

## **Risk and Risk-Handling Strategies in Construction Projects**

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### **ABSTRACT**

*Risk in construction projects is an object of attention due to factors namely, time, cost overruns and quality associated with construction projects. Managing those risks in construction projects is necessary in order to achieve the project objectives in terms of time, cost, quality, safety and environmental sustainability. Project risk management includes the process of risk identification, analysis, and risk-handling strategies (risk-response). Risk response strategy refers to identifying, evaluating, selecting, and implementing effective actions in order to reduce the likelihood of occurrence of risk events and/or lower the negative impact of those risks. The study aims to develop the hypothesis on selection of risk -handling strategy with specific risk situation. So, based on previous literature, the hypothesis are developed which described the relationship among the project characteristics, managers attitude towards risk and degree of controllability of risk event with choice of risk response strategy.*

**Keywords:** construction projects, risk, project management, risk management, risk-handling strategies.

### **INTRODUCTION:**

Risks can encompass both threats and opportunities depending on the situations present in the project. According to Merriam-webster dictionary, risk is possibility of loss or injury to something or to someone. Risk is anything that influences the project at every phase of project. Reducing the likelihood of occurrence of an event or minimizing, controlling and sharing of risks with another party is known as risk management (Iqbal et al. 2015). An organized way to understand risk, identifying of sources of risk, analyzing and management of that risk through the process of risk management is known as risk management (PMI, 2004). It may affect the planning phase and/or to the execution phase of the projects. Its effect could be positive or it could be negative as well (Jaafari, 2001; Smith, 2006; Khodeir and Mohamed, 2015). Risk has negative impact on project's performance in terms of cost, quality, time etc. (Zhi, 1995; Akintoye and Macleod, 1997; Zhang and Fan, 2013). According to Merriam-webster dictionary construction is the act or process of building such as houses, roads, bridges etc. The construction industry includes construction of buildings, roads, highways, specialty trades, bridges etc. it also includes specialized work of plumbing, masons, electrical work and construction of type of structure. Construction projects are risky because of large capital investment, involvement of many stakeholders, complex technology (Shen, 1997), high environmental and social impact. A typical construction project may involve all forms of risks such as contractual, financial, operational, political and technical risks. The process of risk management is performed with an objective to reduce the negative impact of occurrence of events to the project (Project Management Institute, (PMI) 2004). (Perry and Hayes, 1985; Berkeley et al. 1991; Zhi, 1995) suggested that risk management of real estate and construction projects can be possible through the risk management processes. Project risk management process consists of three phases: risk identification, risk assessment and risk response (Perry, 1986; Berkeley et al. 1991; Baker et al, 1998; PMBOK, 2004). The ultimate aim of risk management is identification of sources of risks, and develops appropriate risk response strategies to cope with that risk (Kartam and Kartam 2001; Fan et al. 2008).

Many researchers explored that managing risks in real estate and construction projects has been recognized important in order to achieve the project objectives in terms of time, cost, quality, safety and environmental sustainability etc. (Akintoye and Macleod, 1997; Zou et al. 2007; Iqbal et al. 2015).

Risk response strategies include four types of actions namely risk retention, reduction, transfer, and risk avoidance which are taken to reduce the likelihood of occurrence of risk events and/or lower the negative impact of those risks (Akintoye and Macleod, 1996; Tang et al., 2007; Choudhry and Iqbal, 2013; Hasseb et al., 2014). Risk response is defined as respond to the risky situation by avoiding the risk, reduce the likelihood of occurrence, reduce the consequences, transfer the risk, retain the risk according the suitable applicability of the action to add value to project and for the improvement of efficiency of construction project (Shen, 1997; Tang et al., 2007; Fan et al., 2008; Choudhry and Iqbal, 2013).

Only few studies have attempted to gauge the affect of specific risk event on the selection of risk response strategy. This deserves further research. So, the study reported in this paper aims to fill this research gap. The study aims to develop the hypothesis on selection of risk handling strategy with specific risk situation. Based on previous literature survey the hypothesis are developed which described the relationship among the project characteristics, managers attitude towards risk and degree of controllability of risk event with choice of risk response strategy.

The paper is organized from the four dimensions. Firstly, the risk events, and risk response strategies of construction industry are listed with the help of literature review and consultation with practitioners and consultants. Secondly, the situations of risk events which have impact on selection of risk response strategy are reviewed. Thirdly, hypothesis are developed which described the relationship among the project characteristics, managers attitude towards risk and degree of controllability of risk event with choice of risk response strategy. Finally, the conclusion, and suggestions are discussed.

## **LITERATURE SURVEY:**

Risk management is one of the major problems before project managers. Many researchers have reviewed the problems relating risk management strategies (Baillie, 1980; Becker et al., 1999). Related literature is reviewed which provide knowledge regarding the risk events, risk situations and their impact on the selection of risk response strategy in construction projects. It can be observed that literature related to choice project risk response strategy have aroused attention of researchers from different perspectives.

