Risk Evaluation in The Arabian Gulf Region (Agr) Construction Industry From Multinational Firms' Perceptions

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Abstract
Risk is an ever-present event on any construction project that causes run up costs, delays, and may eventually lead to project failure. International projects are more challenging than domestic projects as they experience a wider range of risks. With the growing amount of construction in the Arab Gulf Region (AGR) and many more multinational firms venturing into new international markets, limited research exists to identify and evaluate the impact of risks on projects in this area. This paper is intended to provide an overview of the risk associated with international projects and to help international companies to better allocate risks. Seventy-four (74) risks encountered in the AGR were identified and their impact on cost and schedule performance metrics was evaluated using a risk index. An analysis was then performed on projects for which cost and schedule were both impacted and the correlation between cost and schedule was compared. Using a non-parametric test, some factors were found to have significantly higher impact on cost or schedule. An International Risk Assessment Tool (IRAT) was then developed to help multinational firms enhance their visual ability to pre-emptively identify, address, and mitigate risks.

Keywords
Arabian Gulf Region, International Construction, Multinational Firms, Risks, Assessment Tool

1. Introduction

Risk is " *a consideration in the process of a construction project whose variation results in uncertainty in the final cost, duration and quality of the project*" (Kartam & Kartam 2001). Moreover, some authors refer to construction risk as a measure of the probability of occurrence and impact of not achieving a defined project goal (Kerzner 2009). No matter how risks are defined in construction industry, it is always beneficial to identify and control them through the life cycle of any construction project to minimize their adverse influence on the success of projects.

Several authors have investigated risks specific to the international construction market including socio-cultural, economic, political, regulatory restrictions, contractual arrangements, and foreign exchange risks to name a few (Baloi and Price 2003; Chua et al. 2003; Chan and Tse 2003; Ashley and Bonner 1987). From the Middle East and North African (MENA) projects perspective, numerous studies focused on identifying risks usually encountered by local (as opposed to multinational) construction firms. Tumi et.

al. (2009); Sweis et. al. (2008); El-Razek et. al. (2008); El-Sayegh (2008); Assaf and Al-Hejji (2006); Koushki et. al. (2005); Mezher and Tawil (1998) and others cited various significant factors that contributed to an increase in the project's schedule and cost in countries like Saudi Arabia, Kuwait, United Arab Emirates (UAE), Jordan, Lebanon, Egypt, and Libya. All of them concluded that there are several factors [outlined in detail in the following section] grouped into ten different risk categories, which lead to poor performance in terms of schedule and cost in these countries. However, there are little to no detailed studies in literature that focus on identifying risks encountered by multinational firms executing construction projects in the AGR. Only one such study was conducted by El-Sayegh (2008) who examined risks encountered by multinational firms in the UAE construction market, and found that they do not differ from those identified above. Given the large number of multinational firms who are interested in executing projects in the AGR, it is imperative to conduct a more comprehensive analysis of the unique characteristics of that region and the resulting risks to multinational firms.

2. Risk Identification

The initial task of the research methodology was targeted toward identifying the top risks encountered in AGC construction industry. The identified risks will then be incorporated in the comprehensive survey that will be used in the data collection stage for further evaluation. First, risks factors were identified through an extensive review of literature as follows: international construction markets (Ozorhon et. al. 2008; Ozorhon et. al. 2007; Dikmen and Birgonul 2006; Gunhan and Arditi 2005a; Gunhan and Arditi 2005b; Chan and Tse 2003; Baloi and Price 2003; Hastak and Shaked 2000); the Asian construction market (Ling and Poh 2008; Zou et. al. 2007; Sambasivan and Soon 2007; Alaghbari et. al, 2007; Andi 2006; Chua et. al 2003) and studies on construction risks encountered in specific MENA countries (Tumi et. al. 2009; Sweis et. al. 2008; El-Razek et. al. 2008; El-Sayegh 2008; Elyamany et. al. 2007; Assaf and Al -Hejji 2006; Zaneldin 2006; Abdul Rashid and Bakarman 2005; Koushki et. al. 2005; Al-Reshaid et. al. 2005; Goda 1999; Mezher and Tawil 1998). Second, standardized construction contracts from different perspectives such as design and construction contracts that are currently in use at construction projects in the AGC region were examined and risks on such contracts were identified with the help of employees at multinational companies currently working in the region. Finally, an open-ended questionnaire asked 222 multinational construction companies to list the top five risks they have encountered in the MENA construction industry. The risk identification task resulted in seventy-four (74) potential risk factors classified into twenty-seven (27) external risks (outside the company's control) and forty-seven (47) internal risks (within the company's control). Figure 1 outlines in detail the seventy-four (74) causes (factors) that lead to cost overruns and schedule delays in the form of a fishbone diagram. There are twenty-seven (27) internal risks (top half) and forty-seven (47) external (bottom half) risks.

