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OVERVIEW OF TECHNIQUES OF RISK MANAGEMENT

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ABSTRACT

Construction management is essential for successful project execution, and both researchers and followers continually find ways to improve construction processes. Risk management helps the project client, contractor or developer, consultant and supplier to meet their goals and reduce negative impacts on project performance in accordance to cost, time and quality objective. There are various techniques evolved in application of risk management stated and discussed in the chapter such as Probability Theory, Certainty Factors, Dempster-Shaffer Theory of Evidence and Fuzzy Logic. The purpose of this report is to investigate and evaluate project risk management techniques available. The aim is to examine the recognition and practical adoption of risk management theories in order to investigate how project knowledge is utilized in the process.

Keywords: Risk Management Theory, Construction, risk management, Fuzzy logic.

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I. INTRODUCTION

Risk Risk management is according to Project Management Institute (PMI) out nine of the knowledge areas and the application of an effective risk management is considered a complex element and necessary for project progress. Construction projects can be described as highly complex in which uncertainty can arise by various sources. Risk management is therefore becoming an important part of the project management of construction projects in a way to efficiently deal with unexpected events. It is important due to the damaging effects imposed by risk and uncertainty.
The objective of an efficient risk management procedure is to regularise risk neutral decision making, which will result in superior performance. structured methods for obtaining more data about uncertainty on the project is needed to achieve that objective.

An inadequate application of risk management is often caused by the lack of structured procedures, the lack of uniformity in the different project stages and an inadequate application of knowledge management and interaction between processes and parties. During the construction phase the main responsibility is to deal with risks is laid upon contractors by deciding if the risks should be reduced, avoided, transferred or retained.

II. RESEARCH METHODOLOGY

Risks in Construction Projects
Construction projects as other types of projects pose serious management challenges' topography rising number of incidents competition among well-established firms, technical challenges and large number of data inputs. Due to this fact the links between the risks involved in the project prove to be challenging. Risk classification is evolving so far and is being recognized in the industry but more suppressive matter is risk identification and ways to overcome them.
So far this has been taken as source of important factor. It is common to classify risk with broad view either it is related to small project or an individual or an organisation .so far risk is accepted as challenge and faced positively in order to make it easier the analysis and identification risk are brought under sorted structure using various concepts' factors considered while grouping them are political, economic legal , social, , physical etc.

Nature of Construction Projects Risks
As it was mentioned earlier, risks are grouped in to category of social economical political cultural etc to make analysis easier and reduce number of categories they are arranged from higher level structure using concept of layer.

The structure of the atmosphere is categorised into three layers general, operational and internal respectively. The general and operation layer is often considered as external layer.

General layer consists of five categories mainly economic, political, social, physical or natural and technology related. This category is large and has very small or little impact on project in direct manner. These five categories are in touch with the organisation to seek what they should do to accomplish the task handed over to them. Some of these are less predictable and hard to know than others, the operational category is an external layer consisting of more specific and quick impact on the project. They include the factors like suppliers' chain, contractors, clients competitors etc. And at last it narrows down to internal layer which is concerned with the project sources including financial human and technology related factors as well as leadership values and ethics.

Organization - Specific risk factors;

- Material related
- Labor related
- Equipment related
- Estimator related
- Management related
- Construction related
- Finance

Global risk factors

- Economic
- Political
- Competition
- Project/design
- Construction
- Estimation

Acts of God

- Heavy floods;
- Massive landslides;
- Earthquakes,
- Tsunamis etc

This classification is important for risk decision making process, since managers are expected to carefully examine both internal and external environments of their organizations or projects in order to evaluate the factors that pose serious challenges to success.

Appropriateness of Techniques for Risk Modeling and Analysis

Different categories of risk that involve in construction project have been presented and discussed. project managers are taken in to consideration with the correct choice of risk analysis technique. It is good to apply the same method to model organisation in particular such as acts of God risk related facts etc. The response nis not direct but it seems that due to the change in the nature of these risks underlying the impact is also likely to change.

Example impact related to Act of God and organisation specific risks or hardly near about same, whereas the phenomenon such as earthquakes and return river discharge period are highly unpredictable. The impacts of human resource deployed and budget performance being utilised in the project can be assessed, the following part discusses the effect of risk analysis techniques related to organisation specific, Acts of God etc

Concluding to the suggestions related to most appropriate tools that can be used are highly advanced, the analysis is expected to bring into light of some modelling analysis as well as its effect.

Probabilistic Analysis Technique

It is the common practice to formulate and analyse risks with the help of techniques suggested by various researchers, maximum tools available in the market are based on probability theory. such as analysis and modelling with the help of probabilistic technique being efficient way to handle risks regardless their type.

Those are in favour of probability state that random methods are best while handling uncertainty issues. The general view in risk management in construction engineering is cognitive. As the process is based upon experience human discussions and assumptions. It seems that relying on probability theory as only effective technique to handle with uncertainty has some past relevance.

