Jordan Journal of Civil Engineering, Volume **17**, No. **3**, **2023**
DOI: https://doi.org/10.14525/JJCE.v17i3.03

Economic and Time Risk Factors Influencing the Construction Projects: A Case Study of Lebanese Construction Projects

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ABSTRACT

In recent years, Lebanon has been grappling with a multitude of crises across all sectors, presenting numerous challenges that have hindered the progress of the construction industry. The construction industry in Lebanon is plagued by a complex array of risks that can lead to the downfall of construction projects. Therefore, this study is primarily concerned with identifying the most crucial economic and time risk factors influencing the Lebanese construction projects. To achieve the research aim, a questionnaire was initially developed from a review of various sources of literature and then refined to reflect the unique circumstances faced by Lebanon in recent years. In addition to that, some interviews to analyze the economic and time risk factors were conducted among expert respondents in the Lebanese construction industry. Then, the relative important index (RII) was applied in order to classify the major risk factors. The findings obtained from the study reveal that currency fluctuation, risk of war, geological risks, risk of pandemics and vendor failures are the most crucial risk factors that influence the time and cost of the Lebanese construction projects. Finally, in order to mitigate the occurrence of the most critical risk factors identified in this study and ensure successful construction projects in Lebanon, effective risk-management strategies should be implemented.

KEYWORDS: Risk factors, Construction projects, Cost, Time, Lebanon.

INTRODUCTION

The project iron triangle, which includes time, cost and quality, is essential to the success of any project. In the construction industry, recent agreements reflect a greater emphasis on achieving high-quality project outcomes while reducing the time and cost involved (Banihashemi and Khalilzadeh, 2022). The risk must be assessed in terms of both the likelihood of something occurring and the influence that would result if it occurred (Gupta et al., 2015). The construction industry is always exposed to business failure and this is due to the fact that it is a risky business with numerous uncertainties that management must deal with. These uncertainties are caused by a number of external and internal factors (Ibrahim and Kagara, 2014). Risks in construction projects are considered generally in cost, safety or loss of preventative measures, timing, system reliability, performance and item-liability issues (Saporita, 2006). Nouban et al. (2020) stated that risks are a group of actions that have a negative impact on construction projects in terms of cost, quality and time. Jayasudha and Vidivelli (2016) said that there are various risks that influence the construction projects, which are operation risk, technology risk, financial risk, procurement risk, political risk, environmental risk, social risk, economic risk, reserves' risk, credit risk, engineering risk, materials' risks, weather risks, insurance risks and people risk. Nouban and Almuhisen (2018) reported that political decisions, social impacts, law changes, nature, changes in demand, market instability and development of technology are risk factors that can be categorized as external risks influencing the construction industry. Mishra and Mishra (2016) classified risks as engineering risks which include client risk and design risk, execution risk,

Received on 8/11/2022.
Accepted for Publication on 10/3/2023.

contract-management risk and resources' risk; and non-engineering risks which include political risk, country risk, natural risk, geological risk and statutory compliance risk. According to Kolhatkar and Dutta (2013), financial risks, such as increase in fuel prices, exchange-rate fluctuation, interest-rate fluctuation, inflation-rate fluctuation, insurance risk, liquidity risk, currency-exchange risk and bankruptcy risk adversely affect construction projects.

Pandemic is one of the factors that created complicated challenges and difficulties for the construction sector. Nweke and Nouban (2022) reported that Covid-19 pandemic had a negative impact on construction projects by increasing the cost and extending the timeline. Khodeir (2019) noted that lack of health and safety in construction projects can lead to extra expenditures and delays in construction. Rather (2018) stated that one of the technical risks that affect the construction project is the uncertainty about the availability and source of materials. According to Rahman et al. (2017), late delivery of materials is argued to be among the most crucial factors contributing to global construction-project delays. Ansah (2011) mentioned that late payments by the client cause extreme cash-flow issues for contractors. Alashwal and Al-Sabahi (2018) said that risks such as revolution or war can take place and have severe consequences for construction projects. El-Sayegh (2008) stated that currency fluctuation is one of the economic external factors influencing the construction project. Sun and Meng (2009) verified that geological, weather and unforeseen site conditions are environmental factors affecting the construction projects. Hassim et al. (2009) ranked poor vendor performance as a factor with a high influence and changes in government laws and regulations as a factor of least impacts on the construction projects. Pamidimukkala et al. (2020) said that natural disasters result in difficulties in construction projects by raising the total cost. Awosina et al. (2018) stated that incorrect cost estimation causes financial losses and loss of credibility (Table 1).

