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RISK CLASSIFICATION AND BARRIER OF IMPLEMENTING RISK MANAGEMENT IN OIL AND GAS CONSTRUCTION COMPANIES

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Abstract

Risk management is one of the most essential and significant part of construction projects due to assuring the attainment of project goals. Because of increasing global energy, more attention is needed to be paid towards risk management in oil and gas companies. The aim of this study is to improve the implementation of risk management within contractor companies in the oil and gas construction project through the evaluation of the most import risk groups and the barriers of implementing risk management in this part of industry. The current study is carried out in Iran and the scope of study includes only the construction project in oil and gas companies. A total of 48 questionnaires were distributed to the respondents and only 35 were obtained duly answered. The data was analyzed using SPSS software during the preliminary stage of this study, a variety of risk groups have been studied, six of it were identified to be the most probable in oil and gas construction projects which includes financial, technical, contractual, design and construction, policy and political, and weather and environmental risk groups. Among these groups "financial risk" is the most critical group, while "weather and environmental" is the least critical group. The important barriers of implementing risk management are lack of expertise in techniques, lack of familiarity with techniques and lack of information and knowledge.

Keywords: Risk management, barrier, oil and gas

1.0 INTRODUCTION

Construction project compared with other industry has been overwhelmed by risk [1] and often resulting in increasing costs with poor performance and time delays [2]. Project risk is an undecided event if it happens, has negative effects on the project objectives (eg, cost, time, quality, etc.) [3].Recognizing significant group risk and the barrier of implementation of risk management are very important for decision making in construction project. Due to the organization, process, environment and the nature of construction activities [4], the construction projects and its client are widely related with the high grade of risk. Construction project exposed to various risk at different phases because of complex and dynamic nature [5] but unfortunately, the construction project has a poor status in risk recognition and analysis when compared to other projects and industries such as finance [6- 7]. Successfully elimination risk in projects is difficult or impossible, while can be effectively managed for those risks that is being identified and assessed in early stage of the projects [8, 9]. Risk management is a sequence of procedure which are needed for the identification, assessment, and response which tend to maximize the effects of positive event and minimize the negative impact of unfavorable event [10]. Therefore, implementation of risk management will promote performance through pursuing chance to raise positive effect project goals and ensuring to approach those goals [5].

Energy Demand is increasing throughout the world. Based on International Energy Agency (IEA), the global energy request will rise at a rate of 1.6% until 2030. Main bases of energy supply for human life are fossil energies and this further emphasis the

importance of oil and gas industry worldwide. Process of production in the oil and gas industry involves time consuming process and numerous phases including exploration, transport, refining, petrochemical and shipping for domestic and oversea markets and delivery. Oil and gas projects contains various risks including social, technical, economic technological risk and hazards and natural disaster [11]. The recognizing and highlighting the significant risk related oil and gas companies can help for proper planning to corresponding risk and eventually eliminate, transfer or control risk and improve productivity in this important part of industry. This study presents the conceptual differences of risk and uncertainty then considers the risk management method and evaluates variety of impotent risk groups. Furthermore it discusses the most important barrier of implementation risk management. Finally this paper presents and ranks six to ten important risk groups and barriers in oil and gas construction projects. The results of this research will contribute for both research and practice in risk management for oil and gas construction projects and also companies that are active in this field of industry.

2.0 RISK AND UNCERTAINLY

Uncertainty and risk are the two most often used concepts in the risk management field with number of authors have different definition. These concepts are very similar that even experts working with risk have various definition and understanding between them. Most of the definition of risk or uncertainty has been according to the special project. Table 1 and 2 compares the definition of two of these concepts according to different authors.

