

The implications of tools and techniques for project risk management in construction projects. A case of Public Authority of Roads and Transportations (PART) in the state of Kuwait

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ABSTRACT:

This study is aimed to discuss the tools and methods used for projects related to construction sites in accordance with the schemes under the risk management. The following research study is done in relation to the Public Authority of Roads and Transportations for the State of Kuwait. To achieve the success of this research study, a descriptive analysis of the secondary data has been done. Different articles and research works have opted that are related to this subject and proper analysis is done regarding the findings of those studies. Furthermore, it has been evaluated that there is significant importance of using different tools and techniques of risk management in the construction industry. Finally, there is seen to be a fractional effect of risk management in all its dimensions of construction projects in the Public Authority of Roads and Transportation (PART) in the State of Kuwait.

Keywords:

Tools and techniques, project risk management, construction projects, Public Authority of Roads and Transportations (PART), Kuwait

1.1 INTRODUCTION

The risk management scheme in agreement to the construction projects is essentially planned for the sole purpose of monitoring and controlling the risky measures that are needed to be prevented beforehand (Aven and Renn, 2010). Furthermore, it is important to recognize and assess the degree of future risks that could arise in construction projects. However, the necessity of evaluating the risk and providing and managing the methods that could help in minimising the possibilities of hazards. According to Chance and Brooks (2015), the projects of risk management are beneficial to impact the discovery of potential risks and analysing the hazards that could result in undermining any specific plan. The author further explained that there are several effects of an unidentified and unavoidable risk that could arise in future. Therefore, a risk management plan can help to develop the methods that can lower the effectiveness of the possibilities arising from future risks.

In addition, the problem identified for the case of Public Authority of Roads and Transportations in the state of Kuwait is regarding the projects of construction sites under risk management and the tools that are used for it. The application of techniques and tools within the criteria of risk management can result

in specific outcomes that lessen the impact of future risks. The aim of this research study is to acquire the specifications of the effects that result from the implementation of the methods and instruments used in a risk management plan in the architecture industry. In a research study by Carvalho and Rabechini Junior (2015), there are a total of five most vital risks that are possible to arise in a construction project, which includes a shortage of capital and assets, shortage of raw material, inadequate and outdated technology, poor quality work from labour-force, and late delivery of supplies. Additionally, there is significant importance of this study as the use of risk management project is a necessity in today's world. The assessing and analysing of the future risks and responding accordingly to those problems with efficient and effective solutions has significant importance (Muha, Škerlić and Erčulj, 2020).

1.2 Literature Review

Risk management is a process of analysing and evaluating the possibilities of risks that could arise in near future, hence providing suitable solutions and developing plans that could lower the effects of those

potential risks (Mohammed and Knapkova, 2016). There have been multiple types of research and studies done on the topic of risk management projects and with the passage of time, the studies were narrowed down for risk management in specific industries and sectors. In a research study by Serpell, Ferrada and Rubio (2017), risk management in construction not only identifies the risks that are possible to be involved with the project but also the mitigation of the impacts and effects in response to the uncertainties in various stages of the project. The author further elucidates that employees always have a chance and opportunity in reducing the possibility of the probable risks by simply identifying them beforehand. Thus, the availability of an action plan regarding the future risks can help in dealing with the hazards that are possible to occur. Similarly, in another study done by Falkner and Hiebl (2015), the importance of risk management can be understood by the publication analysis which is documented for a particular project or a business. It was further explained that the publication analysis of any small or medium-size enterprises is useful in determining the future risks and developing a strategic plan to overcome the possibilities of those risks. Therefore, the characteristics of the small businesses and findings from publication analysis can be aligned together for a significant impact on the business.

The process of observing the implementations and applications regarding the response plan of the future risks is known as risk monitoring and control process. The control process however deals with the tracking of the identified risks, assessing and analysing new possible risks, and evaluating the effectiveness of the risk plan throughout the project. In a research study done by Leo, Sharma and Maddulety (2019), there are several solutions to any problem that are involved with the projects of risk management undertaken in any industry. However, many solutions to the existing problems have been recommended and further studies are carried out to find out more solutions. Additionally, the implementation of tools and techniques of the risk management process in the construction industry have been discussed in various studies in order to bridge the literature gap. The process of studying the subject of risk management in development sectors was started in 1980, most of which have focused on the methods of identifying and evaluating the possible risks in different countries (Cakmak and Tezel, 2019). It was also noted that various researchers proposed different techniques as well as mathematical and theoretical models in order to manage the risks with efficacy and proficiency.