Table 1. Risk factors' sources

Risk factor	Sources
Risk of pandemic	(Nweke and Nouban, 2022)
Health risks	(Khodeir, 2019)
Availability of materials	(Rather, 2018)
Late delivery of materials	(Rahman et al., 2017)
Late payments for contractor	(Ansah, 2011)
Risk of war	(Alashwal and Al-Sabahi, 2018)
Currency fluctuation	(El-Sayegh, 2008)
Geological risks	(Sun and Meng, 2009)
Weather risks	(Sun and Meng, 2009)
Vendor failures' risk	(Hassim et al., 2009)
Changes in Regulations and laws	(Hassim et al., 2009)
Increase in fuel prices	(Kolhatkar and Dutta, 2013)
Natural disasters	(Pamidimukkala et al., 2020)
Inaccurate cost estimation	(Awosina et al., 2018)

Lebanon has been passing through serious crises in all sectors in the recent years. These crises made the Lebanese construction industry fraught with highly complicated risks that can contribute to the devastation of construction projects. Consequently, this study is primarily focused on identifying and categorizing the economic and time-related risk factors affecting construction projects in Lebanon.

LITERATURE REVIEW

In 2008, while many countries were experiencing

economic recession, Lebanon had a remarkable economic growth. This growth was largely driven by the construction industry's recent expansion. Various regions in Lebanon, not just the fashionable downtown Beirut, have experienced a significant increase in construction activity over the past few years. The real-estate development sector is expanding rapidly, with little to no planning or regulation by local or federal authorities (Frommherz-Hassib, 2010). According to IFP Info (2014), the construction industry in Lebanon is still considered a highly desirable sector for investors, both local and foreign. Despite recent challenges, the outlook for the future of the construction industry in Lebanon is very positive. Lebanese development companies have gained valuable experience from their work on numerous projects, not only in Lebanon, but also in other Arab countries, particularly Iraq, which highlights Lebanon's position as a key entry point to the broader Arab construction market. In 2018, Lebanon's Gross Domestic Product (GDP) was expected to rise by 7 to 8 percent and it was suggested that both private and public investments in the country were increasing. However, due to the CEDRE aid package of 11.8 billion USD, most of which was in the form of loans, the construction industry in Lebanon was put under significant pressure to improve. Lebanon has been facing an increasingly severe economic crisis over the last two years and this has led to a number of challenges for the construction sector (Shibani et al., 2022). The real-estate market in Lebanon has been severely affected by the economic crisis that started in 2019. The market for new residential buildings has come to a halt, with many unfinished construction projects left abandoned. Some developers are still trying to complete construction projects where apartments were sold before 2019. The crisis has caused a significant disruption to the real-estate market, catching developers and homeowners off guard and causing a major shift in the industry (Boudisseau, 2022).

The Lebanese construction industry has undergone a negative transformation and this can be attributed to various risk factors. Therefore, this paper aims to examine the risks that have led to the deterioration of the Lebanese construction industry. The focus will be on identifying and discussing the most significant risk factors that pose a threat to construction projects in Lebanon. To achieve this, the study will involve consulting with experts in the Lebanese construction industry to ensure that the identified risks are accurately classified and effectively addressed to minimize their impact on construction projects.

RESEARCH METHODOLOGY

The study was conducted in Lebanon and targeted construction professionals with extensive experience in the industry. Data collection involved two stages: administering a structured questionnaire and conducting interviews with selected participants to obtain more detailed information. The questionnaire was designed first from different sources of literature and then adjusted according to the situations that Lebanon passed through during these years to fulfill the research goals. It consisted of two sections: the first section gathered general information about the respondents, while the second section aimed to identify risk factors affecting construction projects in Lebanon, drawing on various sources of literature. 40 participants from various professions, including civil engineers, mechanical engineers, electrical engineers, architects, contractors and sub-contractors, were selected and the construction sites were visited multiple times to ensure that all members were accessible. Participants were asked to rate risk factors using a 5-point Likert scale, where 1 is strongly disagree, 2 disagree, 3 moderate, 4 agree and 5 strongly agree. Furthermore, to determine the accuracy of the collected data, the responses to the Likert-scale questions will be analyzed using Cronbach's alpha to assess their reliability. To compute Cronbach's alpha, the variance of each item is first determined and added together. Then, the variance of the total score is calculated. Once these values are obtained, Cronbach's alpha can be computed. According to Doloi (2008), the degree of reliability can be determined based on the value of Cronbach's alpha (Cα). A coefficient of Cα greater than 0.9 is considered excellent, while Cα between 0.9 and 0.8 is good and Cα between 0.8 and 0.7 is acceptable. A coefficient of Cα between 0.7 and 0.6 is considered questionable, between 0.6 and 0.5 is poor and below 0.5 is considered unacceptable. Finally, the risk factors were classified according to the RII which was evaluated for each risk using the formula represented in Eq. 1

$$RII = \frac{\sum (W \times n)}{A \times N} \quad (1)$$

where (RII) is the relative-importance index, (W) is the weight of each response, (n) is the response's frequency, (A) is the highest weight of response and (N) is the total number of respondents.

