risk probability (likelihood) and risk seriousness (impact or severity) (Jayasudha & Vidivelli, 2016)

In the risk matrix described in Figure 3, there are six potential values for each risk. Each of those values will be assigned to a zone as follows:

- ➢ If the risk magnitude is equal to (1, 2), then the risk will be considered in the minimum-risk zone.
- ➢ If the risk magnitude is equal to (3, 4), then the risk will be considered in the moderate-risk zone.
- ➢ If the risk magnitude is equal to (6), then the risk will be considered in the zone of high risk.
- ➢ If the risk magnitude is equal to (9), then the risk will be in the zone of maximum risk.

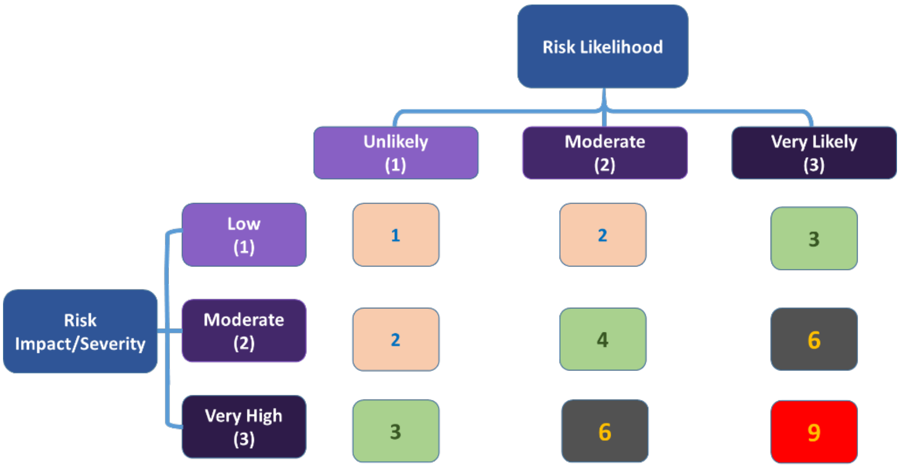

Figure (3): Risk-impact and risk-likelihood matrix

The number of experts who answered each of the previous values in the matrix is then calculated. The final value of risk magnitude is the value which has the highest number of experts' choices. This is described using the formuls:

$$RM(i) = Max(n_i)$$

RM Risk magnitude i.

The final results are explained in Table 6.

Table 6. Number of experts answering each risk magnitude

Risks	Number of experts who answered the risk magnitude value						Final risk magnitude
	n_1	n_2	n_3	n_4	n_6	n_9	
Q1	16	4	0	9	1	7	1
Q2	5	2	0	9	6	15	9
Q3	13	4	1	9	9	1	1
Q4	0	0	1	9	8	19	9
Q5	2	6	4	13	9	3	4
Q6	8	14	2	7	5	1	2
Q7	13	10	1	7	4	2	1
Q8	9	12	2	6	3	5	2
Q9	9	10	0	15	3	0	4
Q10	2	5	1	18	8	3	4
Q11	2	4	4	16	10	1	4
Q12	3	10	3	7	7	7	2
Q13	12	7	4	1	11	2	1
Q14	5	8	4	7	12	1	6
Q15	4	11	2	13	3	4	4
Q16	11	10	3	8	4	1	1
Q17	14	7	0	6	10	0	1
Q18	16	3	4	4	9	1	1
Q19	14	4	4	9	3	3	1
Q20	16	5	6	3	4	3	1
Q21	14	8	2	4	5	4	1

Q22	12	6	5	5	7	2	1
Q23	15	5	4	5	5	1	1
Q24	4	17	1	10	0	5	2
Q25	1	9	4	15	4	4	4
Q26	2	9	2	13	7	4	4
Q27	4	8	1	14	8	2	4
Q28	5	5	3	15	6	3	4
Q29	4	7	2	11	10	3	4
Q30	4	3	2	17	5	6	4

Finally, the risks are divided according to the zones which they belong to in Table 7.