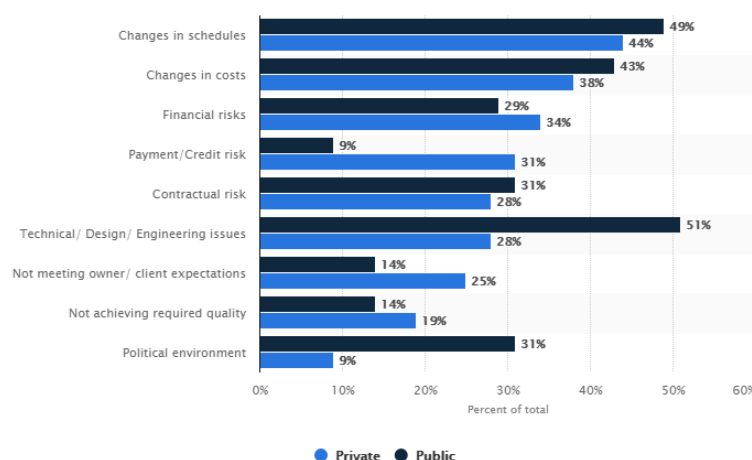


Figure 1: Major Risks for Public and Private Construction Projects (Statista, 2021)

The above figure 1 shows the major risks which are involved in public and private construction projects. In this manner, it can be determined from the above Figure 1 that technical or engineering issues are considered as the most major risk in public construction projects. In this manner, it generates the need for the companies to deal with lack of technical design or engineering capabilities to enhance the scope of project. As per the study conducted by Taofeeq, Adeleke and Hassan (2019), the engineering risks can cause huge loss for the public construction companies as the scope of these projects is large. Therefore, companies must adopt project risk management in order to ensure timely completion of this project along with an allocated budget.

According to a study by Ismael and Shealy (2018), the risks involved in the construction industry of Kuwait are recognised, quantified, and further used in the decision-making process as well as planning for unavoidable future risks. Further explanation regarding this study was done as recognition of the low probability risks and their low impacts in contrast to the high probability risks with greater impacts are known as risk management. The examples of risk involved in construction industry are possibility of failure in a project or any of its phase, postponement of schedule, and increased costs associated with the varying techniques of the construction (AlSanad, 2017). The development of risk analysis reports has

significant importance in ensuring that all the information and occurrence of possible risks are used and maintained throughout the construction period. This is helpful for the managing teams on the construction projects to prepare for any unexpected risk and also to maximise the outcome from that particular project. In another study by Xia et al. (2018), the integrated way of analysing and then managing the risks as well as the members of a particular project can be difficult to attain. However, it was suggested by the author that using the integrated method can be a unique approach for improving the performance of that project. The classification of risk is a vital part and a proposal for this grouping is given as cost risks involved in construction, maintenance, and operations with another group of demand risk involved with traffic forecasts and revenues (Sanchez-Cazorla, Alfalla-Luque and Irimia-Dieguez, 2016).

Theoretical framework

The theoretical framework for this study is comprised of the theory of relational risk management proposed by Lehtiranta (2011). It is a theory that is linked with the multi-organisational construction projects which further helps in assessing the uncertainties regarding performance of collaborative working. The relational risk is associated with multifaceted management issues which can significantly influence the success of the project. It also includes pragmatic approaches such as stakeholder management, relational contracting and relational risk management in construction projects. Hence, relational risk management theory in this research has helped in finding the application of techniques and tools within the criteria of risk management that can affect in particular consequences that lessen the impact of future risks.

1.3 Methods and Techniques

The methods and techniques that are used in this study to identify the impacts of implementing the different tools of risk management in the construction industry are explained briefly in this section.