Probability theory has well established and sound scientific foundations which has been widely used so far. It is a branch of mathematics which is concerned with randomness, it deals with process events through frequency as outcome of repetitive experiment and subjective view

Probability Basics

The main assumption in the theory of probability is that all types of uncertainty are related to ''frequency' measures of randomness. This reasoning is clear in the definition of probability, as follows: ″if a random experiment has N possible outcomes which are all equally likely and mutually exclusive and n of these possibilities have outcome A, then the probability of outcome A is n/N″. The basics of probability theory is, thus, the probabilities, which may be objective or subjective, in order to forecast the occurrence of uncertain events. Objective probabilities are directly found through experiments or statistical records. Objective probabilities apply to repetitive events only. Subjective probabilities on the other hand, represent degree of belief of the decision takers. Individuals with different background are employed to assess the occurrence of the same events separately.

Organization-specific Risks

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Global Risk Factors:

Global risk factors are above organizations' capability. They are related to a more critical, abnormal and punchy atmosphere. The possibility for collecting data to draw useful conclusions becomes restricted. Taking into consideration the cycle of some factors such as ups and downs of economy, it is very hard to make likely estimates about them. Although there were some attempts for estimation the level of risk associated with global risks the available data make the analysis difficult. For example this modelling technique was applied for political risk indices. The analysis has been conducted and the results were followed systematically over the years. The indices measure the firm view over specific countries and aim to help investors and other interested parties in their business decision making. Political defences are complex and dynamic and impact, very difficult to understand. political issue is very less likely to occur, which creates challenges for effective modelling. Same applicable to the economic and social variables. Further, political, economic and social cultural events are rarely mutually exclusive, exhaustive and conditionally not dependent on each other. First, there was strong interrelationships among these factors. for example, Economy, is strongly associated with social and political events. In the view of these characteristics, it can be assumed that probabilistic modelling of global risk factors poses serious challenges in terms of robustness and validity. The uncertainty is in this group of risk factors is much more philosophical rather than random.

Acts of God

Acts of God are generally classified under the contractual terms, because no party is able to manage them and bear the associated costs. They represent extreme events happening from nature as such, difficult to predict. It would be of prior importance for a contractor,

for example, to know the occurrence of a rainfall and land sliding and disrupting construction works. Unfortunately, such evaluation is not available. That is the reason why the best applicable strategy to this type of risk is transfer to a third party.

Several tries have been made to predict the probability of occurrence of these events, but progress has been achieved so far is very small. Stress over the problem have led analysts to develop some systems but, it can hardly be robust due to challenging nature of uncertainty. Therefore, such evaluation may be precise but not exact. In addition, since most nature-related risk are poorly classified and fuzzy in nature they cannot be evaluated with such high accuracy inherent in numbers. These systems have used subjective probabilities instead of objective ones, as further are difficult to obtain due to lack of information. The fact that subjective probabilities cannot be differentiated from objective ones once in the system, is likely to hamper the quality of the analysis. There is guarantee that subjective probabilities capture uncertainty firmly. As a result, probabilistic modelling and analysis of nature-related risks is related to matter of debate.

Certainty Theory Analysis Technique:

Organization-related risk factors can be well modelled through probabilistic ways, global risks and Acts of God are beyond capacity to handle in the same way due to the intrinsic type of uncertainty and scarcity of data and information.

Certainty theory based for handling uncertainty in knowledge-based systems - KBSs. It was developed in attempt to surpass some of the weaknesses of the so-called approaches for inexact reasoning. Certainty theory depends on defining judging measures of belief rather than sticking to strict probability estimates. So, certainty factors (CF) are not probabilities but unofficial measures of belief for a piece of truth. They represent the degree to which people believe that the given information is true. Similarly, they describe how accurate, reliable, truthful people judge statements or proofs. Certainty theory basics are the concepts of ″certainty measures″ which are associated with ″factual readings″.

The certainty factors (CFs) consist of numbers ranging from (–1 to +1) and factual statements, (rules). Negative value of the certainty factor shows that one believes that a fact is not true and a positive value indicates the one believes that a fact is correct with complete knowledge.

CF = 1, proposition is true

CF = -1, a proposition is false

CF = 0, no change in belief

-1 < CF < 1, measure of the degree of belief about the proposition with decreasing and increasing beliefs accordingly.

Global risk factors and Acts of God in engineering projects can be modelled using this theory within knowledge-based systems, where the following format is common:

If A Then B with certainty factor CF = CF (rule).

where A is the antecedent and B, the consequent.

The antecedent comprises facts (evidence) that support the derivation of the (hypothesis).

The CF is the net degree of belief in hypothesis, given that the evidence is observed.