RESULTS AND DISCUSSION

All 40 questionnaires distributed were returned with complete responses, resulting in a 100% response rate. The respondents' profiles were described first, followed by a discussion of the economic and time risk factors affecting Lebanese construction projects. Finally, the most critical risk factors were ranked based on the RII.

Reliability Test

Table 2 reports the overall Cronbach's alpha coefficient value for all the questions used in the study, which was 0.87. This value suggests that the reliability of the data obtained through the questionnaire is good, indicating that the questions were consistent and reliably measuring the construct of interest.

Table 2. Reliability test results

Number of items	Cronbach's alpha	Degree of reliability
14	0.87	good

Respondents' Profile

The results obtained from the questionnaire revealed that 37.5% of the respondents are civil engineers, 12.5% are mechanical engineers, 12.5% are electrical engineers, 7.5% are architects, 17.5% are contractors and 12.5% are sub-contractors, as shown in Figure 1. As demonstrated in Figure 2, the results revealed that only 5% of the respondents are less than 25 years old, 62.5% are between 25 and 40 years old and 32.5% are more than 40 years old. Based on Figure 3, 5% of the respondents have experience less than 5 years, 30% have experience between 5 and 10 years, 40% have experience between 10 and 15 years and 25% have more than 15 years of experience in Lebanese construction projects. Figure 4 illustrates that 12.5% of the respondents have a diploma, 72.5% have a bachelor's degree and 15% have a master's degree.