Table 7. Risk ranking according to risk zone

Symbol	Description	RM	The zone to which the risk is assigned	Rank
Q4	An unprecedented increase in raw-material prices	9	Zone of maximum risk	1
Q2	Loss due to an increase in fuel prices	9	Zone of maximum risk	2
Q14	Unavailability of sources	6	Zone of high risk	3
Q5	Contractual breaches	4	Moderate-risk zone	4
Q9	Project-team deliberation about risks	4	Moderate-risk zone	5
Q10	Losing critical work teams/forces at a critical time in the project schedule	4	Moderate-risk zone	6
Q11	Incorrect feasibility study	4	Moderate-risk zone	7
Q15	Change in work quantities	4	Moderate-risk zone	8
Q25	Sub-contractors delivering work post deadline	4	Moderate-risk zone	9
Q26	Sub-contractors leaving or quitting	4	Moderate-risk zone	10
Q27	Late design changes ordered by the client	4	Moderate-risk zone	11
Q28	Improper and inadequate designs	4	Moderate-risk zone	12
Q29	Improper specifications	4	Moderate-risk zone	13
Q30	Improper cost estimation	4	Moderate-risk zone	14
Q6	Improper checking for contractual documents	2	Minimum-risk zone	15
Q8	Limited tender time	2	Minimum-risk zone	16
Q12	Poor relationships and disputes among contractual parties	2	Minimum-risk zone	17
Q24	Prices' review	2	Minimum-risk zone	18
Q1	Loss due to interest fluctuation	1	Minimum-risk zone	19
Q3	An increase in employees' payments	1	Minimum-risk zone	20
Q7	Unavailability of past experience for this specific kind of projects	1	Minimum-risk zone	21
Q13	Time constraints	1	Minimum-risk zone	22
Q16	Getting approvals in accordance of project schedule	1	Minimum-risk zone	23
Q17	Safety of the staff	1	Minimum-risk zone	24
Q18	Labor and equipment shortage	1	Minimum-risk zone	25
Q19	Labor accidents	1	Minimum-risk zone	26
Q20	Unexpected structural elements collapsing	1	Minimum-risk zone	27
Q21	Electric fuses	1	Minimum-risk zone	28
Q22	Incorrect geotechnical studies and identification of underground and site investigation	1	Minimum-risk zone	29
Q23	Work termination due to an outbreak (i.e., corona virus)	1	Minimum-risk zone	30

Combining the Two Methods

To develop an overall risk plan for the company, we will be using only the risks located in the moderate-, high-or maximum-risk zones. This being said, only the top fourteen risks are located in such zones. To get to the final ranking, we will be comparing the top fourteen risks in both methods and then consulting with experts. Table 8 displays this comparison.

Table 8. A comparison between the two used methods

According to the Ranked Risk Magnitude Index		Rank	According to Risk Zones	
Q4	An unprecedented increase in raw-material prices	1	Q4	An unprecedented increase in raw-material prices
Q2	Loss due to an increase in fuel prices	2	Q2	Loss due to an increase in fuel prices
Q12	Poor relationships and disputes among contractual parties	3	Q14	Unavailability of sources
Q30	Improper cost estimation	4	Q5	Contractual breaches
Q10	Losing critical work teams/forces at a critical time in the project schedule	5	Q9	Project-team deliberation about risks
Q5	Contractual breaches	6	Q10	Losing critical work teams/forces at a critical time in the project schedule
Q11	Incorrect feasibility study	7	Q11	Incorrect feasibility study
Q29	Improper specifications	8	Q15	Change in work quantities
Q26	Sub-contractors leaving or quitting	9	Q25	Sub-contractors delivering work post deadline
Q25	Sub-contractors delivering work post deadline	10	Q26	Sub-contractors leaving or quitting
Q28	Improper and inadequate designs	11	Q27	Late design changes ordered by the client
Q27	Late design changes ordered by the client	12	Q28	Improper and inadequate designs
Q15	Change in work quantities	13	Q29	Improper specifications
Q14	Unavailability of resources	14	Q30	Improper cost estimation

The top three risks according to the zones will be considered the top three final risks, as they are located in the zones of maximum and high risk. “Poor relationship and disputes among contractual parties” was found to be missing from the risk-zone method. According to the experts, it is not considered a risk in the high-risk zone and thus will be placed at number fifteen. The rest of the ranking is somewhat similar with the exception of “project-team deliberation about risks”, which was found to be missing from the ranked risk index top fourteen list. This will be placed at rank 7.

The final ranking of all the fifteen major risks is shown in Table 9.

Table 9. The final risk ranking to develop an overall risk plan

Symbol	Description	Ranked Risks
Q4	An unprecedented increase in raw-material prices	1
Q2	Loss due to an increase in fuel prices	2
Q14	Unavailability of resources	3
Q30	Improper cost estimation	4
Q10	Losing critical work teams/forces at a critical time in the project schedule	5
Q5	Contractual breaches	6
Q9	Project-team deliberation about risks	7
Q11	Incorrect feasibility study	8
Q29	Improper specifications	9
Q26	Sub-contractors leaving or quitting	10
Q25	Sub-contractors delivering work post deadline	11
Q28	Improper and inadequate designs	12
Q27	Late design changes ordered by the client	13
Q15	Change in work quantities	14
Q12	Poor relationships and disputes among contractual parties	15