Dempster-Shafer Theory of Evidence Analysis Technique:

Dempster-Shafer theory of evidence is generally called cognitive probability because it provides an alternate methodology for the assessing of numerical degrees of belief. It helps to overcome the flaws of Certainty Factors and can be applied to sample method whose behaviour comes under cognitive uncertainty. Instead, Dempster Shafer attempts to differentiate between uncertainty and avoidance. It uses belief functions instead of probability. In this manner it can be considered a simplified version of the Bayesian theory of subjective probability and that is why it is stated as theory of belief functions. These degrees of belief may or may not have the mathematical properties of probabilities. The theory gained momentum in the 1980's when researchers made some tries to adapt probability in expert structure. The Dempster-Shafer theory is based on two core thoughts,

1-obtaining degrees of belief for one problem from subjective probabilities for a related problem, Dempster's rule for combining such degrees of belief when they are related on independent items of evidence.

To simplify how it functions, a organization may be interested to evaluate the fiscal policy risk in a area or a country where it is planning a project. This is usually a critical factor as project financial/economic credibility can be largely influenced. It is obvious that objective probabilities for this kind of risk are difficult to evaluate. The organization can therefore, resort to subjective

probabilities and then develop belief functions. If this probability is set at 90%, for example, then, the probability of the unstable and detrimental to business would be 10%. In such circumstances, the company can be sure that the structure is dependable. The degree of belief attached to the structure's reliability is then 0.90 and the degree of belief that it is unreliable is consequently 0.10.

A question would be – ''was a specific rise in corporal taxation rate fair/balanced?''.

Based on the inherent dependency, the fairness of the taxation stands out a degree of belief of 0.90. The degree of belief of it being unfair is 0.0 and not 0.10.

The later degree of belief does not mean surety about an unlikely unfairness. It simply means that the credibility of the policy gives no excuse to believe the contrary. The numbers 0.90 and 0.0 together constitute a belief function.

The sample presented describes the above-mentioned basics of Dempster-Shafer Theory, namely the degrees of belief attached to two related questions and the rules for combining them. The degrees of belief associated with the specific taxation are determined on the basis of the dependency of the policy/structure which has an initial degree of belief. Dempster-Shafer theory provides a platform for combining various degrees of belief.

For example, different risks with capability to influence project progress can be considered for evaluation. Putting together degrees of belief on these variables would initiate development and combination of belief functions following stated rules in order to ascertain the occurrence and impact of different phenomenon. The main assumption behind the rule is prior independence of the questions for which probabilities have been estimated.

Fuzzy Set Analysis Technique:

Fuzzy set theory is a branch of modern mathematics that was found by Zadeh to model vagueness intrinsic to human cognitive processes - humanistic systems. it has been used to handle poorly-defined and critical problems due to lack of information that simulates the real-world structure. It is therefore applicable for uncertain reasoning that includes human thinking. Due to this inherent uncertainty, it proves that Fuzzy sets are more applicable to handle Global risk factors and Acts of God than other method. Individuals involved in engineering projects handle these risks in an appropriate way, using simple language, and not probability to seek their likelihood and impact. Risk management can be widened, to large extent and can be considered concentrative in nature. The process of risk management in construction industry is mainly relayed upon experience, assumptions and human decision-making power. Zadeh mentioned that fuzzy sets can handle vagueness type of uncertainty better than any other way and vagueness is a particular type of uncertainty to be treated by probabilistic method. According to the fuzzy set theory a meaning in natural language is a matter of level. Considering one variable of global risk factors a question can be formulated: ″ is the advancement dangerous?″. The answer is not always simple ''yes or no''. Depending on the respondent who is to respond. The meaning of advancement is not precise. It varies from person to person. Basic fundamental of fuzzy set theory is the concept of linguistic variable and degree of membership. Most construction engineering decision problems are complex and imperfect, they might be better elaborated by linguistic expressions rather than by numbers. Numbers are related with precision, while decision issues like managing risks need not or do not have specific outcomes but perfect ones. Further, due the imperfection related to linguistic expressions the transition from one level to another is simple. For example, the transition from ″very heavy rain'' to ″heavy rain″ is not harsh, but gradual. Linguistic expressions play an important role in this regard because elaboration is at the very core of risk management in construction. Finally, fuzzy sets have the ability to preserve the uncertainty inherent to the problems the analysis instead of making assumptions.

III. SUMMARY

		Modelling and Analysis Suitability				
No	Technique	Risk Group			Prominent Uncertainty	Tools
		(A) Organization - Specific	(B) Global	(C) Acts of God		
1	Probability	Very good	Very Poor	Very Poor	Random (A)	DSS
2	Certainty factor	Very poor	Good	Good	Epistemic (B and C)	KBS
3	Dempster-shafer theory of Evidence	Poor	Good	Good	Epistemic (B and C)	KBS
4	Fuzzy set Theory	Poor	Very Good	Very Good	Epistemic (B and C)	KBS-DSS

This is the summary from researchers' point of view but application of these theories can be introduced in rural areas too. But in rural areas Dempster Shafer and fuzzy set cannot be applied there Probability and certainty factor can be successfully applied with no or less complications.

IV. COCLUSION

These techniques are of great importance but are still unknown in rural areas people's belief cause great unlikeliness towards these techniques necessary calculations through techniques are way beyond their understanding and thus they follow old practices blindly. The change is unavoidable but yet to be excepted by people in industry

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