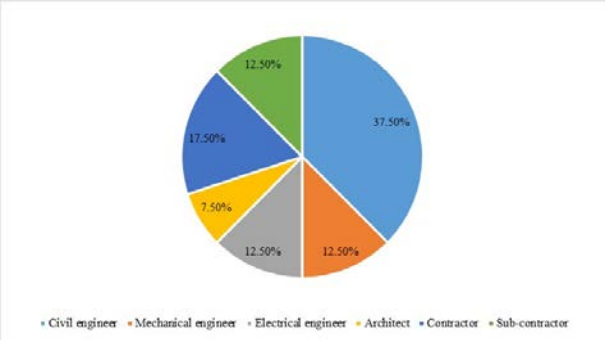

Figure (1): Respondents' professions

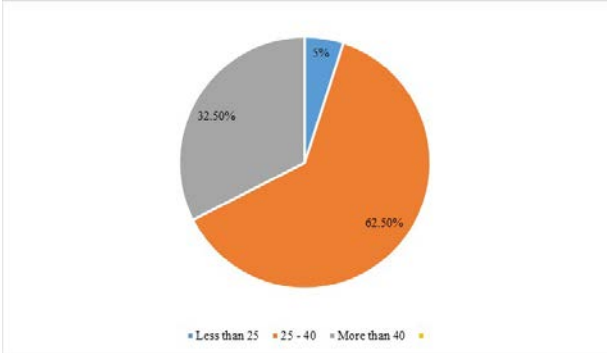

Figure (2): Respondents' ages

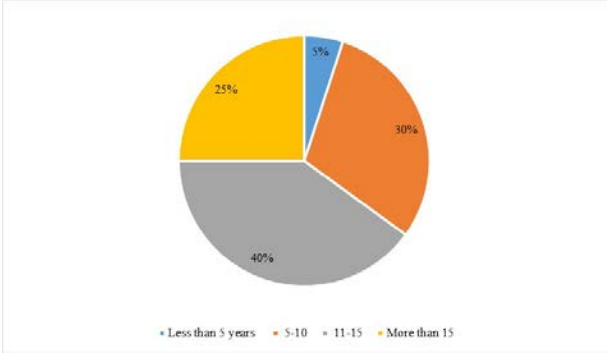

Figure (3): Respondents' years of experience

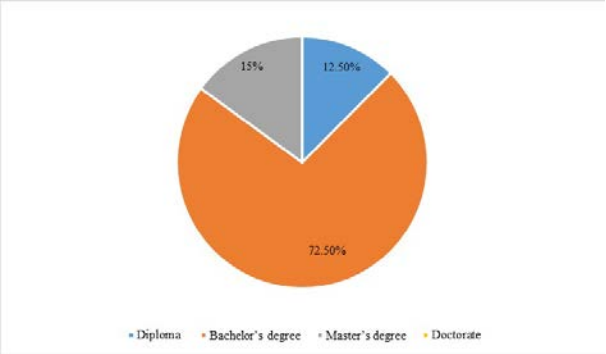

Figure (4): Respondents' education levels

Economic and Time Risk Factors

The second portion of the questionnaire representing

the rating of respondents to economic and time risk factors is tabulated in Table 3. The interviews with some of the expert respondents were conducted to explain their points of view about their rating to the risk factors by stating some of the obstacles that they faced during their work in construction projects. According to the first factor mentioned in the questionnaire, the respondents stated that during the Covid-19 pandemic, all construction projects stopped working because of the lockdown, which led to delays in finishing the projects. Also, some materials' prices, transportation and labor salaries increased. Regarding health risks, construction fields are always exposed to several types of accidents that may result in death because of safety failures which may also result in delays in the construction process. According to the worst situation that Lebanon was passing through during the recent years, various materials were lacking in Lebanese construction markets, which made the owning markets increase the prices of the demanded materials. Moreover, this factor was also causing delays in the construction process because of the difficulty in finding alternative materials. Late delivery of materials is another risk factor influencing the construction projects. It is a cause of time and cost overrun because of less productivity and bad quality performance because of hurry in work. Late payments for contractors had a negative impact on construction projects' stability. This causes financial difficulties for contractors and cash-flow problems. In addition to that, these financial difficulties cause sometimes delays in projects, because some sub-contractors stop working for not receiving payments. Risk of war, currency fluctuation and geological risks are risk factors that most respondents rate as agree and strongly agree. The last war Lebanon passed though was on 2006 for 34 days. During these 34 days, the construction projects totally stopped and some projects got destroyed, which caused a huge loss for the project owners. Even after the war, many roads and bridges got bombed, so that the construction projects faced a problem in transportation. Furthermore, due to the huge destruction caused by the war, various construction materials became unavailable in the markets and even if they were available, the priority was to reconstruct the main roads, bridges and infrastructures. Currency fluctuation is a risk factor that hit the Lebanese construction industry economically and created an extreme loss. Lebanon's currency was related to the US dollar with a fixed rate for approximately 20 years. Because of the Covid-19 pandemic, Beirut's port explosion and other political arguments, the currency started to lose its value against the US dollar and the US dollar started to disappear. These accidents deprived clients and contractors to get their savings or they had to withdraw their savings at very low rates. Also, some contracts were created according to the Lebanon's currency which forced the contractors to postpone the work until they create new contracts that align with the rates. Besides, many construction materials have been despised until their prices rise again. Geological risks are related to the sub-surface conditions of the construction fields and the soil type. These may increase the cost of excavation. Additionally, in certain areas, the soil may not be strong enough to support the weight of the construction, requiring additional work and adding to the overall cost of the project. Weather risks, regulation and law changes and natural disasters are risk factors that none of the respondents faced during their work. Regarding the vendor failures' risk, some vendors supply the construction projects with poor-quality materials instead of the required ones, aiming to gain more. This failure led to demolition and reconstruction of structural members which have been constructed with bad-quality materials. In the recent years, Lebanon was suffering from a fuel crisis because of the lack of fuel and high price of available fuel. The shortage of fuel slowed the progress in construction and increased the cost in order to provide the machines with fuel. Inaccurate cost estimation can generate cash-flow problems. Some project owners preferred to reduce the quality of work and quality of materials to overcome the problem, while others preferred to abandon the projects. Finally, the respondents reported that most of these risks have hit the Lebanese construction industry and created extreme losses. So, risk management must be implemented in order to avoid or reduce the occurrence of these risks.

