Identifying and Analysing Key Factors Associated with Risks in Construction Projects

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Abstract The construction industry has a fragmented nature associated with it. It is necessary to identify the impact of the key factors associated with risk on construction projects so that the timely alternatives or solutions could be taken to avoid them. The objective of the paper is to identify and analyse the various risks factors globally associated with construction projects. In this, the risks factors in the international construction sector were compared to the Indian industry of construction, in order to find out the similar risks globally. The methodology adopted for the study is to review the previous year's research papers for the international industry of construction and Interview of a construction company in India and after analyzing the data the common risks in both the industry were found. It is concluded that the retention good quality of labourers has the highest impact globally in the construction sector. The categories of risks related to clients, subcontractors, finance, contractors and government were found common. The appropriate management plan for risks in construction should be implemented right from the beginning of the project in order to minimize its impact and proper solution or alternatives could be taken accordingly at each and every stage of the project. One of the solutions to transfer risk in this sector is by taking appropriate insurance policy for the project.

Keywords Risk factors · Construction projects · Construction productivity · Project management · Construction management

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1 Introduction

In India, the construction industry is one of the oldest industries with ample amount of employment opportunities for the rural and urban population. The size of this industry varies from single ownership to a large industry providing employment to thousands of people. Before independence, the construction work was confined to the individual and community level. Under the rule of Lord Dalhousie, Public Welfare Department was established for the construction of roads, canals, etc., in the years 1875 AD. But after independence as well Indian construction industry continued the evolution with the projects like Bhakra Dam, which was a breakthrough project for India [1, 2].

Previous studies have revealed that the construction industry does not have a good record track in performing a risk assessment as compared to other industries. Construction activities are hazardous in nature due to which there are frequent accidents, which are sometimes severe as well. Also, construction activities need a large amount of investment majorly on public projects. All these factors also increase the risk of the project. Construction projects require many people with disparate skills, knowledge and interests, as well as the coordination of a variety of different, yet related activities. There is no such project which will not have a risk in it, so a project can be successful only when the risks are identified at the initial stage and proper mitigating measures are taken at every step to minimize the impact of that risk [1, 3–5].

1.1 What Is Risk?

According to BS 6079-3:2000: "An uncertainty inherent in plans and the possibility of something happening that can affect the prospect of business or project goals ("BS 6079-3:2000 Project management. Guide to the management of business related project risk," 2000)".

According to the Association of Project Management: "It is defined as the combination of a probability or frequency of occurrence of a defined threat or opportunity and the magnitude of the consequences of the occurrence."

According to PMBOK Guide 5th edition: "Project risk is "an uncertain event or condition that if it occurs as a positive or negative effect on one or more project objectives such as scope, schedule, cost or objectives (A Guide to the Project Management Body of Knowledge (PMBOK® Guide) – Fifth Edition, 2013)"

According to ISO-31000 "Risk is defined as the effect of uncertainty on objectives ("ISO-31000-2000(E)," 2009)".

2 Review of Literature

Baccarini and Archer in the year 2001 presented a methodology, which ranks project based on risk. This was taken up by the department of contract and management services in Western Australia. Hillson in 2002 proposed a methodology for the assessment of threat along with the opportunity concurrently within the P-I models quantitatively as well as qualitatively. Ward and Chapman in 2003 proposed a six steps path for estimation of uncertainty which is "minimalist" path. Jannadi along with Almishari in the year 2003 gave a software for the generation of risk scores, the variables for the software were fed on the basis of a model of risk as probability, the harshness of impact and vulnerability to all hazards of activity [2, 6–8]. For the purpose of quantification of risk which was allocated to each element of the project Cagno et al. in 2007 identified the sources of uncertainty, affected activities and risk owners by using the P-I model. They tried to improve the model of risk by giving the controllability concept which is the ratio of expected risk impacts before and after mitigation actions have been applied. Zhang in 2007 introduced project susceptibility by giving the argument that once the event of risk will occur, a projection system will have interactions with these events, which would determine the risk consequences that are ultimately experienced. Han et al. in 2008 gave a three-dimensional model of risk, i.e. Significance of risk -Probability of risk -Impact of risk. In the year 2009, Cioffi along with Khamooshi suggested a method that leads to the relevant budget for contingency by combining the impact of risks and at a given confidence level evaluating its overall impact. In international construction projects. Hastak and Shakes in 2000 used AHP, with a model of risk modelled as Probability and its impact. DSS was given by Dey in 2001so that the risk can be easily managed right from the beginning stage of the construction project. To find out and identify which is the best strategy for the management of risk EMV of each risk response strategy is used in the construction project [9–14]. For assessment of risk as well opportunity in international projects. Dikmen and Birgonul in 2006 used AHP along with a framework for multi-criteria decision making. For joint ventures related construction works, Hsueh et al. in 2007 used utility as well as AHP theory to develop multi-criteria for the purpose of assessment of risk. However, the author does not give any risk assessment tool in this paper. AHP was used by Zayed et al. in 2008 to allocate weight to risks before project risk levels are been calculated. Tah and Carr in 2000 developed a qualitative risk assessment model and in the year 2001 tried to overcome the limitation of FST [15–20]. Baloi and Price in 2003 after comparing many theories found FST as a vital means of solving the problem for estimating the nature of construction uncertainty. DSS was developed by Shang et al. in the year 2005 for facilitation of evaluation of risk at the design and conceptual stages. Zeng et al. in 2007 attempted to mix the strengths of FST and AHP [21–24].

