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Identifying Significant Factors Affecting Decision Maker's Risk Attitudes in Multinational Construction Projects in Iran

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ABSTRACT

During the lifecycle of construction projects, especially in the planning phase, the participants are confronted with enormous Risk Based Decision Making problems, which are usually addressed through identifying, analyzing and responding to potential risks, and ultimately optimizing solutions. The fact that human resource is the most important critical success factor in RBDM is a widespread agreement. Therefore, as decision maker's risk attitudes would influence their behavior, factors affecting the risk attitudes can help predicting their behavior and make various risk attitudes well understood. In this regard, understanding and managing these attitudes through study and reduction of their impact can significantly increase the effectiveness of risk management. Meeting all the goals of this research is not simply possible by using a quantitative technique therefore, a method is presented for evaluating and ranking factors by combination of "focus group interview" as a qualitative method and "decision making in conditions of uncertainty" as a quantitative method which is one of the modern techniques in decision making and mathematical evaluation of vague data. In this paper, it has been trying to define the critical factors which can affect the decision maker's risk attitudes in multinational construction projects in Iran and prioritize them based on their weights according to the research methodology. In this research, "completeness of project information" and "engineering experience" clarified as the two most important factors. Therefore, increasing project information through R&D units and recruiting people with a high professional work experience would decrease the effect of these two factors on deviation of risk based decisions.
KEYWORDS: Risk attitude, Multinational construction projects, Focus group interview, Gray system theory, Iran.

INTRODUCTION

The risk project management includes processes related to conducting and planning risk management, identifying, analyzing, response, monitoring and risks control in a project which increasing the chance of positive events and reducing the chance of negative events are its aims [35, 14]. Risk Based Decision Making (RBDM) is the core of risk management in construction projects [13, 7]. During the maturation of construction projects, especially in the planning phase, decision makers have encountered many problematic issues related to RBDM which were generated by identifying, analyzing and responding to potential risks [1, 36, 22]. Since decision makers' risk attitudes are influential on their behavior, factors affecting these attitudes can help the prediction of such behavior and cause the betterment of understanding the various risk attitudes [17]. However the ability to understand the risk attitudes and factors effective on it, improve the quality of decision-making [28].

Most of the previous studies in the realm of risk management in construction projects stressed on the causes of successful risk management while the influential factors on decision makers' risk attitudes for construction projects have been suffered from the lack of focus. The decisions which are made without attention to decision makers' risk attitudes are unreal since their attitudes show their personal characteristics and experience in parallel with economic regulations and management conditions. So the factors, which impact attitudes of decision makers, have been remained unknown [17].

The second part of this paper presents the review of literature; in the third part we introduce the research methodology, aims, techniques of focus group interviews and gray systems theory. The fourth part is specified to research findings and the method of evaluation of the effective factors on multinational construction decision makers' risk attitudes and the last part presents the results and comments for future studies.

2. Related studies to risk attitudes

The relation between attitude and decision making behavior has been studied in different fields [40] Planned behavior theory which was introduced by Ajzen (1993) was one of the dominant model of presenting the relation

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between attitude and decision making behavior in these studies. In this model, attitudes, observed subjective norms and behavior control can affect the behavioral intention [19]. According to studies of Teo and Loosemore (2001), attitudes are based on positive or negative analysis of a particular behavior which is in line with beliefs and personal knowledge of events. Therefore even in the same conditions, different attitudes can be applied which will lead to different outcomes [28]. From this perspective attitude plays an important role in forming the behavior of decision makers. In the realm of construction risk management, predicting the decisions without proper understanding of risk attitudes will be difficult. Harvey (1988) expanded a decision making model to analyze the risk attitude. He considered two impacts of risk attitudes on general decision making rules in different time durations to be answered whether risk attitudes in Scotland are similar to England's or not.

Helliar et al (2002) conducted a research in the field of related attitudes to risk experiment. Based on the results, a series of strategies for accepting and controlling the risk was proposed. Han et al (2005) studied risk attitudes and decision making behavior based on a series on experiences in auctions and tried to predict risk attitudes under realistic decision making circumstances. This study was different in comparison with other which concentrated only on difference between risk attitudes of decision makers. Efforts have been done for studying risk attitude in decision-making process in construction projects, such as investigating attitudes playing a role in transferring time-related risk [40], risk attitude and bid decision behavior in selection international projects [6].