Table 3. Risk factor findings

Risk factor	Strongly disagree	Disagree	Moderate	Agree	Strongly agree
Risk of pandemic	2	5	6	12	15
Health risks	9	8	12	7	4
Availability of materials	7	9	10	9	5
Late delivery of materials	11	7	8	8	6
Late payments for contractors	9	9	13	5	4
Risk of war	0	5	3	12	20
Currency fluctuation	0	0	5	7	28
Geological risks	2	3	7	9	19
Weather risks	13	11	9	4	3
Vendor failures' risk	4	5	13	8	10
Changes in regulations and laws	16	13	6	3	2
Increase in fuel prices	7	9	10	9	5
Natural disasters	17	13	7	2	1
Inaccurate cost estimation	3	7	18	7	5

Risk Factors' Ranking

As shown in Table 4, RII values were calculated and the risk factors were ranked from the most crucial factors to the least crucial ones. According to the respondents, currency fluctuation, risk of war, geological risks, risk of pandemic and vendor failures are the most crucial risk factors that influence the time and cost of construction projects. According to Badawy et al. (2022), at the planning phase, the most significant risks in residential construction were fluctuation of exchange rate, variation in costs of building materials, augmentation in fuel cost, inflation and foreign-exchange taxes. Mohammed (2016) statistically analyzed that the top risk factors that have a major impact on the cost of construction projects in Irbil city of Iraq are rise in costs of building materials, bad cost management, project's design change, incorrect cost estimation and low equipment efficiency. Additionally, the duration risk factors are work suspension, poor scheduling caused by contractor, delay in making a decision by the owner, owner's failure in funding the project and late payments by the owner. Referring to Karim et al. (2012), lack of materials, delay in delivery of materials, lack of efficient equipment, poor processing quality and difficulty in fluidity are the most critical risk factors in Muar and Batu Pahat districts in Malaysia. Yadeta (2020) ranked the most critical risks in the construction projects in Ethiopia as insufficient schedule, delay in payments, approvals and submittals, price inflation and bribes. Referring to Dixit et al. (2019), the most important factors influencing construction projects are the resources' availability, contract disputes, clearness of project scope, capability of design and frequently modifying the design. According to Dixit and Sharma (2019), the major factors controlling time overruns in high-rise construction projects in India are design alteration, lack of adequate planning, lack of resources and incorrect productivity computation. Gündüz et al. (2013) studied the risk factors that cause delays in Turkish construction sector and found that insufficient contractor experience, inadequate project scheduling, poor supervision in site, design changes and delay in material delivery are the top 5 significant risk factors that result in delays in the construction process. Pourrostam and Ismail (2011) investigated the causes of delay in the Iranian construction industry and concluded that the main causes of delay are lack of management in construction sites, late payments by the client, order changes during construction by the client and inadequate planning by the contractor. Iqbal et al. (2015) statistically classified the top risk factors that influence the construction in Pakistan as payment delays, problems in funding the project, safety accidents, poor design and poor execution plan. Shibani et al. (2022) classified the risk factors that negatively affect the productivity of Lebanese construction projects as political corruption, currency fluctuation, corruption in the construction sector, risk of

war and inflation in material prices.

The findings of these studies revealed that some risk factors are compatible with the risk factors obtained from the current study, such as currency fluctuation, risk of war, geological risks, risk of pandemic and vendor failures' risk, while other risk factors are not compatible and this is due to differences of countries, governments, regulations, site conditions and nations.

Table 4. Ranking the risk factors according to the RII values

Risk factor	RII	Rank
Currency fluctuation	0.915	1
Risk of war	0.835	2
Geological risks	0.8	3
Risk of pandemic	0.765	4
Vendor failures' risk	0.675	5
Inaccurate cost estimation	0.62	6
Availability of materials	0.58	7
Increase in fuel prices	0.58	8
Late delivery of materials	0.555	9
Health risks	0.545	10
Late payments for the contractor	0.54	11
Weather risks	0.465	12
Changes in regulations and laws	0.41	13
Natural disasters	0.385	14

CONCLUSIONS

This paper presents and analyzes the findings obtained from the questionnaire and the interviews conducted. The primary conclusion of the study is that currency fluctuation, risk of war, geological risks, risk of pandemic and vendor failures are the most critical risk factors affecting the time and cost of construction projects in Lebanon.

1. Currency fluctuation is a result of the devaluation of the Lebanese currency against the US dollar, causing financial difficulties for owners and contractors and making contracts in Lebanese currency less valuable.
2. The risk of war disrupts the construction process and makes it challenging to obtain construction materials, as the priority shifts to rebuilding damaged infrastructure.
3. Geological risks arise from unexpected sub-surface conditions and soil type, resulting in increased costs and delays due to additional necessary works.
4. The risk of pandemic results in construction project shutdowns and increased costs for materials, transportation and labor salaries.
5. Vendor failures occur when poor-quality materials are used in construction, necessitating the demolition and reconstruction of structural elements.

Given the impact of these risks on the cost and time of construction projects, it is crucial to implement risk management in the Lebanese construction industry to mitigate or reduce their occurrence.

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