Risk Analysis & Risk Management in construction

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Abstract:-Construction is a risky industry and there is no other industry that requires proper application of business practices much as construction industry. The main objective of this research is to gain understanding of risk factors that could be in front of building projects. The study aims also to investigate the effectiveness of risk preventive and mitigate methods Moreover, the usage of risk analysis techniques id addressed. The results of this study recommended that there is an essential need for more standardization and effective forms of contract, which address issues of clarity, fairness, roles and responsibilities, allocation of risks, dispute resolution and payment. Both owners and contractors are called for identification of possible risk factors that could be faced and to allocate them contractually. There is a need to keep a computerized historical data of finished projects to help in rights reservation and to be an information source for future comparison. A standard form of contracts which address issues of clarity, fairness, roles and responsibilities, allocation of risks, dispute resolution and payment should be adopted for all the projects. More effort should be made to properly apply risk management in the construction industry.

Index Terms-Monte carlo simulation, Sensitivity Analysis, Breakeven Analysis

1. Introduction

The nature of the construction projects makes the industry unique in that the manufacturing facility or plant must move to the construction site.). There are many different descriptions of the construction industry, drawn from different specialist disciplines. For example, the term "construction" can include the erection, repair, and demolition of things and diverse as houses, offices, shapes, dams…etc. . Construction is difficult to comprehend fully because the relationships between the parts are not always clear and the boundaries of the industry may be characterized as:

- It is fragmented
- It is sensitive to economic cycles
- There are extraordinary diversity of professions, specialists and suppliers
- It is largely affected by external environments

There is no other industry that requires the proper application of business practices much as construction industry. The many variables and complex relationships that exist between variables that must be considered in the process of building a construction project necessitates sound business practices and decisions. The variable environment surrounding the construction project complicated decisions to be made concerning the use of labor, materials and equipment. In addition, governmental influence and labor practices have a bearing on business decisions that must be made (Adrian, 1975). On the whole, construction contractors have been slow in applying proper management methods to the conduct of their business (Clough and Sears, 1994). Management in construction industry have been characterized as being weak, insufficient, nebulous, backward and slow to react to changing conditions. Nevertheless, in the overall picture, the construction industry is at or near the top in the annual rate of business failures and resulting liabilities (Clough and Sears, 1994). Explanations are given for why the construction has been slow in applying management procedures that have proven effective in other industries. The reasons are (Rafter, 1997):

- Construction projects are unique
- Construction projects involve many

skills largely non-repetitive in nature

- Projects are constructed under local conditions of weather, location, transportation and labor that are more or less beyond the contractor's control.
- Construction firms, in main, are small operations, with the management decisions being made by one or two persons (Clough and Sears, 1994)
- There are special problems in construction
- The future cannot be forecasted
- Construction is a high-risk business.

2. Methodology

It provides the information about research strategy, research design, target population and sample size. It also discusses some of the practical problems encountered. A detailed methodology and tools used are described.

3. Research Strategy

Research is diligent, systematic inquiry or investigation to validate old knowledge and generate new knowledge (Burns & Grove, 1987).

Research strategy can be defined as the way in which the research objectives can be questioned (Naoum, 1997).

There are two types of research strategies namely quantitative research and qualitative research (Naoum, 1997). Quantitative approaches seek to gather factual data and to study relationships between facts and how such facts and relationships accord with theories and the findings of any research executed previously (Fellows & Liu, 1997), where qualitative approaches seek to gain insights and to understand people's perception of "the world" whether as individuals or groups (Fellows & Liu, 1997). Qualitative research is "subjective" in nature, emphasizing meanings, experiences and so on (Naoum, 1997).

In this research, a quantitative approach is selected to determine the variables and factors that affect the risk management practices in building projects in Jammu and Kashmir to find out if there is a systematic risk management practices through the contracting companies.

4. Research design

The term "research design" refers to the plan or organization of scientific investigation, designing of a research study involves the development of a plan or strategy that will guide the collection and analyses of data (Polit & Hungler, 1999). Burns & Grove (1997) defined the term design as "some consider research design to be the entire strategy for the study, from identifying the problem to find the plans for data collection.

In this research a closed-ended questionnaire with interview is used to collect data from respondents. In structured interview, questions are presented in the same order and with the same wording to all interviewees. The interviewers have full control on the questionnaire throughout the entire process of the interview.

In structured interview, the interviewer administers a questionnaire, perhaps by asking the questions and recording the responses, with little scope for probing those responses by asking supplementary questions to obtain more details and to pursue new and interesting aspects (Fellows & Liu, 1997). Naoum (1998) summarizes the main advantages of structured interview as follows:

1. The answers can be more accurate.
2. The response rate is relatively high (approximately 60-70 percent), especially if interviewees are contacted directly.
3. The answers can be explored with finding out "Why" the particular answers are given.