It can be said that there has been little attention to identification the effective factors on decision makers' risk attitudes in multinational construction projects. Since decision making behavior is influenced by risk attitudes, before getting a proper understanding of decision making behavior in construction projects, identification of important factors for decision makers' risk attitudes are essential [17]. In this paper we used the list of factors proposed by Wang & Yuan(2010). Their research was specified to contractors in China while we considered all the multinational decision makers in multinational construction projects in Iran (These multinational projects are the simplified comparing to the original form of multination projects, and they are applied by an exterritorial site which has only one bound with central company. [25].) and we used gray numbers theory to make experts' opinions more accurate in evaluating the effective factors.

3. RESEARCH METHODOLOGY

This research has two main stages. The first one is related to literature review which is about the probable risks in multicultural construction projects, and how important project aims, estimated cost, time, quality, safety and environment can be influenced by these risks. All these studies are related to identification and management of risks in construction industry. The second stage represents a list of primary important factors which can be influenced on decision makers' attitudes. Since there have been few studies associated with effective factors on risk attitudes of decision makers, making such a list is only possible with the help of previous studies, therefore we used focus group interview approach to complete the list and identification of important factors and then excluded the less important factors after detecting the chief factors through gray systems theory.

3-1. Focus groups interview

Focus group is one of the qualitative interview techniques which is designed for interaction among groups' members to attract the attention for deeper discussion and reveal the different and new aspects of the subject. [42]. One of the features of interviews is the interaction among the members that stimulates the intention to think and share the attitudes and ideas. However it is possible that the result doesn't appear in the individual interviews [29]. It must be known that the focus group meeting is not a session for solving problem or making decision, yet it is just an interview [34].These groups are usually consisted of 8 to 12 people who have in common features related to the discussion.

The interviews can be classified as [43]: Structured interview or standard interview, Semi-structured interview and unstructured interview (which there is no prepared questions except a general question which is asked at the beginning of the interview). In qualitative researches unstructured or semi-structured interviews are used more frequently. Focus group interviews have been used in several fields such as Anthropology [32], Political sciences [9], Medicine [10], Biology [2], and hygiene services therapy [4] and [5]. This technique has been used in Strategic Management with the combination of SWOT (a tool for data collecting in a particular area) [42] and [43].

3-2. Gray systems theory

In the late of 1960s 'Dang' had studied the prediction and control of economical and FUZZY system and encountered systems with high uncertainty. Indices of these systems were hardly justified by Fuzzy Mathematics or Probability and Statistics. In Fuzzy Mathematics we deal with uncertain issues which are justifiable by experts

through discrete/continuous membership functions. In problem solving with the help of Probability and Statistics it is needed to recognize the distribution functions related to enormous volume to achieve the proper reliability. In such a condition if there are few experts and little level of experience, lack of the ability to extract the membership function or few number of samples what can be done? To have optimized solving, Dang In 1982 introduced Gray Systems Theories [37] These theories can be categorized in 5 areas: assessment, modeling, prediction, decision making and control. One of the proposed approaches of this theory is in the area of decision making. In recent years, grey system theory has been an effective methodology that deals with uncertain and indeterminate problems [21].

The Gray number refers to a number with undetermined value with an interval which encompasses its value. Gray numbers can be only with lower bound $\otimes \in [\underline{a}, \infty]$ or higher bound $\otimes \in (-\infty, \overline{a})$ or with lower bound $\underline{a}$ and higher bound $\overline{a}$ simultaneously. In this condition gray number is called interval and is shown: $\otimes \in [\underline{a}, \overline{a}]$

If two gray numbers are given as: $\otimes_1 \in [a, b]$, $a < b$; $\otimes_2 \in [c, d]$, $c < d$;

And *is used as the symbol of an operation between $\otimes_1$ and $\otimes_2$ then:

1) $\otimes_3 = \otimes_1 * \otimes_2$

Which $\otimes_3$ is an interval gray number. So we must have: $\otimes_3 \in [e, f]$, $e < f$; And for each $\otimes_1$ and $\otimes_2$ we have: $\otimes_1 \sim * \otimes_2 \sim \in [e, f]$. In the case of addition, subtraction, multiplication and division of two gray numbers $\otimes_1$ و $\otimes_2$ symmetric and inverse of any gray number are defined as below [31].