Based on the risks identification task; a comprehensive survey was developed to quantitatively evaluate each risk factor from the perspective of multinational firms working on AGC projects. The participants were requested to rate the seventy-four (74) identified risks' relative frequency; as well as, impact on project cost and schedule. A total of 280 multinational construction firms associated with the AGC construction industry were contacted; resulted in a 43.6 percent response rate for 122 completed surveys. A list wise deletion was implemented, where any case with missing data was excluded from the analysis resulted of 66.4 percent (i.e., 81 out of 122) completed surveys. The participants consisted mainly of designer/consultant (56 percent) and project-manager (36 percent), and were from USA (70 percent) and UK (24 percent). Most of the projects used the lump sum as a financial contract type (83 percent). In most cases, companies were involved during the construction phase (66 percent). The Venn diagram in Figure: 2 illustrates the distribution of the eighty-one (81) projects.

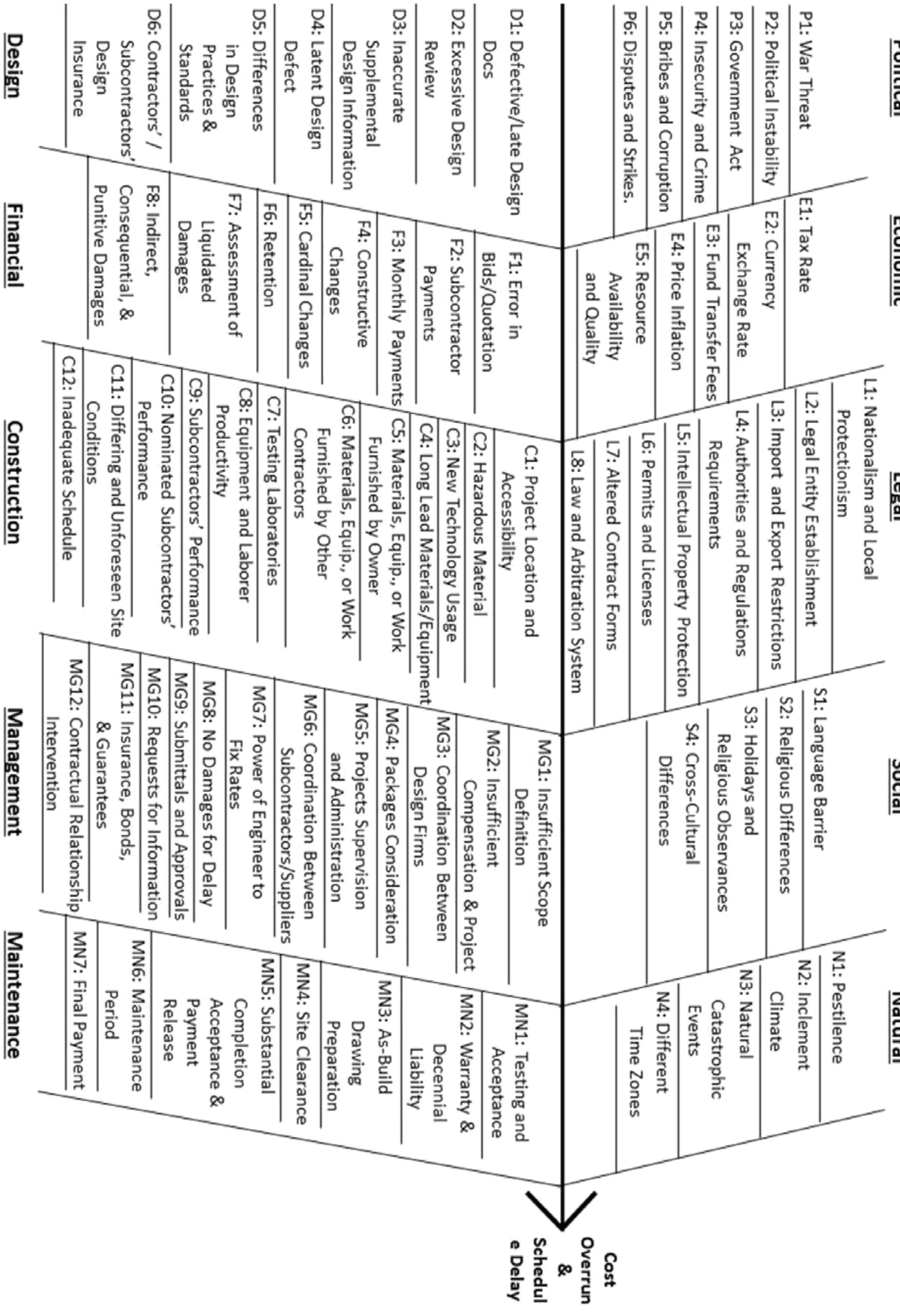

Figure 1: Fishbone Diagram Showing the 74 Risks

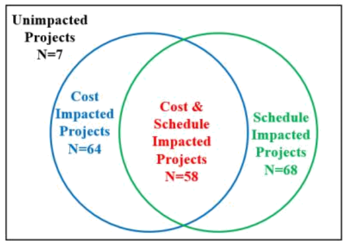

Figure 2: Venn Diagram Illustrating the Distribution Of The Projects

The analysis presented in this paper was performed on the fifty -eight (58) impacted projects (intersection in the Venn provided in Figure: 2 above) that experienced both cost overruns and schedule delays.

3. Data Analysis

3.1. Risk Prioritization

The significance of each risk factor was calculated in terms of its frequency (α) and degree of impact (β). Risk Significance (RS) can be expressed as a function of both attributes as follows: , (Shen 2001). Each risk factor resulted in two risk significance scores: one for the cost and the other for schedule.