Table 1 Risk definition in research

Year	Risk definition	Author
1982	Risk is chance of an adverse event depending on the circumstances	Butler [12]
1977	Risk is the possible for undesirable or adverse consequences of an occurrence or activity	Rowe [13]
1998	Risk is combination of hazard and exposure	Chicken [14]
2000	Risk an uncertain occurrence or condition that, if happens, has a positive or a negative result on a project objective	PMBOK [15]
2005	Risk is exposure to the consequences of uncertainty	Cooper [16]
2009	Risk is the declaration of what may rise from that lack of information	Cleden [17]

Table 2 Uncertainty definition in research

Year	Uncertainty definition	Author
2002	a lack of certainty, involving inconsistency and vagueness	Chapman [18]
2004	unidentified occasion from an unidentified set of possible results	Hillson [19]
2006	There might be not sufficient knowledge about the incidence of an event, but we aware that it might happen	Smith [20]
2006	doubt about our ability to prediction of the future outcome	Lorenz [21]
2009	Uncertainty is what maybe occurs when all the risks have been recognized.	Cleden [22]

According to Al-Bahar [23], risk is considered to be the likelihood of occurrence of accident positively or negatively which affects the project objectives as a consequence of uncertainty. Risk is defined as the comprising of two components: first is the possibility of incident, and second is the consequence of incident [24-25]. The possibility element may result to uncertainty, which may lead to more than one consequence toward a problem [26].

All definition of risks submitted in Table 1 describes the risk as a condition where lack of some aspect can cause danger to the project. Most commonly stated by all the authors as leading reasons for a failure are lack of knowledge and information factors. The best definition of risk was prepared by Cleden [17] that is very near the purpose of this paper. It has been explained that risk is a gap in knowledge and information, if the problem is not resolved correctly, will create serious problems to the project. On the other hand the definitions provided in Table 2 are parallel to each other and the joint factor is contrasted due to lack of knowledge. Therefore the highlighted difference between two description of risk and uncertainty is awareness.

3.0 RISK MANAGEMENT

Risk management is the process of classifying and evaluating risk, and to implement the method as to reduce it to a satisfactory extend [27]. Risk management is a method which helps to recognize and determine all the risks to which the project or business is exposed so that the aware decision can

be taken on how to control or manage the risks [24]. A formal definition is given in the international standard IEC 62198 as a combination of the probability of the event occurring and its consequences for project objectives [28]. Risk management is the recognition, valuation, and ranking of risks followed with the coordinated and economical application of resources to monitor, control, and minimize the probability and effect of undesirable events [29].

Risk management starting as a separate field of study was concerned for human health and environment. In the early 1960, because of awareness and fear of general public of incidents, leading to increase legislation and attention to increase safety and decrease the human health risks. This was resulted to increase the attention of industries to assess and analyze risks at commercial level. Society for Risk Analysis (SRA) was founded in August 1980, that this was initially absorbed during the influence of chemical risk on human health. In this year risk management was being applied in the field of construction management [30]. Risk management has focused on various kind of complexity related to the large scale of project such as international collaboration, technology, geography or finance. [31, 32]. Recently, Risk management has begun to impact the increasing amount of companies not just big company but also small projects [30].

Project risk management is a formal process that the key purpose of project's risk management is to identify, assessment, and control the risk for project success [33]. Different researches have various definition, but to maximize the opportunities and to minimize the consequences of risk as it is a consensus between all of them [34, 15, 35]. According the PMI [36] it classifies six main steps for the risk management process: risk management planning, risk identification, qualitative risk analysis, quantitative risk analysis, risk response planning, risk monitoring and control. Zou *et al*. [8] defined risk management as the organized process of recognizing, analyzing, and controlling risks connected to construction projects aiming to achieve project objectives. Overall risk management is divided into seven steps: risk management planning, risk identification, risk assessment, risk analysis, risk response, risk monitoring and risk communication [37-38]. This research is focused on systematic risk management that simplified three main steps: risk identification and classification, risk analysis, and risk response. In addition risk response has been divided into four techniques: avoidance, reduction, sharing, and retention [39, 24].

The main goal of risk identification is to achieve a list with possible risk to be managed in a project [36]. different techniques can be applied in order to find all potential risks which might impact a specific project same as brain storm, interview, questioner, benchmarking, past experience, checklists, and research assumptions. Several researches shown among construction projects brainstormed and checked the most techniques during risk identification [40, 34, 41, 28]. Based PMI [36], the best method is the one that the project teams are most familiar with and most obtained from the project objectives. The purpose is to define the potential of these problems, in order to aware the project teams.