The addition of two gray numbers:

1) $\otimes_1 + \otimes_2 \in [a + c, b + d]$;

The diverse of a gray number:

2) $-\otimes = [-b, -a]$

The subtraction of two gray numbers:

3) $\otimes_1 - \otimes_2 = \otimes_1 + (-\otimes_2) \in [a - d, b - c]$

The diverse of one gray number:

4) $a\ b > 0$ ، $\otimes^{-1} \in [1/b, 1/a]$

The multiplication of two gray numbers:

5) $\otimes_1 \cdot \otimes_2 \in [\min\{ac, ad, bc, bd\}, \max\{ac, ad, bc, bd\}]$

The division of two gray numbers:

6) $\otimes_1 / \otimes_2 = \otimes_1 \cdot \otimes_2^{-1}$ $cd > 0$, $\otimes_1 / \otimes_2 \in [\min\{a/c, a/d, b/c, b/d\}, \max\{a/c, a/d, b/c, b/d\}]$

7) $K \in \Re^+$ ، $K \cdot \otimes \in [Ka, Kb]$

The other regulations for addition and division for real numbers can be expanded to interval gray sets [33].

4. RESULT AND DISCUSSION

4-1. Identification of important factors and their weights

Mentioned important factors in previous literature were extracted through literature review. Then with the use of focus group interview technique the lists were completed. During the interviews ideas of eight experts were recorded and gathered. The unstructured interview took 25 minutes and 26 factors were approved by experts which are shown by Fij.

F01: Education background. Attitudes toward risks within the decision making process may vary greatly, depending on contractors' education background. Generally decision makers with high educational level tend to be more logical while those with lower educational level tend to be more fearless and instinctive in making decision [24].

F02: Engineering experience, F03: Social experience. By strong engineering and social experience, decision makers become familiar with potential risks of project. So experience plays an important role in decision making procedure. Therefore risk attitude can be influenced by experience.

F04: Professional knowledge, F05: Range of knowledge. Various knowledge background and range of knowledge influence decision makers directly when they work on professional parts of project and result in different risk attitudes.

F06: Physical health. Physical health of decision makers affects the rate of bearable pressure by them, their tendency to short-time profit and their abilities to encounter the risks.

F07: Social level. Decision makers with different social levels have different risk attitudes facing the same situation[17].

F08: Character traits. Character trait is a feature of someone or something that separates it from others. Different kinds of character traits have been studied by Wang (2002). He found that different character traits result in different behavior. For example independent decision makers like to solve the problems individually. They

sometimes tend to impose their opinions while submissive decision makers tend to agree with other's ideas. All these different traits result in different risk attitudes.

F09: Boldness. Boldness is referred to those who desire to experience the risks. Courageous decision makers always have the ability to make decision undoubtedly [17].

F10: Values. Value means people's opinions about what is right or wrong or important in life. This subject has been introduced by Li And Liu(2003). In a similar situation attitudes based on values may be different. While some of the decision makers are interested in justice others prioritize money.

F11: Moral values. Liu (1998) believes moral value is the quality of being encountered with standards or a system of beliefs which is consisted of common sets. Each set as a member of society has similar moral values that may influence the risk attitude [17].

F12: Decision motivation. Wang (2000) believes with a clear decision motivation, the decision is of significant directivity, which causes the action to move towards a specified and determined direction.

F13: Engineering interest. The decision makers' interest in projects, influences the development and creation in construction duration which affect the risk attitudes.

F14: judgment ability. This is the ability of decision makers to analyze and judge the problems based on experience and personal knowledge. This ability plays an important role in decision making process.

F15: Intuition. Intuition is the ability which becomes important when facing complicated issues. The solution based on intuition is usually desirable.

F16: Sensitivity to external information. This factor refers to decision makers who can response to engineering deviations through different information assessment very fast [17].

F17: Psychological endurance. Li & Liu (2003) have believed that Psychological endurance is an ability which causes decision makers to tolerate the pressures out of several sources.

F18: Willpower. Willpower is the ability to control the mind and body to reach the target.

F19: Desire for decision objectives. Origins can usually lead people's activities to certain aims. As a result decision makers' behavior can be influenced enormously by their demands when facing the risks.

F20: Consequences of decision making. Decision makers may consider the consequence of their decisions. As a result, it can affect their risks attitudes.

F21: Time constraints for decision making. In an unpredicted situation a quick response and fast decision making are needed. Therefore there is a little time to make decision. In such a case contractors' risk attitude based on specified time for decision making will be different.

F22: Completeness of project information. It is vital to have complete engineering information to make proper decision because it can enhance the confidence of decision makers in making important decisions [17].

F23: Company's economic strength. This factor has always been important and effective on risk attitude. According to an empirical study conducted by Haimlevy Slovic and Fishaoff (1982) there is a reduction of risk aversion with increasing the company's economic strength.