Cost Risk Significance, denoted as , is obtained by multiplying the frequency of the factor by its impact on cost [, ,] for project . Schedule Risk Significance, demoted as , is obtained by multiplying the frequency of the factor by its impact on schedule [, ,] for project . A risk significance score was obtained for each factor on each project. An average significance score, also called risk index, RI, was then obtained for each factor by averaging scores from all 58 projects (Shen 2001).

RI , $\frac{\Sigma}{}$ and RI , $\frac{\Sigma}{}$ where j refers to risk factor. The results presented in Table 1 below; showed that "Insufficient definition of scope" (MG1) had the most influence on cost overruns and schedule delays while "Pestilence" (N1) had the least influence.

Table 1: Risk Prioritization Results

Risk	,	Risk	,	Risk	,	Risk	,
MG1	20.10	MG6	13.91	MG1	18.34	C4	15.24
E4	16.09	N2	13.72	C12	18.00	C6	15.05
F4	15.60	D3	13.70	N2	16.98	C8	14.79
P1	14.36	C12	13.41	P1	15.47	F4	14.13
E5	14.28	P2	13.40	E5	15.32	D1	13.77

3.2. Correlation

After ranking and prioritizing the risk factors that highly affect project cost and schedule, it was beneficial to investigate the correlation between the impact of a risk factor on project cost versus its schedule. Briefly, a positive correlation coefficient indicates that one variable increases with the other and a negative sign indicates that one variable decreases as the other increases. The results show that *all 74* correlation coefficients are positive with "Latent Design Defect" (D4) having the highest correlation coefficient (0.98) and "Currency Exchange Rate" (E2) having the lowest correlation coefficient (0.23).