1.3.1 Study Model

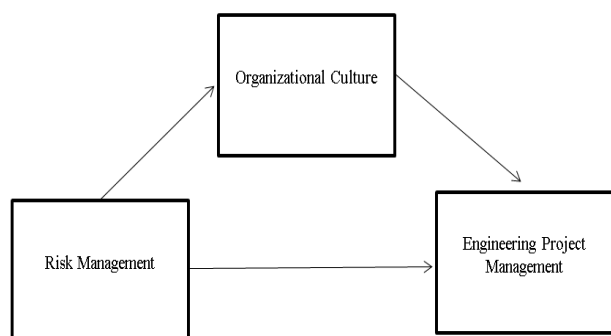


Figure 2: Study Model

The mediating role of organizational culture in improving the impact between risk management and engineering project management can be represented by the study model represented in fig 2, which shows the study model including the hypotheses and relationships that the study aims to test.

1.3.2 Hypotheses of study

The first main hypothesis:

Ho1: There is no statistically significant effect at a moral level ($P \leq 0.05$) for risk management in terms of its dimensions (technical risk management, logistics risk management, financial resource risk management, Human resources risks management, social and political risks management and environmental risks management) on the management of engineering projects in terms of their dimensions (cost, quality, time and Scope) in the Public Authority of Roads and Transportation in the state of Kuwait

It gives way to the following hypotheses:

Ho1-1: There is no statistically significant effect at amoral level ($P \leq 0.05$) for technical risks management in the management of engineering projects in their combined dimensions in the Public Authority of Roads and Transportation in the state of Kuwait

Ho1-2: There is no statistically significant effect at amoral level ($P \leq 0.05$) for logistics risks management in the management of engineering projects in their combined dimensions in the Public Authority for Roads and Transportation in the State of Kuwait

Ho1-3: There is no statistically significant effect at amoral level ($P \leq 0.05$) for financial resources risk management in the management of engineering projects in their combined dimensions in the Public Authority of Roads and Transportation in the state of Kuwait

Ho1-4: There is no statistically significant effect at amoral level ($P \leq 0.05$) for human resources risk management in the management of engineering projects in their combined dimensions in the Public Authority of Roads and Transportation in the state of Kuwait

Ho1-5: There is no statistically significant effect at amoral level ($P \leq 0.05$) for social and political risks management in the management of engineering projects in their combined dimensions in the Public Authority of Roads and Transportation in the state of Kuwait

Ho1-6: There is no statistically significant effect at amoral level ($P \leq 0.05$) for environmental risk management in the management of engineering projects in their combined dimensions in the Public Authority of Roads and Transportation in the state of Kuwait

The second main hypothesis:

Ho2: There is no statistically significant effect at a moral level ($P \leq 0.05$) for risk management in terms of its dimensions (technical risk management, logistics risk management, financial resource risk management, Human resources risks management, social and political risks management and environmental risks management) in the organizational culture of the Public Authority of Roads and Transportation in the state of Kuwait

The third main hypothesis:

Ho3: There is no statistically significant effect at a moral level ($P \leq 0.05$) for the organizational culture in the management of engineering projects in terms of their combined dimensions in the Ministry of Public Authority of Roads and Transportation in the state of Kuwait

The fourth main hypothesis:

There is no statistically significant effect at a moral level ($P \leq 0.05$) for risk management in terms of its dimensions (technical risk management, logistics risk management, financial resource risk management, Human resources risks management, social and political risks management and environmental risks management) on the management of engineering projects in terms of their dimensions (cost, quality, time and scope) with the presence of organized culture in the Public Authority of Roads and Transportation in the state of Kuwait

1.3.3 Research Design

There are three methods of research that are commonly used for any study which includes quantitative, qualitative, and mixed-method (Pluye et al., 2018). The quantitative research method deals with the collection and examination of numerical data and applying statistical models to interpret the outcomes of it. Whereas, the qualitative methods involve the collection of non-numerical data which mostly includes questionnaires, interviews, and first-hand observations. The combined research of quantitative and qualitative data is known as the mixed method in research approaches. The selected method of research for the following study is qualitative, as it helps in generating the content, provide industry-related insights, and most importantly it involves human nature.