Furthermore fundamental research has been done in the field of risk identification for construction projects, significant consequence of which is to categorize many risks that affects the construction project delivery. Chapman and Ward [18] classified risks into four subclasses: industry, client, project and environment that these subcategories risks are divided into fifty eight subset risks. Baloi and Price [37], and Li *et al*. [42] categorized risk to six main groups that are financial, economic, managerial, legal, construction, design and environmental risks. Shen *et al*. [43] classified risk according to the nature of risks into six groups: financial, management, legal, market, technical, policy and political. It is mentioned that the classification of of risk should be connected to construction project and based on the objective of study. Kalayjian [44] represented four group of risk for Third World, classified that this kind of risks are commonly faced in today's global construction which includes: financial risk, political risk, reather and environmental risk, design and construction risk, Design and Construction Risk. Zou [8] prioritize risk based on their weight of effect on typical project objective regards to time, cost quality, environmental sustainability and safety. Hassanein and Afify [45] classified risk into seven groups according to a case study in Egypt which are as follows: financial, design, technical, contractor, owner obligation, contractor, allocation of liabilities. According to Tang *et al*. [46], the five most significant project risks are: premature failure of the facility, poor quality of work, safety, financial risk, and inadequate or incorrect design. Uher and Toakley [34] found out that most of the industrial practitioners were familiar to risk management, but generally as qualitative rather than quantitative analysis methods were used and requested in the conceptual phase was relatively low. Lack of knowledge, commitment to training and professional development caused to impede the widespread adoption of risk management.

4.0 BARRIERS OF IMPLEMENTATION OF RISK MANAGEMENT

S Several studies have been carried out in finding out the barrier affecting the implementation and adopting of risk assessment, however, most of the researches have been within the developed countries. Table 3 shows the summary of most common barriers for implementation of risk management project.

Hwang [5] showed lack of sufficient time, lack of budget, low profit margin, and not economical were among the top four effective barriers for the implementation of risk management among small construction in Singapore. It is mentioned that lack of time is due to lower proportion of project with risk management implementation that tends to go with shorter project duration. In the same study carried out in Singapore Hlaing *et al*. [48 in his study about construction contractor knowledge on construction risk identification declared that lack of time is the top level of barrier for risk management implementation, while lack of budget and lack of familiarity with techniques are at lower level. Lyons and Skitmore [41], identified time as a base constrain since construction of project mainly are using just in time for the customer satisfaction. Baloi and Price [37] mentioned despite risk management process as advanced and accessibility of the extensive of information and knowledge of risk management, still experts have no fully perception on the value of risk managing. In addition lack of expertise in techniques and lack of familiarity with techniques are other barriers of the efficient adoption. Investigation for implementation risk management in small construction by Griffith and Headley [47] displays that spending time for managing small project should be disproportionate to project cost but the respondent's outcome shows they did not believe that implementation of risk management was economical. This result exposed that disproportion between the project duration and the time spent, and low profit margin, inadequate budget investment and not economical are the main barriers for the implementation of risk management in small projects. According to Smith and Bohn [9], small projects are limited to spend time for scheduling and adopting risk management where small construction is time consuming, and project players are not interested to implement risk management. Furthermore main characteristics of small project are low profit margin and these projects should be economical to increase profit margin. In continuation he added that lack of sufficient knowledge and information would be other reason for avoiding risk management implementation by small projects. Research done by Tang *et al*. [46] in Chinese Construction Industry indicated that "lack of joint risk management mechanisms by parties", "shortage of knowledge/techniques on risk management," and "different recognition of risk control strategies" constitute the top three barriers to risk management. In addition completion between companies and different understanding of risk control strategy are other barriers of implementing risk management during the study.

Table 3 Barriers of implementation of risk management in research

Barriers	Griffith [47]	Smith [9]	Tang [46]	Lyons [41]	Hlaing. [48]	Baloi [37]	Hwang [49]
Lack of sufficient time	√	√		√	√		√
Lack of enough budget	√				√		√
Low profit margin	√	√					√
Not economical	√	√					√
Different interpreting of risk control strategy			√				
Lack of adequate information and knowledge		√	√			√	√
Lack of familiarity expertise in techniques						√	
Lack of familiarity with techniques			√		√	√	
Lack of joint risk management mechanisms by parties			√				
Competition among companies			√				
Lack of sufficient time	√	√		√	√		√

5.0 RESEARCH METHODOLOGY

The literature review helped to improve the understanding of risk and risk classification, barrier of implementation of risk management, and collecting information to promote the evaluate questionnaire used during this research. The questionnaire was distributed among professionals who worked with oil and gas contractor-organizations and had direct involvement in construction projects.

