IDENTIFICATION OF RISK SIGNIFICANCE IN THE PHASES OF PROJECT LIFE CYCLE OF A CONSTRUCTION BUSINESS PROJECT USING TRIANGULAR FUZZY NUMBER

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ABSTRACT: *This paper was aiming at the identification of risk significance in the phases of project life cycle of construction business by using a model, "Triangular Fuzzy Number", to find out the range of expert choice about risk significance in each phase viz. Initiating, Planning, Execution, Monitoring and Control, and Closing. People at supervisory level associated with construction firms were targeted for collection of data through questionnaire. The top most area of the model "Fuzzy Triangular Number" signified the risk, involved in "Execution phase" of the project, then came the phases of Planning, Initiating, Monitoring and Control, and Closing respectively at second, third, fourth, and fifth positions. Certainly, these positions made clear the involvement of risk management in each phase of project life cycle of construction business.*

Keywords: Construction, Project Management, Risk Management, Project Life Cycle

INTRODUCTION

There are so many slips between cup and the lips. This well-known saying refers to the likelihood of risk in every walk of life including business activities. The project life cycle systematically, consists of five phases i.e. Initiating, Planning, Execution, Monitoring and control, and Closing. Each one of the five phases, is not free of risk. Due to some reason or the other certain draw backs may crop up at any stage of construction of a project inflicting risk of depletion of resource and finally deterioration of usefulness of the project, a vigilance of high value and a strong apprehensive ability are therefore, necessitated for the survival of the project. We can't keep our self away from this reality that risks are implicated in the life cycle of every project [1]. Risk factors in construction business are high on the grounds that construction projects are fabricated just once and they are unique and complex sometimes, moreover, in every project of construction business, risks are related throughout project's beginning stage to ending stage, its life cycle [2].According to these circumstances risk factors are hardly noticed at the very outset. They are noticed at later stage when they start influencing the targets of the project namely, Scope, Schedule, Time and Quality [3]. So it is necessary to anticipate the likelihood of risk involvement, before the establishment of the project.

Risk identification and Risk management is the main focus of Project management, previously Taroun [4] presented that the identification of risk factors in project life cycle of construction business is not really new previously its roots belong to the advancement of the Program Evaluation and Review Technique (PERT) in the 1950s for handling lack of determination of project scheduling. Moreover he presented that Risk Management (RM) became a well-established function of Project Management in 1980s and during 1990s the researchers examined distinctive studies to explain exceptional nature of risks related to construction project, and after that risk assessment thrived as a hot researching point.

According to Baker et al., [5] the term "risk analysis" firstly used by Hertz [6] he used this term in order to give risk management a right direction for all kinds of business, according to him the trace of the origin of the risk management is 3200 BC. Edwards and Bowen [7] analyzed and evaluate the literary works on construction and project risks published during the period from 1960 to 1997. They also explained the usage of statistical methods and after that implementation of Monte-Carlo Simulation (MCS) during 1970s. In 1980s many risk management approaches developed like Fuzzy Sets Theory (FST) was developed as an affordable solution for managing risks in construction business projects [4].

Until 1990s many theories were developed and using for identifying and managing risks like PT-based tools, Monte-Carlo Simulation (MCS), Analytical Hierarchy Process (AHP), and Fuzzy Sets Theory (FST) [4]. To evaluate proposal risks, Hull [8] introduced a diverse method based on MCS and PERT. By the start of 2000 Decision support systems (DSSs) were used to access risks, DSSs was proposed for overseeing risks in early phases of construction project by utilizing AHP and Decision Tree [9]. The expand in publications of papers covering risk management after 2005 is remarkable, Fuzzy Sets Theory (FST) was used to develop a Decision Support System (DSS) for intelligent risk assessment in construction [10]. Thomasa et al. [11] utilized fault tree to model diverse situations and used variables to survey risks likelihood of occurrence and effect. They endeavored to enhance risk identifications by recognizing the assessments of experts they called this system Fuzzy-Delphi, the proposed model does not evaluate project risks rather it gives a way to evaluate the risk levels of particular danger situations.

Risk Management, therefore, plays a very important role in the cost benefit of the project, especially in construction projects where uncertainty is related, so existence of uncertainty emphasizes on the effective and to fit risk management procedures. However, until now, many researches focus on assessment of risks, risk management techniques, likelihood of occurrence and impact of assessed risks, in Construction projects [12] rather than they use a systematic approach to identify the more risky phase of the project in its life cycle. So, the perspective of this paper is to emphasize on distinguishing more unsafe or significantly risky phase of life cycle of construction project using Triangular Fuzzy Number.

Table-1 Summery of identified risk factors (constructs) along with variables

Sr.#	Risk Factors (Constructs)	Variables
1.	Proposal Risks	Not Understood Scope and Under/Over Estimation.
2.	Engineering Risks	Delayed Engineering, Under/Over Design and Inexperienced Engineers.
3.	Procurement Risks	Delay in Material Delivery, Change in Specification/Price of Material, Delay in Approval of payments.
4.	Financial Risks	Delayed Payments, Fluctuation in Currency Rates, High Inflation Rate, and Cost Escalation.
5.	Contractual Risks	Misinterpretation of Terms and Conditions, Stay Order by any 3rd Party, and Construction Disputes.
6.	Construction Risks	Quality, Unavailability of Labor Resource, Tough Site Conditions, and Strikes/lockout/ Idle Time.
7.	Security Risks	Accident on Site, Terrorism, Loss of Human Resource or Machinery, and Threats from 3rd party.
8.	Natural Risks	Unexpected Weather Conditions, Earthquakes, and Wind Strom