1.3.4 Data Collection

The collection of data can be categorised in two main aspects, commonly known as primary method and secondary method (Chu and Ke, 2017). This study was developed based on data collection by secondary method under the category of qualitative research. The use of secondary data collection method is beneficial for this study as it is cost-effective. A lot of expenses are foregone which usually adds up while researching, interviewing, and regulating the questionnaires. Additionally, it is also important to use secondary data as it helps to save time and efforts as compared to that of the primary research.

1.3.5 Data Analysis

The process of applying statistical models and logical techniques in a systematic way to describe, align, and evaluate the data is known as the data analysis. The most important component of confirming data integrity is the accuracy and appropriate analysis of the findings acquired from the research. This study has used the content analysis technique to research the data. The method of content analysis has several benefits such as it helps in examining the communication directly from the text (Renz, Carrington and Badger, 2018). Also, that it can be used for both quantitative and qualitative research methods. Furthermore, this technique is beneficial in allowing a closeness to the data as the coded form of the text can be interpreted and analysed statistically.

1.4 Analysis**1.4.1 Critical Evaluation of Project Risk Management Adoption in Construction Projects**

Construction projects are considered to be costly due to the reason that they are more time consuming and involve different materials. As per the study conducted by Luong, Tran and Nguyen (2021), the cost of a project is high in construction as it involves multiple resources and for a longer period of time. In this manner, with the increased cost of entire project, the risk is also increased in the construction projects. Therefore, it generates the need for the companies to ensure project risk management concept. It is due to the reason that with the help of project risk management practices and adoption, the companies will be able to deal with the risks involved in a construction project. However, the increased cost of entire project also restricts the companies to adopt project risk management. The study of Romprasert and Jermstittiparsert (2019) argued that most of the companies believe that project risk management is an additional cost and it enhances the cost of entire project further. On the other hand, it has been stated in the study of Hilorme et al. (2019) that project risk

management can help to mitigate the loss of investment. It is because of the reason that the project risk management allows supplier, consultant, developer, contractor and client to minimize negative impacts over the project performance of construction project along with meeting their commitments.

In order to gain numerical insight into the risks that are experienced in construction project management, survey questionnaire was conducted with engineers and technicians that represented the study community. The study community is represented by the employees that occupy the engineering and technician positions in the PART in the State of Kuwait. Furthermore, it is assumed that they should be familiar with engineering project management, which they ought to have experienced during their work. Also, their number should be 274 (Human Resources in PART in the State of Kuwait). This community was chosen to be a part of research due to their exposure to the participation in

the projects and experience that they have obtained throughout their career. After, multicollinearity and autocorrelation tests were performed.

In Multicollinearity test, Pearson correlation coefficients were utilised to identify the problem of multiple linear correlations between independent study variables. After conducting literature review, the independent risk variables were identified as technical risk management, logistical risk management, financial resource risk management, human resource risk management, social and political risks, environmental risks and organisational culture). Table 1 show the matrix of the correlation coefficients between the independent study variables, as the values of the coefficients. It can be seen in the table that independent variables of the study are all statistically significant at a level of significant (0.01 **), which suggests that there is no problem of multiple linear correlation between the independent variables.

Table (1): Matrix of Pearson correlation coefficients between independent study variables.

variable	Technical risk management	Logistic risk management	Financial risk management	Managing human resources risks	Social and political risk management	Environmental risk management	Organizational culture
Technical risk management	1						
Logistic risk management	0.330**	1					
Financial risk management	.434**0	.652**0	1				
Managing human resources risks	.330**0	.701**0	0.573**	1			
Social and political risk management	.377**0	.674**0	.629**0	0.741**	1		
Environmental risk management	.357**0	.575**0	.511**0	.578**0	.625**0	1	
Organizational culture	.435**0	.632**0	.553**0	.621**0	.671**0	.476**0	1

From the above table, it can be seen that the highest correlation value is between social and political risk management and human resource risk management, which is (0.741 **). Other correlation values between the independent variables were less than that and ranged between (0.701 ** - 0.330 **), which it is less than 0.80. This suggests that there is absence of the

collinearity between all the independent variables, highlighting that the sample taken is free from the problem of multiple linearity.