The questionnaire consisted of three sections. The first section was the demography that consisted of basic information of respondents and their companies. The second section was the classification and ranked six most important project risk group. These six risk groups were obtained from the extensive range of literature carried out for paper, conference, and books specially those which focused on the construction projects. In addition pilot surveys with a few construction expert in the oil and gas field was verified by the risk groups. At this stage it was requested from the respondents to rate a 5-point scale (1=least likely and 5=most likely) the risk groups according to the probability of occurrence in the oil and gas projects. The last and third section consisted of 10 barriers to the risk management in oil

and gas projects that are being identified and presented in the review of literature. The respondents were asked to rank the barrier of implementation of risk management according to their level of importance in a five-point scale ((1=very unimportant and 5=very not important) [50]. A total of 45 questionnaires were distributed in Iranian oil and gas contractor. 37 questioners was returned back and two questionnaires were rejected due to high number of unanswered questions which represented the response rate to be 77%. This shows that response rate is valid and acceptable according to the statement of Moser and Kalton's [51].

In this research one sample t-test as statistical method for analyzing data collection and alpha Cronbach for reliability test was used. One sample t-test is described as a statistical procedure for the determination of mean difference between the sample and known value of the population mean. The purpose of one-sample t-test is to define whether there is adequate indication to conclude whether a sample comes from the population with a specific mean [52,53].

The confidence interval (CI) on the mean is related to one sample t-test. When the specified value of the population mean is not being tested, it is aneed to apply CI. Otherwise, it is needed to know a range of conceivable values of unusual population mean from which the sample was certain. The fundamental hypothesis of one-sample t-test is that the population from which the sample t-test is normal. Selection of population with normal sample t-test is the fundamental hypothesis of one-sample t-test [53].

In this research the CI has been set at 95% then the significance value should be more than 0.05 of the set level of significance, therefore the null hypothesis is acceptable. According to Null hypothesis there is no significant difference of ratings among diverse respondents. As an outcome, it can be concluded that the population from which the sample is a choice and has a normal distribution.

Test of reliability of a questionnaire focuses on the extent to which respondents have consistently answered questions. Cronbach's alpha is the most commonly used measure of reliability (i.e., internal consistency) [59]. This surveys the average inter-item association of the items in a questionnaire [54]. Cronbach's alpha can have a range from 0.0 to 1.0, and it quantifies the degree to which items on instrument are correlated with one another [55, 56]. If all items are calculated the same sample (without any error), alpha will be equivalent to one. Then higher value of Cronbach's alpha is more appropriated. According to Hinton *et al.* [57], acceptance range of alpha is 0.7 or higher. But Helms and Henze [58] stated that even if alpha is close to one, this does not essentially insure homogeneity of the questionnaire. The correct interpretation of Cornbrash's alpha is essential for reporting the internal constancy of the advanced outcome measures [58].

6.0 DATA ANALYSIS AND DISCUSSION

6.1 Respondent Profile

The respondents were practitioners in the Iranian oil and gas construction companies. Table 4 presents the profile of the data collected from the questionnaire. Respondents include, consultants 22.9%, project manager and manager director 11.4% and 8.6%, respectively. Followed by head of technical and contractor job position 14.3% and 11.4% correspondingly. The results show that the 57.2% of respondents are high level of managerial compared with 42.8% of respondents that are in other position. This increases the reliability of achieved information due to high proportion of direct engagement in project managerial issues. In addition, 48.6% of the respondents have more than 11 years of experience in the construction projects, which would ensure that the responses collected were accurate.