To draw conclusions about populations and not just samples, a correlation test was performed. This statistical method tests if the correlation truly exists or was detected due to a random sampling error. The

Bonferroni correction was used to account for multiple comparison. The results of this analysis showed that all p-values were significant, thus indicating that cost impact and schedule impact are positively correlated with a non-zero population correlation coefficient.

3.3. Factors Significance on Cost and Schedule

The average impact on both cost and schedule were computed for each of the seventy -four (74) factors. Table 2 shows the factors that had a higher average cost impact and those that had a higher average schedule impact.

Table 2: Classification of Factors Based on Their Higher Average Impact

Higher Average Cost Impact (47)	Higher Average Schedule Impact (27)
D5, L8, C13, L2, D3, MN4, MG8, MN7, F5, P2, MG5, F4, S1, MG6, P5, MN3, MG1, L5, N4, MG2, MN5, MG4, L1, C14, L4, C3, L7, P3, F1, F6, F2, F8, MG11, S4, L3, C7, E1, MG7, MN6, MN2, E4, S2, F7, N1, F3, E3, E2	D4, MN1, P4, D6, N3, C2, C8, MG3, L6, P1, S3, P6, D2, C11, D1, C10, C9, C1, MG9, C5, C4, MG10, C6, MG12, E5, C12, N2

By simply comparing averages, seventy -four (74) factors were found to have a higher impact on cost and twenty-seven (27) factors were found to have a higher impact on schedule.

A statistical test was then conducted to test whether there exists a significant difference between the impact on cost and on schedule for each factor. In other words, a test was needed to check if the average cost impact of the forty-seven (47) factors is statically higher than their impact on schedule and whether the schedule impact of the twenty -seven (27) factors is statistically higher than their impact on cost. Due to the ordinal nature of the data and the dependency between the samples, the non-parametric Mann Whitney U test was used. This test is used to check whether two samples are derived from the same population using a significance level of 0.05. However, since seventy -four (74) independent comparisons were performed, the Bonferroni correction was used to counteract the problem of multiple comparison.

The results showed that while there is no significant difference between the impact of most factors on cost or schedule, seven factors did have significant p-values and their impact was higher on one of the project criteria. These seven factors are reported in the Table 3 below.

Table 3: Factors with Higher Impact on either Cost or Schedule and the Rationale behind It

Risk Factor	C/S**	Reason
MG9: Submittals and approvals	S	The cycle of paperwork that started as soon as the construction begins between the contractor and the designer to control the approval and make sure that the contract is strictly followed by the contractor. Can take more time than anticipated and affects the progress of work.
C6: Materials, equipment, or work furnished by other contractors	S	When another contractor is responsible for delivering certain materials or equipment for the project, failure to follow the master schedule precisely has a substantial affect the schedule.
C12: Inadequate schedule	S	If the schedule was not well prepared; having false resources loaded with incorrect relationship were used; this can significantly affect the project schedule.
		If the prices for material or equipment escalate during the construction

E4: Price Inflation	C	stage, the cost of the project will increase.
E3: Fund Transfer	C	The fund transfer fee should be accounted for in the contractor’s bid

Fees		price and can therefore affect the cost of the project.
E2: Currency Exchange Rate	C	The fluctuation of currency will influence the project cost so the contractor should account for the exchange rate in the total price.
E1: Tax Rate	C	Multinational firms are required to pay income taxes (for example) for their original home countries. USA's contractors working in the AGR have to add these amounts to their project cost.

** Here C Indicates an Average Higher Impact on Cost and S an Average Higher Impact on Schedule

4. **International Risk Assessment Tool**:

The culminating effort of this research on the evaluation of AGR risk factors was the International Risk Assessment Tool (IRAT). The IRAT was created using Microsoft Excel (2013), and was designed to be user-friendly and intuitive, quickly allowing multinational firms to assess risks for their projects in the AGR. With this tool project managers are able to identify potential risks they might encounter on their project and visualize their potential impact by inputting the frequency and expected impact of risk factors. The IRAT is comprised of various tabs including: introduction, description of the seventy-four (74) risks, risk assessment, and risk mapping. The introduction tab introduces the tool and emphasize the importance of risk assessment on international projects. In this tab, the user will provide specific information for the project on which IRAT is being used. A sample of this tab is shown in Figure 3 below.