### **Risk response strategies:**

Risk response is the strategic option focusing on actions to reduce project risk and enhancing project profitability. Many researches and agencies have defined risk response in different ways with ultimate objective of project profitability. Project Management Institute, (2004) defined risk response as to identifying, evaluating, selecting, and implementing effective actions in order to reduce the likelihood of occurrence of risk events and/or lower the negative impact of those risks. Risk response strategies play vital role in mitigation of negative impact of risk on project objectives (Millar and Lessard, 2001; Zau et al., 2007). Risk response strategies include four types of actions namely risk avoidance, risk retention, reduction, and transfer, which are taken to reduce the likelihood of occurrence of risk events and/or lower the negative impact of those risks (Akintoye and Macleod, 1997 ;Tang et al. 2007; Choudhry and Iqbal, 2013; Hasseb et al., 2014; Iqbal et al., 2015).

Risk can be avoided by eliminating the cause of threat. Risk avoidance is also known as risk elimination or risk reduction (Perry, 1986). Risk can be avoided by changing the exposed area. Avoidance of risk means looking at or chooses other alternatives in the project. The better option to avoid the risk is to change the scope of project, procedural changes, regular inspections and site investigation, different methods of construction, more detailed planning, more training and skill development programmes etc. (Perry, 1986; Cooper et al., 2005). Risk retention: which risks are retained by a party, the reason for retaining that risk could be: the risk may be controllable or uncontrollable, or when only option to retain the risk, cause the risk prevention or transfer is impossible, avoidance is undesirable, possible financial loss is small, probability of occurrence is negligible and transfer of risk is uneconomic (Perry, 1986).

Risk transfer: (Perry and Hayes, 1985 ;Khumpaisal, 2007) suggested four transfer routes of risk in construction projects (1)from client to contractor or designer, (2)contractor to subcontractor, (3)client, contractor, subcontractor or designer to insurer, and(4) contractor or subcontractor to surety. The essential characteristics of transferring risk is to share those consequences with party other than client and the premium should be paid by the client for the recovery of loss which occurred from the risk event.

The literature has revealed the risk situations as handling customer complaints, production facility hurdles, new product development, overseas market expansions, handling new real estate project etc. (March and Shapira

1987; Wehrung et al., 1988). (Royer, 2000) suggested brainstorming sessions with project team, clients and experts to respond to project risks. (Fan, et al., 2008 p. 708), revealed alignment of risk handling strategy with project characteristics (project size, knowledge regarding similar projects, project complexity, weak technical skill background, complexity, large project scale, tight project schedule, environment, political, legal, regulations and economic aspects). Further, they perform optimization analysis to derive a minimum-cost risk-handling strategy for a particular risk event and link project characteristics and risk situation to select suitable risk-handling strategy.

There are two types of risk response actions which can be taken through the risk response strategy namely, risk prevention and risk adaption. (Fan et al., 2008) risk prevention means when project managers take actions at the planning stage to condense the likelihood of incidence of risk events. Risk adaption: when actions taken at the stage of execution of project (Kartam and Kartam, 2001) explored that there are two types of risk management actions: preventive actions and adaptive actions, former actions taken at early stage of project to reduce the occurrence of risk and latter is used reduce to loss of the effect of risk. Conducting a market survey can be helpful in providing more information on new product development and thereby reduce the probability of product failure is an example of risk prevention strategy.

This study will look at the risk management actions taken through the risk response strategies. The specific strategies were proposed to mitigate the risks in the project. The literature survey presents specific risk-handling actions of risk handling strategy namely - adaption strategy and prevention strategy based on related research work on construction risk management.

Table no. 1 shows the, type of risk, controllability, and selection of risk response strategy.

**Table No. 1**

<b>Authors/Year</b>	<b>Type of risk</b>	<b>Degree of controllability</b>	<b>Specific risk-handling actions</b>	<b>Type of risk-handling strategy</b>
Perry (1986), Shen (1997) Akintoye and Macleod, (1997)	Related to design	High	Further, site investigation of field survey	Risk prevention
Zhi(1995)	Risk of security	High	Installation of CCTV at site location.	Risk prevention
	High inflation	Low	Lump-sum contracts	Risk prevention
Shen (1997), Fan et al., (2008)	Inflation rate	Low	Prepare reserve	Risk adaption
	Non-availability or shortage of manpower and equipment	high	Increase manpower and equipment	Risk adaption
	Low- productivity	high	Increase working hours	Risk adaption
Fan et al., (2008), Zhang and Fan (2013)	Act of God: earthquake, flood etc.	low	Purchase insurance coverage	Risk adaption
	Alteration of project scope/specifications	medium	Enhance control and communication	Risk prevention
	Failure of on time completion by subcontractor	Medium	A. Select a second subcontractor. B. Perform more strict selection of subcontractor	A. Risk prevention B. Risk adaption
Enshassi et al.,(2008), Shen, (1997)	Inaccurate project program		Refer to previous and ongoing similar projects for accurate program	Risk prevention
Shen (1997), Enshassi et al., (2008), Choudhry and Iqbal, (2013), Iqbal et al., (2015).	Inaccurate execution plan/schedule	High	Produce a proper Schedule by getting updated project information	Risk Prevention