Table 4 Respond Profile

Respond Profile		Number	Percent
Job Position	Consultant	8	22.9
	Project manager	4	11.4
	Site manager	3	8.6
	Head of tech. dep.	5	14.3
	Contractor	4	11.4
	Others	11	31.4
	Total	35	100
Year of experienc e	Under 5 years	5	14.3
	6 to 10 years	13	37.1
	11 to 15 years	7	20
	16 to 20 years	7	20
	Above 20 years	3	8.6
	Total	35	100
Type of project	Gas construction projects	19	54.3
	Oil construction projects	9	25.7
	Petrochemical construction projects	4	11.4
	Others	3	8.6
	Total	35	100

6.2 Classification of Risk Groups

During a construction project, risks can result from many circumstances. Based on the first objective of this study being to identify and classify risks in construction projects and through literature review, a total of six sources of risk in Iranian gas and oil construction projects were compared, as shown in fallow .technical, financial, contractual, policy and political, Design and Construction and Weather and Environmental are the most important risks in this kind of project in Iran.

Table 5 shows the most probable occurred risk groups in the contractors' point of view that the data achieved is summarized, ranked and analyzed using the mean index analysis.

In Table 5, the results of the relative importance of risk identification processes are shown based on their

mean value (average index). According to Table 5, financial and policy are the greatest risks in construction projects. Financial risks acquired the highest mean index (3.83), whereas weather and environmental risks are the lowest mean index (2.2).

The risks related with oil and gas construction projects includes financial risks (project funding problems), policy and political and contractual risks. These general risks effected the achievement of construction project goals in oil and gas project in Iran. Los initial capital invested is a common concern with any investment. Financial risk can be the relationship between the organization (or individual) and the asset or expectation of revenue that maybe damaged or lost .

To examine that if the ratings among different respondents have no significant differences, the single sample t-test was applied to each one of the risk groups. To conduct the single sample t-test, normality test was conducted at first to check if the data have normal distribution for t-test.

Table 5 Relative importance of risk classification

Classification	Mean Index	Kolmogorov-Sig.	Shapiro-Sig.	Rank
Technical	2.66	0.002	0.007	4
Financial	3.83	0.000	0.000	1
contractual	2.83	0.001	0.006	3
Policy and political	3.08	0.023	0.012	2
Design and Construction	2.60	0.000	0.001	5
Weather and Environmental	2.20	0.000	0.000	6

As shown in Table 6, results of normality test for technical, financial, contractual, policy, design and weather revealed that the data are not normal since p value< 0.05 for Shapiro-Wilk and Kolmogorov-Smirnov. It is worth mentioning that if p value>0.05, then it can be concluded that the data obtained are normal. Therefore, all the data are converted into z score to be normalized for the purpose of conducting single sample t-test.

It can be seen from Table 5 that all of the risk groups have significance levels greater than 0.05 showing that there is not any significant difference in respondents" rating. It is worth reminding that statistically significant results are indicated by asymptotic significance values below 0.05 in this research.

Table 6 One-Sample Test of different risk class

Classification	Test Value = 0.000		
	T-Value	Sig. (2-tailed)	Mean Difference
Zscore(Technical)	.000	1.000	.000
Zscore(Financial)	.000	1.000	.000
Zscore(contractual)	.000	1.000	.000
Zscore(Policy and political)	.000	1.000	.000
Zscore(Design)	.000	1.000	.000
Zscore(Weather)	.000	1.000	.000

6.2 Barriers of Implementation of Risk Management

For the purpose of second objective of this study, the respondents were requested about the significance degree of pre-identified barriers of implementation of risk management in the oil and gas construction industry. In the first place, the summarized data acquired from questionnaire study in this section have been analyzed by the means of mean index analysis to identify the most important barrier hindering the implementation of risk management. Table 7 illustrates the respondents' responses described as mean index and frequencies for each barrier. As illustrated in table, there are ten barriers identified.

The ratings based on mean index show that Lack of expertise in techniques Lack of familiarity with techniques, Lack of information and knowledge, Lack of joint risk management mechanisms by parties, Lack of budget and different recognition of risk control strategies to be important where the mean index values for each of these barriers are between 3.5 and 4.5. However, four other barriers namely Low profit margin, Lack of time , not economical and Competition among small constructions have mean indexes between 2.5 and 3.5 meaning that the degree of importance of these barriers located on average importance.