5. Research population

A population consists of the totality of the observation with which we are concerned (Walpole & Myers, 1998). In this research, the population is the total number of contractors (20 contracting companies) of the first class who have valid registration by the Contractors Union and the same number of owners.

6. Sample Size

Sampling defines the process of making the selections; sample defines the selected items (Burns & Grove, 1987). Wood and Haber (1997) defined the sampling as the process of selecting

representative units of a population for the study in a research investigation. Scientists derive knowledge from samples; many problems in scientific research cannot be solved without employing sampling procedures (Wood & Haber, 1997).

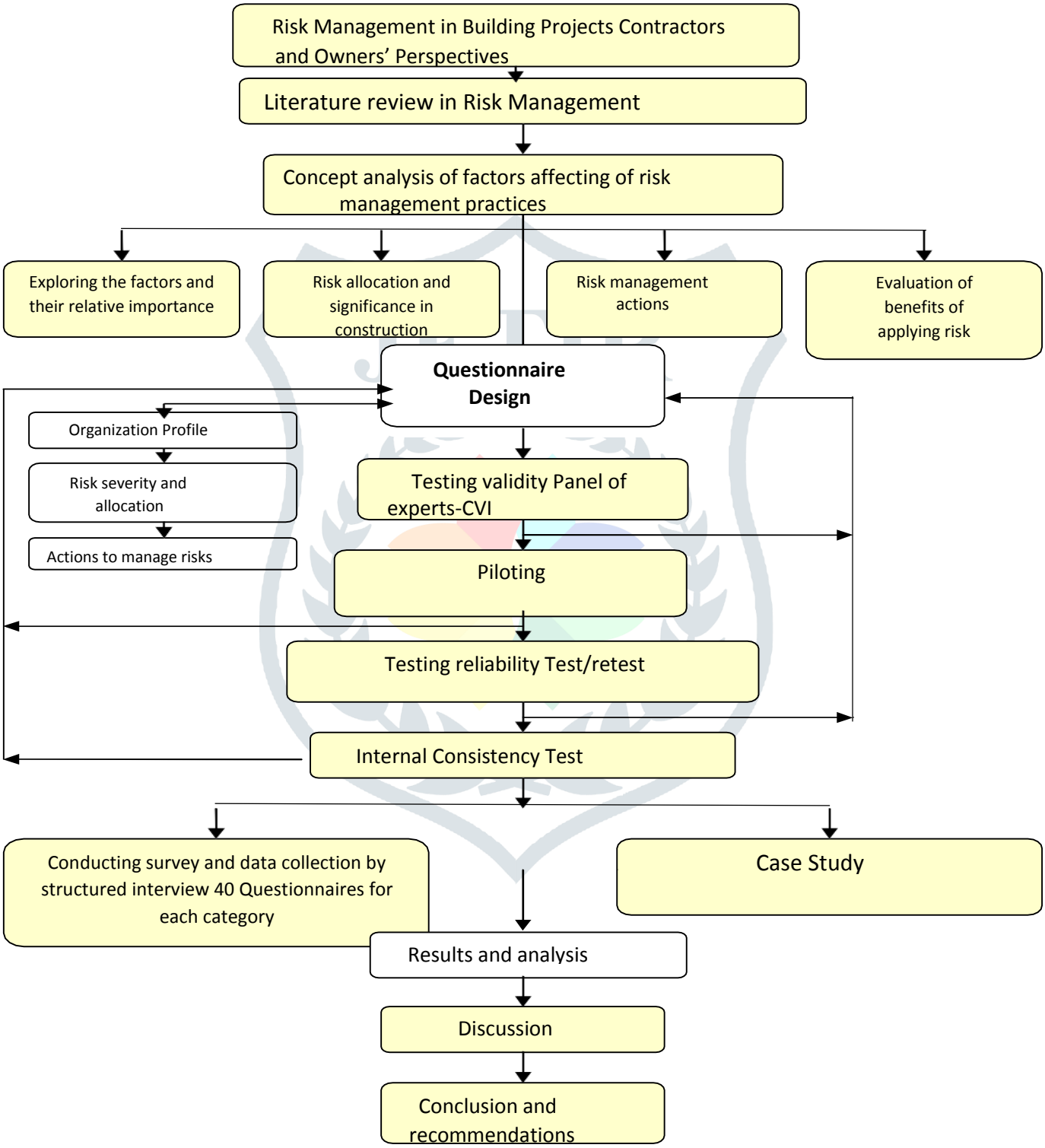

Chart1.Methodology flow chart

The formula below was used to determine the sample size of unlimited population (Creative Research Systems, 2001):

$$SS = \frac{Z^2 \times P \times (1-P)}{C^2}$$

Where SS = Sample Size.