The autocorrelation test validated that data is not subject to the problem of self-correlation as it impairs the capability to predict.

Table (2): The calculated Durban-Watson test values and their comparison with the tabular values to determine the self-correlation problem.

The result	(du Upper Limits	(dl Minimum limits	Value (D-W) (d) Computed	The premise
There is no self-correlation	1.722	1.530	1.505	H ₁
There is no self-correlation	1.651	1.598	1.066	H ₀₁₋₁
There is no self-correlation	1.651	1.598	1.474	H ₀₁₋₂
There is no self-correlation	1.651	1.598	1.338	H ₀₁₋₃
There is no self-correlation	1.651	1.598	1.484	H ₀₁₋₄
There is no self-correlation	1.651	1.598	1.125	H ₀₁₋₅
There is no self-correlation	1.651	1.598	1.564	H ₀₁₋₆
There is no self-correlation	1.722	1.530	1.815	H ₀₂
There is no self-correlation	1.651	1.598	1.869	H ₀₂₋₁
There is no self-correlation	1.651	1.598	1.726	H ₀₂₋₂
There is no self-correlation	1.651	1.598	1.993	H ₀₂₋₃
There is no self-correlation	1.651	1.598	1.989	H ₀₂₋₄
There is no self-correlation	1.651	1.598	1.793	H ₀₂₋₅

There is no self-correlation	1.651	1.598	1.895	H ₀₂₋₆
There is no self-correlation	1.651	1.598	0.821	H ₀₃
There is no self-correlation	1.737	1.515	1.427	H ₀₄
There is no self-correlation	1.665	1.584	0.819	H ₀₄₋₁
There is no self-correlation	1.665	1.584	1.213	H ₀₄₋₂
There is no self-correlation	1.665	1.584	0.915	H ₀₄₋₃
There is no self-correlation	1.665	1.584	1.089	H ₀₄₋₄
There is no self-correlation	1.665	1.584	0.915	H ₀₄₋₅
There is no self-correlation	1.665	1.584	1.153	H ₀₄₋₆

It can be seen from the above table that the sample and taken and the data collected regarding the independent variables identified are free from the issue of self-correlation and are valid and reliable.

Based on the above, and from the researcher's point of view, a management that is reliable and precise in assessing potential risks, contributes considerably to achieving the goals and success of the project by monitoring and following up on technical, logistical, financial, human, social, political and environmental risks. Risk management is not an optional process but rather a necessity for the success of any project, as it must be applied to all projects and included in the operating plans to become an integral part of every aspect of project management.

1.4.2 Analysing the Implications of Tools and Techniques for Project risk Management in Construction Projects in Kuwait

The creation of risk inquiry reports has noteworthy importance in confirming that all the evidence and existence of possible risks are used and sustained during the construction period. This is supportive for the working teams on the construction projects to arrange for any unforeseen risk and also to make the most of the outcome from that particular project. Xia et al. (2018) have stated that the integrated way of examining and then handling the risks as well

as the members of a specific project can be problematic to achieve. However, it was suggested by the author that using the unified method can be an exceptional approach for improving the performance of that project. Another technique of project risk management is the root cause analysis which is regarded as a systematic process that can identify important risks pertinent in the project (Vizzini, 2017). This tool is not only responsive but also preventive when it comes to managing risks in the construction projects. Moreover, probability and impact matrix can also be used for analysing risk in construction projects in Kuwait. It is the tool that helps in prioritising risks in order to make sure that better utilisation of resources is undertaken.

The first and foremost step towards the project risk management implementation is associated with the determination of risks. The companies have to determine the potential risks which can occur and might affect the entire project adversely. As per the study conducted by Muriana and Vizzini (2017), the determination of risk is the initial step which is used in techniques of project risk management. In addition to this, the step is also considered vital especially for construction projects as they are more vulnerable to risks due to the involvement of high cost. The study of Urbański, Haque and Oino (2019) argued that risk determination is regarded as important for project risk

management. Through these steps, companies can determine the risks which are further evaluated and assessed based on their effect.