F24: External economic environment. A good external economic behavior causes active behavior of decision makers when they accost projects' risks. However, bad economic environment can make decision maker's behavior inactive.

F25: Policy environment. A national or regional policy environment is the base of implementation the project. Different policies applied during conducting a project, influence the decision making directly.

F26: Regulations related to engineering. This factor is related to some rules of project's regulations introduced by the government [17].

According to qualitative extracted criteria and uncertain judges by experts in determination of the rate of importance, we used one of the decision making approaches in uncertain situation in this study. Since there are several numbers extracted criteria, using pair comparison to determine weight of criteria was not efficient. Therefore through interviews and use of gray numbers (table 1) and collected ideas of experts [41] and factors' weight $\otimes_{w=} \{\otimes_{w1,} \otimes_{w2,\ ...,} \otimes_{wk}\}$ have calculated as below:

If decision makers group (experts) is consisted of "K" people, to evaluate the weight of factor "Qj" the relationship below can be used:

8) $\otimes_{wj\,=\,1/K} [\otimes_{wj}{}^{1} + \otimes_{wj}{}^{2} + \ldots + \otimes_{wj}{}^{K}]$

Which $\otimes_{wj}{}^{k}$ (j= 1,2,…,n) is the "i^{th}" criterion value from the perspective of "K^{th}" decision maker which is shown by gray number $\otimes_{wj}{}^{k} = [\bar{w}_j^k , w_j^k]$.

Table 1: evaluation scale to determine the weights [41]

Scale	Very High	High	Medium High	Medium	Medium Low	Low	Very Low
⊗W	[0.9,1.0]	[0.7,0.9]	[0.6,0.7]	[0.4,0.6]	[0.3,0.4]	[0.1,0.3]	[0.0,0.1]

If we consider K=8 then we can summarize the analysis of experts' ideas into table 2:

Table 2: the weight of factors

	Q_1	Q_2	Q_3	Q_4	Q_5	Q_6	Q_7	Q_8	$\otimes w_j$
F01	L	M	VH	MH	H	VH	H	MH	(0.6125,0.7625)
F02	H	MH	VH	H	VH	VH	MH	H	(0.75,0.8875)
F03	MH	H	VH	M	H	MH	MH	MH	(0.6375,0.775)
F04	H	H	VH	MH	VH	M	M	MH	(0.65,0.8)
F05	H	ML	ML	MH	MH	ML	MH	MH	(0.499,0.6125)
F06	VL	H	L	VL	M	M	H	ML	(0.325,0.4875)
F07	ML	MH	M	M	MH	ML	MH	ML	(0.4375,0.5625)
F08	H	VH	H	VH	H	H	MH	MH	(0.725,0.875)
F09	H	VH	MH	H	VH	H	MH	H	(0.725,0.9375)
F10	MH	L	H	MH	ML	MH	M	MH	(0.4875,0.625)
F11	MH	M	ML	M	ML	M	ML	L	(0.35,0.5)
F12	MH	MH	H	H	H	VH	H	MH	(0.6875,0.8375)
F13	ML	VH	MH	L	M	VL	VL	H	(0.375,0.5375)
F14	VH	H	MH	H	H	VH	H	M	(0.7,0.8625)
F15	H	H	MH	H	H	VH	H	MH	(0.7,0.8625)
F16	H	ML	H	MH	H	H	MH	MH	(0.6125,0.7625)
F17	MH	H	M	MH	MH	M	MH	L	(0.498,0.65)
F18	MH	VH	L	H	MH	VH	MH	H	(0.6375,0.775)
F19	VH	VH	MH	MH	MH	VH	H	L	(0.6625,0.7875)
F20	H	H	VH	H	H	H	H	ML	(0.675,0.85)
F21	H	M	M	M	H	M	M	M	(0.475,0.7125)
F22	VH	VH	MH	M	VH	VH	VH	H	(0.775,0.9)
F23	H	VH	ML	MH	MH	H	H	H	(0.65,0.8)
F24	VH	VH	MH	ML	MH	MH	H	MH	(0.65,0.7625)
F25	H	VH	M	M	H	VH	MH	MH	(0.65,0.8)
F26	M	L	M	L	MH	VL	MH	VL	(0.275,0.425)

To identify the important factors that influence the risk attitudes of decision makers, we omitted the unimportant factors with little importance rate from exerts' perspectives. Unimportant factors were those with the value smaller than 0.5[42]. Therefore in table 2 factors 5, 6, 7,10,11,13,17,21,26 are omitted. After omitting the unimportant factors, 17 main factors are remained known as effective factors on of decision maker's risk attitude in multinational construction projects.