Z = Z Value (e.g. 1.96 for 95% confidence interval).

P = Percentage picking a choice, expressed as decimal, (0.50 used for sample size needed).

C = Confidence interval (0.05)

$$SS = \frac{1.96^2 \times 0.5 \times (1-0.5)}{0.05^2} = 384$$

Correction for finite population

$$SS_{New} = \frac{SS}{1 + \frac{SS-1}{Pop}}$$

Where pop is the population = 20 first class contracting companies according to the PCU records.

$$SS_{New} = \frac{384}{1 + \frac{384-1}{20}} = 19.05 \approx 20$$

20 questionnaires are to be distributed to contracting firms; all of them are classified as first class companies. To carry out a comparison between contractors and owners' perspectives, the same number of questionnaires will be distributed to owners.

7. Sample method

The objective of sampling is to provide a practical means of enabling the data collection and processing components of research to be carried out whilst ensuring that the sample provide a good representation of the population (Fellows & Liu, 1997).

8. Methods of Quantitative Risk Analysis

Any specific risk analysis technique is going to require a strategy. It is best to begin by providing a way of thinking about risk analysis that is applicable to any specific tool might be used.

- Probability Analysis is a tool in investigating problems which do not have a single value solution, Monte Carlo Simulation is the most easily used form of probability analysis.
- Monte Carlo Simulation is presented as the technique of primary interest because it is the tool that is used most often.
- Sensitivity Analysis is a tool that has been used to great extent by most risk analysts at one time to another.
- Breakeven Analysis is an application of a sensitivity analysis. It can be used to measure the key

variables which show a project to be attractive or unattractive.

- Scenario Analysis is a rather grand name for another derivative of sensitivity analysis technique which tests alternative scenarios; the aim is to consider various scenarios as options.

9. Questionnaire design

The questionnaire survey was conducted to determine the opinion of contractors and owners regarding the risk factors.

The questionnaire was composed of five sections to accomplish the aim of this research, as follows:

1. The organization profile (contractor and owner)

2. Risk factors that have been identified by literature, experts and by the researcher.

3. Risk preventive methods which could be used to avoid risk to take place.

4. Risk mitigate methods that could be used to mitigate risk impact or likelihood.

5. Risk analysis techniques that could be used to analyze and estimate risk factors impact.

Table 1. Risk variables (factors) included in the questionnaire

Construction Project Risk	*Physical*	Occurrence of accidents because of poor safety procedures
		Supplies of defective materials
		Varied labor and equipment productivity
	Environmental	Environmental factors (floods, earthquakes… etc.)
		Difficulty to access the site (very far, settlements)
		Adverse weather conditions
	Design	Defective design (incorrect)
		Not coordinated design (structural, mechanical, electrical, etc.)
		Inaccurate quantities
		Lack of consistency between bill of quantities, drawings and specifications
		Rush design
		Awarding the design to unqualified designers
	Logistics	Unavailable labor, materials and equipment
		Undefined scope of working
		High competition in bids
		Inaccurate project program
		Poor communications between the home and field offices (contractor side)
	Financial	Inflation
		Delayed payments on contract
		Financial failure of the contractor
		Unmanaged cash flow
		Exchange rate fluctuation
		Monopolizing of materials due to closure and other unexpected political conditions
	Legal	Difficulty to get permits
		Ambiguity of work legislations
		Legal disputes during the construction phase among the parties of the contract
		Delayed disputes resolutions
		No specialized arbitrators to help settle fast
	Construction	Rush bidding
		Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications
		Undocumented change orders
		Lower work quality in presence of time constraints
		Design changes
		Actual quantities differ from the contract quantities
	Political	Segmentation
		Working at hot (dangerous) areas (close to IDF positions)
		New governmental acts or legislations
		Unstable security circumstances (Invasions)
		Closure
	Management	Ambiguous planning due to project complexity
		Resource management
		Changes in management ways
		Information unavailability (include uncertainty)
		Poor communication between involved parties

10.Results and Discussion

The aim of this study is to determine the risk factors in construction industry, allocation of these factors, methods used to deal with risks and the techniques adopted in analyzing these risks. The results of the study are illustrated in this chapter. Mainly, the severity of risk factors, allocation of each, methods of dealing with risks and techniques of analysis. Then, a comparison will be held between contractors and owners' perspectives regarding the severity and allocation of each risk factor.

11.Conclusion

- The findings obtained from the case study show that the most five important risk factors that seriously caused the project to delay are in a descending order:

- Poor communications between the home and field offices (contractor side)
- Varied labor and equipment productivity (due to political and environmental circumstances)
- Closure
- Segmentation of Gaza Strip
- Incorrect design, that led to re-design work, which took – sometimes - several days to be approved.

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