On the other hand, the second step is associated with the assessment or analysis of the risk. Once the risk is determined, it is essential for the companies to assess and analyse the risk. As per the study conducted by Wang and Chen (2017), the assessment of risks determined is essential for public construction projects. It is due to the reason that there are various stakeholders in the public construction projects which increase the risks and criticality of the projects. Various people are involved or affected by the projects which require critical assessment of the risks

determined. In addition to this, the construction of roads and transportation in Kuwait requires companies to be more vigilant in terms of analysing or assessing the risks. These risk must be rated accordingly based on their impact on the project. In this manner, the companies will be able to provide rating to risks after analysing or assessing (Qiu et al., 2020). In this regard the study of Kulik and Weber (2010) asserted that the use of tools and techniques in project riskmanagement provide with the benefits of avoiding untimely issues, enhancing capability to negotiate, meeting consumer needs, and decreasing cost overruns and schedule slips.

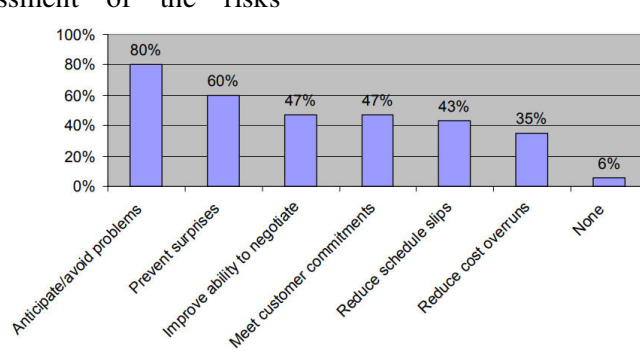


Figure 3. Benefits of using tools and techniques in project risk management (Kulik and Weber, 2010)

Another implication of the tools and techniques involved in project risk management is associated with the risk response. It refers to the development of risk mitigation strategies that can help the company to control the risks that emerged. As per the study conducted by Romprasert and Jernsittiparsert (2019), the risk response can assist the companies in order to develop an effective risk control plan which can contribute towards cost control. It is due to the reason that the cost of construction projects is already high and sudden increase in risks can further increase the cost of a project. On the other hand, monitoring of risk is essential and is considered a vital tool for project risk management. It is due to the reason that monitoring allows companies to determine the progress and of control strategies that are developed against the risks.

1.5 Conclusion and Recommendations

The following research can be concluded as the associations and implications of various tools and techniques of risk management projects have significant importance in construction industry. The research report includes a brief introduction of the selected topic while explaining the risks that are involved within the construction sector. A detailed literature review has been provided in accordance with similar researches done regarding the topic of risk management and its importance in various sectors while identifying the literature gaps. Furthermore, the

methods and data exploration techniques that are used in this research study have been depicted with the continuation of the analysis of the data particularly used for this research work. The final section of the report deals with the recommendations and future implications of this study for further exploration.

Several recommendations can be suggested for a smooth implementation of the risk management projects in the construction industry, some of them are discussed in this section of the report. Firstly, it is recommended that risk management analysis must be made compulsory as a part of every project. This must be done before the start of any project in order to minimise the possibility of unannounced and unwanted risks that could arise during any phase of the project. Secondly, the management of risks and maintaining a proper record of the risks must be made obligatory to ensure the maximum efficiency of the project. Lastly, it is also important to identify and differentiate the possible risks and opportunities that are associated with the project.

1.6 Future Implications

As suggested above regarding the recommendations of the implication of different tools and techniques of risk management in the construction projects, the future implications of these evaluated outcomes will have significant importance in reducing the effects of uninvaded future risks. Firstly, the construction companies that involve themselves in the management

of risk effectually and resourcefully are better off with saving more in terms of profit margins. It is always beneficial for the construction teams to save the trouble of looking over the sudden risks as the risks are evaluated and dealt on the right time. Secondly, the construction companies can also benefit from the risk management projects as it aids in increasing productivity. The explanation of this certainty can be done as that the interpretation of future risks and compiling possible solutions help in keeping the project phases in proper alignment. Last but not least, the use of risk management projects in construction can be advantageous as it increases the rates of improved success of the projects. Also, that it assists in making better decisions for the current and new projects.

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