Lack of expertise in techniques in construction industry achieved the highest mean index (4.08). Lack of familiarity with techniques accounting for mean index of 4.02 is the second most important barrier, followed by lack of information and knowledge and Lack of joint risk management mechanisms by parties representing mean index of 3.94and 3.88 respectively. This shows that experts still don't have adequate information in risk management and techniques then training are necessary for risk managing implementation. a research work by Palma [60] on claims and contract disputes in a number of construction projects, had reflected the occurrence of a number of risks that were not well analyzed or integrated by either parties, customers or contractors, and that were one of the main causes of some of those claims and disputes. In addition, lack of methods for storing, distributing and sharing the information and knowledge generated by each project team, a vital resource is lost, which becomes a major factor that

affects a company's business performance. Then training about risk management and techniques for both position of client and contractors is a key factor in realizing risk and improving of implementation risk management in Oil and Gas Company in Iran. "Competition" among Oil and Gas constructions the least important barrier with average importance. "Lack of budget", "low profit margin", and "not economical", which were all related to the expense of risk management implementation, were ranked fifth, seventh and ninth barriers groups. These result implied that the experts in this part of Iran Industry did not believe risk management implementation is depend on expenses or waste money in project.

For examining if the ratings among different respondents have no significant differences, the single sample t-test was applied to each one of the risk groups. To conduct the single sample t-test, normality test was conducted first to check if the data have normal distribution for t-test.

It can be seen from Tables 7 that all of the risk groups have significance levels of greater than 0.05 showing that there is not any significant difference in respondents' ratings. It is worth reminding that statistically significant results are indicated by asymptotic significance values below 0.05 in this research.

Furthermore to test reliability for our questionnaire, alpha Cronbach was calculated for all barriers. Table7 shows that alpha Cronbach for all barriers are above 0.7. According to Hinton [55], Alpha Cronbach above 0.7 shows that a questionnaire is reliable. Since the Alpha Cronbach is above 0.7, it can be inferred that the questionnaire is reliable. Results of Cronbach's Alpha if Item Deleted also show that deletion of no item leads to higher Alpha Cronbach; therefore, no item must be deleted.

Table 7 Mean index, sample t test & Cronbach's Alpha test

Barriers of Implementation of Risk Management	Mean Index	Rank	T-value	Significance Level	Cronbach's Alpha if Item Deleted
Lack of time	3.0000	8	.020	.978	.774
Lack of budge	3.8000	5	.003	.998	.772
Low profit margin	3.1714	7	000	1.000	.756
Not economical	2.9714	9	.004	.097	.769
Different recognition of risk control strategies	3.6286	6	001	.995	.735
lack of information and knowledge	3.9429	3	.005	.989	.752
Lack of expertise in techniques	4.0857	1	000	1.000	.758
Lack of familiarity with techniques	4.0286	2	.002	.996	.722
Lack of joint risk management mechanisms by parties	3.8857	4	000	1.000	.759
Competition among small constructions	2.8286	10	008	.985	.779

7.0 CONCLUSION

This study considered the risk management in gas and oil companies in Iran in order to classify risk group and barrier of implementing risk management. In the first objective variety of risk groups were presented in literature review and six risk groups were selected and ranked through questionnaire by experts as most probable risk groups in oil and gas companies. Financial, policy and political, contractual, technical and weather and environmental are verified as most possible risk groups. In the second objective ten barriers recognized to prevent implementation of risk management in oil and gas companies in Iran. Seven of this barriers was found to be more important because of high mean index that are : 1- Lack of expertise in techniques, 2- Lack of familiarity with techniques, 3- Lack of information and knowledge 4- Lack of joint risk management mechanisms by parties, 5- Lack of budget 6. Different recognition of risk control strategies, and 7- Low profit margin. Furthermore, the main barriers preventing implementation of risk management in gas and oil companies in Iran are due to the lack of expertise in techniques, lack of familiarity with techniques and lack of information and knowledge. Training and education of construction contractor in oil and gas companies for using risk management techniques can be a useful way and best practice to improve profitability, better time management, reduce costs and promote customer/client relationships.

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