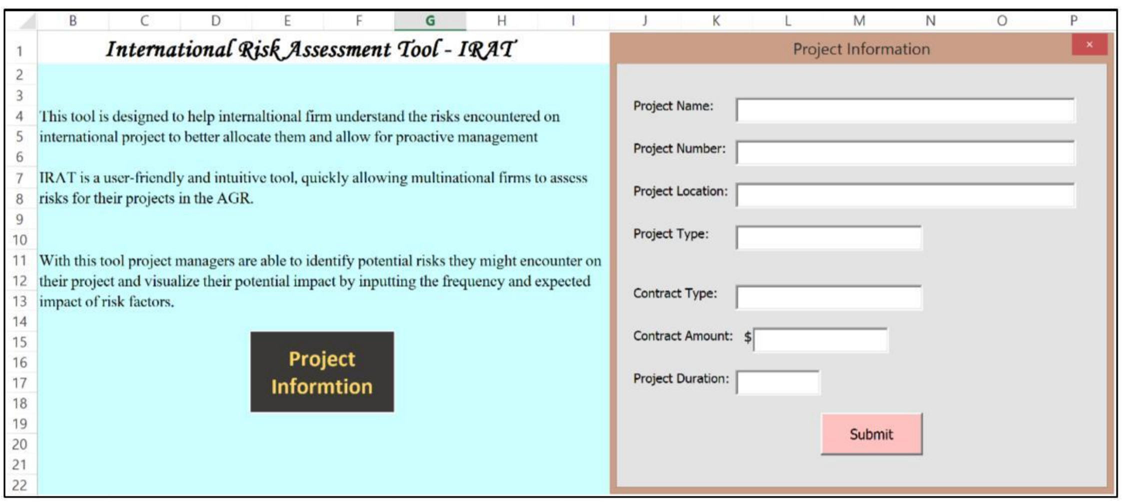

Figure 3 : IRAT – Project Information

Next, a detailed description of the seventy-four (74) factors and their categories and sub-categories is outlined in the description tab. The risk assessment tab in IRAT consists of two sections. The first section requires users to input the expected frequency and impact of each of the seventy-four (74) factors. The second section displays risk assessment information to the user. The IRAT will visually display the severity of each factor and whether cost or schedule is more impacted. An example of how to use the IRAT and what output to expect is illustrated in Figure 4 below.

As shown in Figure 4, the color and the diameter of each circle under the "cost" and "schedule" columns is an indication of the severity of each factor. IRAT will also generate the Risk Mapping Matrix (RMM) to allow a closer examination of the overall severity of risk factors. An example of IRAT RMM is shown in Figure 5.

The cells will contain an indication of the risk factor; P1 for instance is an abbreviation for War Threat, a political risk. Each of these risks will be linked to another sheet for a full description of the designation.