RESULTS AND DISCUSSION

In Table 9, the number one risk was “an unprecedented increase in raw-material prices”. As expected in such economic situations, prices are constantly shifting and, with that, costly overruns are the primary risk for the Syrian construction industry. This means that any risk plan for any type of projects must take this issue into account. Providing alternatives, coming up with flexible project specifications and smart and accurate contracts are the key measures to reducing inevitable impacts in terms of cost and time. In real projects performed by the targeted companies in Lattakia, the sudden and large increase in raw-material prices could not be found directly in the project’s documentation, but rather indirectly as cost and time overruns and, in extreme cases, it resulted in major costly changes. “Loss due to an increase in fuel prices” came at number two and is located in the maximum-risk zone. Constant and repeated halts in different construction activities are expected, as a lot of equipment, tools and construction operations depend on gas and petroleum. This means that an extra amount of cash-flow must be present in any risk plan to control this problem. In 2022, fuel and petroleum product prices went up three times in Syria and in 2023, they have gone up two times already. A series process of evaluation and maintenance of equipment used for construction activities by public firms is needed to determine the actual fuel and petroleum consumption. “Unavailability of resources” is the third most important risk and is located in the high-risk zone. This comes as no surprise, as the scarcity of resources is one of the main concerns for builders in Syrian construction nowadays. Experts at the General Firm for Construction in Lattakia said that floor tiles, for instance, had to be changed several times in the finishing works for story buildings due to unavailability and the constantly-changing high market prices. This has led to several time and cost overruns, as well as quality overruns. When Jrad and Aldbs (2015) investigated forty-four of the most common risks associated with dam projects in Syria, the most significant risks were found to be “improper geological site investigation” as well as “tremendous cost overruns” (Jrad & Aldbs, 2015). The latter confirms our results as the spike in material and fuel prices as well as the constant resource unavailability would eventually result in tremendous overruns, especially when not performing a proper feasibility study. Mustafa (2017) studied the risks of cost overruns in Syrian road projects. The number one risk was “an increase in raw-material cost” and was deemed to be of high importance. Inflation, changes in currency prices, shortages and inefficient equipment, slow decision-making and additional work packages not included in the original contract and changes in specifications and quantity of materials were found to be of moderate importance and scored high in the top ten ranking list (Mustafa, 2017). Most of those risks were found in our final list. This supports the idea of a potential general risk plan based on our final ranking. At number four comes “improper cost estimation”. By providing solid solutions and accurate forecasting of the previously-discussed risks, improper cost estimations can be drastically reduced. “Losing critical work teams/forces at a critical time in the project schedule” is at number five. This directly means that costly time delays are expected. If this problem is as important as this research shows and as experts think, additional teams must be considered when planning any project, especially in critical times of a construction process. “Contractual breaches” and “poor relationships and disputes among contractual parties” came at number six and number fifteen, respectively. This was the case for some of the projects that the General Firm for Construction in Lattakia supervises; namely, the general site works for residential buildings. The original duration of the project was 360 working days. However, the project was delayed for extra 50 days. The documentation suggested that this delay was caused by poor communication between projects’ parties, which led to late work delivery. All of the design risks mentioned in our hierarchy were present in the top fifteen list and are namely “improper cost estimation”, “improper specifications”, “improper and inadequate designs” and “late design changes ordered by the client”. This suggests that thorough inspections and checking must be done by experienced engineers to avoid costly design problems. “Incorrect feasibility study” is ranked eighth, as it is well understood that feasibility is a key factor and mistakes in such a preliminary phase can have devastating effects on the project later on. Coming in rank 11 and rank 12 are “sub-contractors leaving or quitting” and “sub-contractors delivering work post deadline”. These risks are directly related to the contractor. A company is then expected to choose a reliable contractor, which can minimize the possibility of such risks happening. Khaddour (2022) evaluated sustainability threats in mega-scale residential projects from the perspectives of private, public and private-public partnership construction companies in Damascus, Syria. Delays in providing alternative housing options came at number one with 0.4 magnitude. Coming next was the unexpected increase in costs and/or lack of finance with a magnitude of 0.35. Managerial issues, such as the unclear distribution of responsibilities and the absence of appropriate regulations for sustainable building in Syria, also scored high in the final ranking (Alshboul et al., 2022). As we can see, our final list includes most of the top ten risks for different types of projects. As Porter stated, considering the top eight largest risks will cover approximately 90% of the total risks (Porter, 1981). This list would be used to build a risk plan for a company. It would also enable it to avoid 90% of the damage caused by those risks.

CONCLUSIONS

The Syrian construction industry is plagued with risks that can present themselves as threatening challenges to the overall success of any construction project. As a counter step, an authentic data-driven and expert-approved risk plan must be developed. This can and should be used to minimize risks' impacts in the future. This paper proposed a methodology to identify and assess major risks as a step in a comprehensive, well-rounded risk-management process. Using a combination of ranked risk magnitude index and the assigned risk zone, a list of major risks was established. By using two of the most common risk ranking methods, researchers were able to develop a final risk list that includes the real risks needed in a risk plan. The top fifteen risks in the Syrian construction industry were mainly management, financial and design risks. Locating in the zone of maximum risk came "an unprecedented increase in raw-material prices" and "the loss due to an increase in fuel prices" at number one and number two, respectively." "Unavailability of resources" was next in the zone of high risk. "Improper cost estimation" and "losing critical work forces at a critical time" scored high in the final ranking. The top fifteen risks established in this work will enable companies to build a reliable risk plan for all types of projects, especially in early phases of the project's life cycle. It is also highly recommended that companies develop an additional, more specific risk plan based on its type to ensure best results.

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