MATERIAL and METHODS

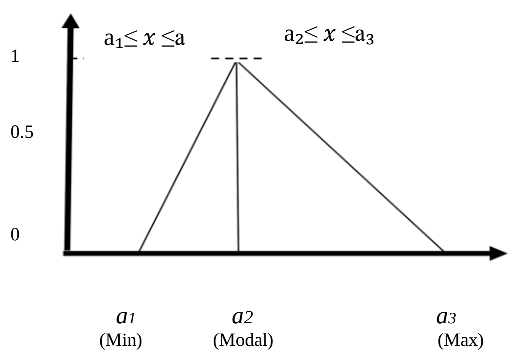
For investigation of risk significance in project life cycle of construction business, total 8 Risk Factors (constructs) along with variables measuring those constructs summarized in Table-1 were identified. These below mentioned risk factors can be involved in any construction projects [13-14-15-16-17-18-19].

Data were collected through a structured questionnaire from experts of construction business the sample size was 50, because all respondent were at the level of supervisor, the respondents were supposed to choose the answer among Strongly Disagree, Disagree, Neutral, Agree, and Strongly Agree (range from 1 to 5 Respectively). In order to find out the significantly risky phase of the construction project life cycle, we used Triangular Fuzzy Number from the study of Kauffmann and Gupta [20]. Following were the steps of the algorithm of triangular fuzzy number.

Step 1: For each phase Modal (most likely value of the phase of PLC) value was calculated.

Step 2: In Triangular Fuzzy Number. Figure 1.0, Maximum value got by adding 1 in Modal value, and by subtracting 1 from Modal value gave the Minimum value.

Figure 1.0: Triangular Fuzzy Number



Step 3: After setting min, modal and max values, then calculated aggregate distance index of triangular fuzzy number by using the following Equation – 1

Equation-1: $\hat{A} = \{(a_2 - a_1)\,\alpha + a_1\}, - \{(a_3 - a_2)\,\alpha + a_3\}$

Step 4: After the calculation of aggregate distance index, similarity number average then calculated by using following Equations:

Equation - 2: $\lambda(x) = \frac{\hat{A} - a_1}{2(a_2 - a_1)}$ $\quad a_1 \leq x \leq a_2$

Equation - 3: $\lambda(x) = \frac{\hat{A} - a_3}{2(a_2 - a_3)}$ $\quad a_2 \leq x \leq a_3$

Step 5: Calculated values from step 4 added to calculated aggregate distance indexes which gave the expert choice range of each phase which distinguished the phase either was risky or not.

RESULTS AND DISCUSSION

By applying the triangular fuzzy number algorithm on each phase we got the result of ranges of expert opinion as Initiating Phase = 3.15 to 4.15, Planning Phase = 3.25 to 4.25, Execution Phase = 3.55 to 4.55, Monitoring and Control Phase = 2.95 to 3.95 and Closing Phase = 2.55 to 3.55 the calculated range told the expert opinion about **Initiating Phase:** The range of choice of expert was 3.15 to 4.15, as 3 was for "Neutral" and 4 was for "Agree", so from the resultant lowest and highest values of range showed that expert agreed that this phase was a bit risky. Similarly,

Planning Phase: The range of choice was 3.25 to 4.25, so expert agreed that it was a risky phase because the range was toward "Strongly Agree" response.

Execution Phase: Expert choice range was 3.55 to 4.55, this response was more toward "Strongly Agree" response than the planning and initiating phase respectively. Thus this phase was also very risky in expert opinion.

Monitoring and Control Phase: Range of expert choice was 2.95 to 3.95, the expert choice was between "Neutral and Agree" responses so the phase was not much risky but risks were related to this phase because the high value of range showed it was toward "Agree" response.

Closing Phase: Here the range was 2.55 to 3.55, the expert opinion is among "Disagree, Neutral, and Agree" responses so expert opinion showed that this phase had natural risk intensity.

So, consequent upon a careful implementation of expert choice model, the following positions of phases of project life cycle of construction project had been arrived at the top most area involving risk was "Execution Phase". Then Planning, Initiating, Monitoring and Control, and Closing phases stand respectively at second, third, fourth, and fifth positions in this regard. As shown in the figure-2.0.

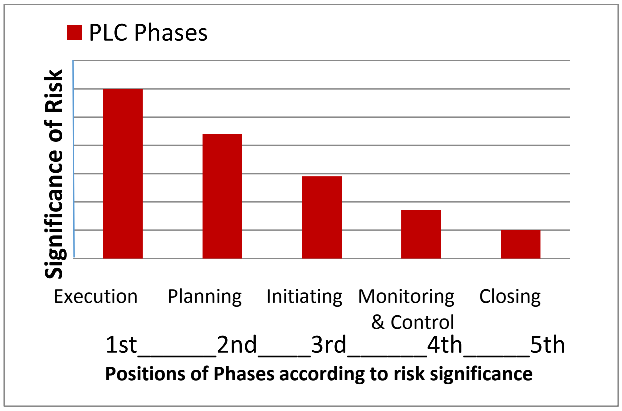


Figure: 2.0- Position of PLC Phases

CONCLUSION

The outcomes of different phases of project life cycle depict that, to fit risk assessment and management, the risk management insight should be considered foremost in Execution phase particularly and then Planning, Initiating, Monitoring and Control, and Closing phases generally, we cannot eliminate risks in phase of Project life Cycle however we can minimize these risks by putting effort in each phase according to the risk significance.

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