The "completeness of project's information" with the value of (0.775, 0.9) has the first place and is one of the external factors. The achieved study's results of Ward et al. (1991) shows if contractors have enough and proper information in the moment of decision making about risks, can tolerate the risks desirably and find an alternative relationship between risks and interests even if they can't predict the risks or consequences of the projects. So facing the risks without enough understanding of them will result in a wrong strategy. The "engineering experience" with the value (0.75, 0.8875) is introduced as the second important factor. It is clear that the conceptual phase of a new multinational construction project has the most risks within, since decisions made in this phase includes project's aim such as cost, quality, time, safety and environment. Also the highest value of uncertainty exists in this phase [16]. Therefore the complicated, changing and untrustworthy nature of multinational construction projects prevents the project to be implemented in the real world like it is programmed [3]. This means that decision makers face lots of risks and uncertainties when conducting the projects. So those with enrich engineering experiment are more familiar with risks and have higher skills to predict the probable risks that prevent the success of the project.

Other factors such as "decision motivation", "professional knowledge", "boldness", "judgment ability" and "Desire for decision objectives" are human factors. Human factors are defined by Thevendran (2002) as "a person,

project team and organizational factors that can affect people's behavior and work environment in a way that causes reduction or improvement of the project's procedure". Thevendran and Mawdesley expressed the definition more and subcategorized the human factors into three groups, individual factors, project team factors and organizational factors. Individual factors are capacity, knowledge and skill, stress, motivation, feeling and factors related to culture. It can be concluded that decision maker's risk attitudes in Iran are influenced by individual factors. This issue has been introduced by Thevendran And Mawdesley(2004) and Sabaa(2001), who focused on the importance of human factors in project's success. In this paper we expanded their achievements by investigating the details of individual effective factors on risk attitudes of decision makers of multinational construction projects.

Among the 17 factors, five of them (factors 20,22,23,24,25)are related to external environment while twelve of them are dependent on experience and individual traits of decision makers. We can come to this conclusion that internal factors can play a vital role in affecting decision maker's risk attitude in multinational construction projects. As the factors numbered F01, F02, F03, F04, F08, F09, F12, F14, F15, F16, F18 and F19 are internal factors which by reducing their impact on individuals, it can be more assured that different people in same conditions will make the most logical decision regarding acceptance or rejection of risks in multinational construction projects. "Education background" and "professional knowledge" are related to decision maker`s knowledge, also "social experience" and "engineering experience" are related to decision makers experience. These will conclude that knowledgeable and well-experienced decision makers can be trustworthy for making decisions in risk related situations. In this regard, more reliable outcomes can be reached by employing individuals with these characteristics. Factors numbered F08, F09, F12, F14, F15, F16, F18, and F19 are personal characteristics, therefore, bolder, more motivated and more sensitive decision makers with high enthusiasm towards project goals will confront project`s risks more capably and as a result, project benefits will increase due to their capacity toward taking risks. Discovering these characteristics in people is a matter of psychological tests, which unfortunately lack of these standard tests in construction companies in Iran is a limit to employ qualified personnel in decision making posts.

5. Conclusion

Risk attitudes of main decision makers of multinational construction projects (contractors, organization managers, project managers and beneficiaries) have been influenced by various factors. Recognition and understanding of all the factors to reduce the influence on risk attitudes is not essential and functional. Lu et al. (2008) introduce a convenient way to identify some of the important factors to help the contractors to be focused through maximizing the usage of limited sources such as financial, manpower, time and managers effort. In this paper, 26 probable effective factors on risk attitudes of contractors in multinational construction projects in Iran have been studied. By interview and gray data to have accurate calculation, these factors have been ranked. 17 factors have the most influence on risk attitudes of decision makers in Iran. By recognizing and reduction the effect of factors we can support realistic decisions making in an industry with a complex environment and high uncertainty. The "completeness of project information" and "engineering experience" have been identified as the most important factors. Therefore with the increasing volume of environmental information through betterment of research and development units and employment of experienced people we can reduce the influence of these important factors on deviation risk - based decisions. Although this research has been conducted in a specific filed of construction industry in Iran, it can be used for other fields too. This paper provides the identification of critical factors of a particular filed for further studies under this subject.

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