3 Research Methodology

The methodology used for the research was a thorough literature review, a postal questionnaire to practitioners in China and a statistical result analysis of the questionnaire and the risks identified from those results. In addition to this, in the Australian industry of construction, a comparative study was also performed [25–27]. The two sections of the questionnaire included the general informal of the respondents and the 85 risks associated with the construction projects. Respondents were asked to indicate what was the likelihood of happening or occurrence of the mentioned risks as "highly likely, likely or less likely" and the magnitude of consequences on the various objectives related to project that would result as "high, medium or low". 85 risks factors identified were categorized into 7 groups: 8 risks related to clients, 8 related to designers, 39 related to contractors, 4 related to sub-contractors/suppliers, 5 related to government bodies, 5 related to superintendents, 16 related to external issues. After the analysis of the questionnaire survey, it is found that out of 85 risks many were repetitive and the count was cut down to 25 after the filtration. On the basis of the analysis of the survey following risks were found in China construction industry (Figs. 1 and 2).

The risks from a previous year's research paper in the sector of construction have been identified in the international construction market and compared to that

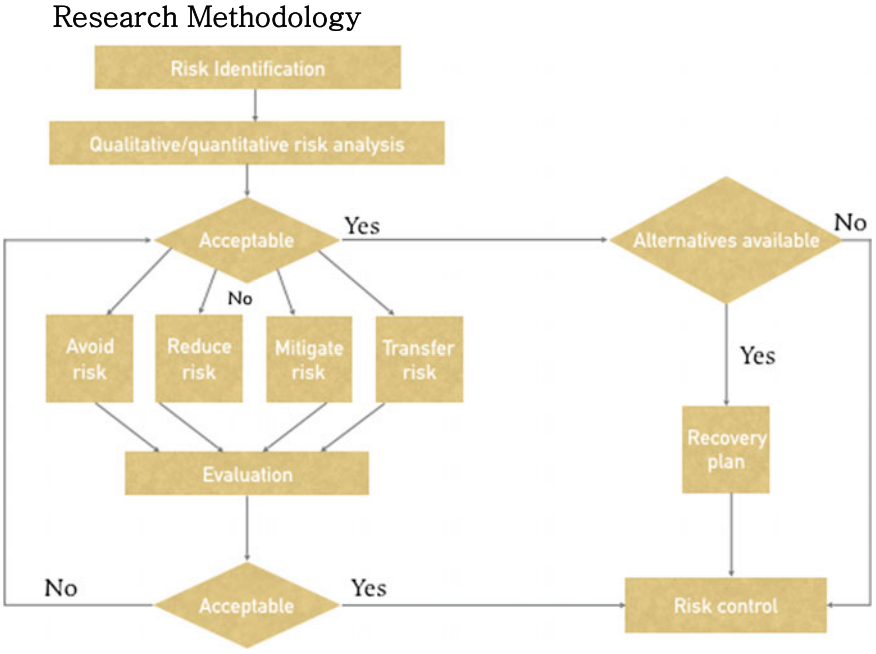

Fig. 1 Project risk management process

Fig. 2 Risk management flow chart

of the Indian industry of construction which was found through an interview. It was observed that the labourers have the maximum impact on the construction projects globally. Their quality of workmanship, their capabilities and availability have a vital role to play in minimising the risk impact globally. After which project feasibilities related risks have an effect on the project if not performed with accuracy [28–31].

4 Results and Discussion

Risks related to plant and machinery, funds of the project, quality and competency of contractors and government policies were the global risk factors. And various other risks associated with client, contractors, sub-contractors, suppliers and government had an effect on the construction projects globally. The project should have a management plan for risks right from the beginning in order that the identified risks could be evaluated properly so that the proper plan for risk response could be made and implemented at the right time (Fig. 3).

By using a risk management assessment techniques like PERT, Monte-Carlo Simulation, etc. appropriate strategy could be adapted to identify whether the risks could be avoided or not, is reducible or not, transferable or not and can be mitigated or not. If these strategies do not work, then again the analysis of risk is performed. The proper plan should be made and implemented in the project right from the feasibility

Fig. 3 Representation of new risks factors

stage to the construction phase so that the risks related to client, contractors and other stakeholders could be reduced.

In order to make the construction project safe appropriate policy of insurance could be taken so it can act as a risk transfer tool in case of any mishappening or the failure of the project.

4.1 Limitations of the Study

Since the construction industry is very vast and is fragmented in nature so many new risks can arise during the project depending on multiple factors such as force majeure, unknown risks, risks related to political issues, government policies, etc., so with every new different risk different solution or mitigation strategies are to be proposed. And the risk is a vast field in itself and there are no appropriate risk assessment techniques which can identify all the risks integrated into the project [32–34].

Ethical approval: "*For this type of study formal consent is not required.*" In the present research there is no direct involvement of human/respondents. All the data were collected using structured questionnaire survey and there is no test/procedure/observation is conducted with the respondents while collecting the data.

Informed consent: "*Informed consent was obtained from all individual participants included in the study.*" A statement of formal consent was added in the introductory part of the questionnaire while sharing with the respondents.

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