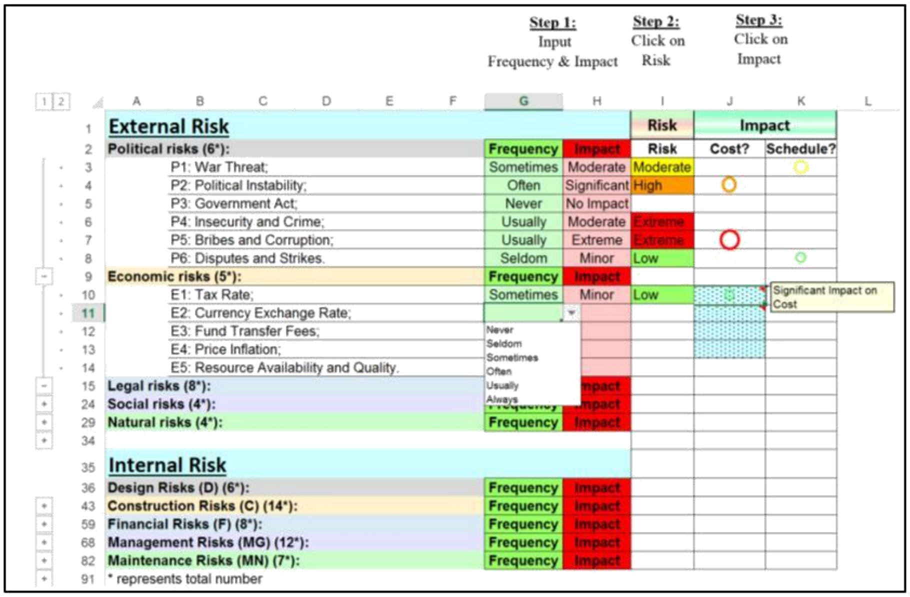

Figure 4 : IRAT Output Display

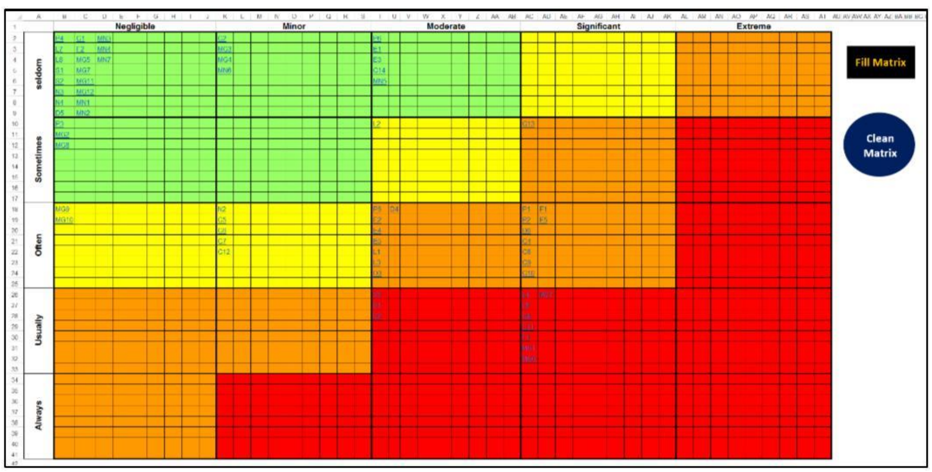

Figure 5 : IRAT Risk Mapping Matrix (RMM)

The "Project Information", "Risk", "impact", "Fill Matrix" and "Clean Matrix" buttons (among others) are macros written into the IRAT's MS excel file that run the analysis for the user and show the severity of each risk factor and its impact on either cost or schedule and map those risks into the RMM.

All of the results that are described in this paper can be derived by using this tool. IRAT has also the option to summarize and convert the generated results and RMM into a PDF. The tool could be also used as a database where multinational firms can store the history of risk assessment on their projects. The project information, project risks' frequency, impact and severity will be stored and aggregated project after project in a separate sheet to serve as a historical database for the company for future projects. This could also serve as a data collection tool for future researches.

5. Conclusion:

As the Arabian Gulf Region (AGR) remains a strategically important area of the world, the construction industry in that area has been experiencing an unexpected boom. The paper attempted to investigate the myriad of risk factors that affect project cost and schedule. Seventy-four (74) factors were identified and grouped into ten categories. A risk index was then established for each factor where “Insufficient definition of scope” (MG1) was found to have the most influence on cost overruns and schedule delays while “Pestilence” (N1) had the least. A correlation analysis was then performed to show that the impact of a risk factor on cost is positively correlated to its impact on schedule. A statistical test was also performed to check if there was any statistical significance between the impact of each factor on cost and schedule. The results showed that three factors had a significantly higher impact on schedule and four other factors showed significantly higher impact on cost. Finally, the IRAT tool was developed to summarize the findings of this research in a visual representation that can assist multinational firms in identifying, evaluating, and addressing risk on international projects in the AGR.

6. References

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