### **Project characteristics and selection of risk response strategies:**

Speed of construction, location of project, size of project, unfamiliarity of the client with the project etc. are some of characteristics of project which were taken into consideration before selecting the suitable risk response strategy for the risk event (Perry, 1986, p. 211). Project characteristics have significant affect on selection of risk response strategies. (Fan, et al., 2008 p. 708), revealed alignment of risk handling strategy with project characteristics (project size, knowledge regarding similar projects, project complexity, weak technical skill background, complexity, large project scale, tight project schedule, environment, political, legal, regulations and economic aspects). Further, they perform optimization analysis to derive a minimum-cost risk-handling strategy for a particular risk event and link project characteristics and risk situation to select suitable risk-handling strategy. Moreover, specific risk response strategy has different amount of cost, which depend on the characteristics of project. (Royer, 2000) asserted that selection of risk response strategy by ignoring project characteristics and environment may cause irrational management behavior towards managing risk.

### **Risk response strategies and project managers' attitude towards risk:**

Attitude of the managers is important when applying risk management techniques (Perry, 1986, p. 213). Risk management depends mainly on the intuition, judgment, and experience of the managers (Akintoye and Macleod, 1997). Selection of risk response strategy was associated with the attitude of management towards the risk and uncertainties. (Fan et al., 2008; Aminu, 2013) investigated that the attitude of project managers towards the risk events have influence the choice of risk response strategy.

### **Controllability of risk events and selection of risk response strategies:**

Nature of risk is defined by its controllability. Controllability of risk occurrence means changing the risk event's possibility of occurrence with the application of risk response strategy (Perry, 1986; Millar and Lessard, 2001). Some risk events namely, economic conditions (fluctuations in exchange rate and inflation rate), and occurrence of natural calamity, act of god, (earthquake, flood, drought and famines etc.) have low degree of controllability and less could be done to control or to change the possibility of occurrence and results. Whereas, there are events (technical problem, schedule, shortage of manpower and material, quality) have high degree of controllability (Gray and Larson, 2005; Fan et al., 2008). Low degree of risk events can be minimize by taking the risk adaption strategy whereas, high degree of risk can be reduce by applying prevention risk response strategy. For instance, to control or minimize the affect of risk of non-availability of material, managers can adopt a risk prevention strategy, while, risk adaption strategy can be adopted when there is low controllability over the risk. For instance, managers can select risk adaption strategy to reduce the affect of economic conditions and occurrence of natural calamity, act of god (Fan et al., 2008).

## **PROPOSED HYPOTHESIS:**

### **Project characteristics and selection of risk response strategies:**

Project characteristics have significant affect on selection of risk response strategies. (Fan, et al., 2008 p. 708), revealed alignment of risk handling strategy with project characteristics (project size, knowledge regarding similar projects, project complexity, weak technical skill background, complexity, large project scale, tight project schedule, environment, political, legal, regulations and economic aspects). Further, they perform optimization analysis to derive a minimum-cost risk-handling strategy for a particular risk event and link project characteristics and risk situation to select suitable risk-handling strategy. (Royer, 2000) asserted that selection of risk response strategy by ignoring project characteristics and environment cause irrational management behavior towards managing risk.

Zhang and Fan (2013) explored that selection of risk response strategy should be based on characteristics of project. Further, project characteristics have affect on the cost of risk response actions which were taken through the risk response strategy. Moreover, specific risk response strategy has different amount of cost, which depend on the characteristics of project. For instance (Fan et al., 2001) found that a large scale construction project such as nuclear plant involve government, environment policies, and to communicate with theses parties require huge amount, and effect the selection of risk response actions. (Fan et al., 2008) explored the relationship between the project characteristics and selection of risk response strategy. Further, found that project characteristics have influence on the choice of suitable risk response strategy. Therefore, it leads to the following hypothesis:

**H1:** Project characteristics significantly affect on selection of risk response strategies

### **Risk response strategies and project managers' attitude towards risk:**

Many managers make decision of selecting risk-handling strategy based on their own attitude, preference towards the risk event (Royer, 2000). Attitude of the managers is important when applying risk management techniques (Perry, 1986). Risk management is depends mainly on the intuition, judgment, and experience of the managers (Akintoye and Macleod, 1997).

Perry (1986) explored that choice of risk response technique depends on available information, experience and attitude of project managers. (Fan et al., 2008; Aminu, 2013) investigated that the attitude of project managers towards the risk events have influence the choice of risk response strategy. (Patil, 2015) found that response actions towards risk events depends on the subjective judgment of project managers that how they react to the risk event. Judgment and subjective knowledge gained from the past experience of the similar project, affect the attitude of project managers which ultimately influences the risk response strategy taken by them to reduce the possibility of occurrence of risk event and their effect on the project. Further, (Srinivas and Ravinder, 2011), found that major risk events or the majority of risk were related to construction or contractual process, which were better dealt according to the judgment, from past experience and attitude towards the risk. (Millar and Lessard, 2001) found that selection of risk response strategy was associated with the attitude of management towards the risk and uncertainties. So, it is hypothesized that:

**H2:** Attitude of project managers towards the risk events influences the choice of risk response strategy.

### **Controllability of risk events affects the selection of risk response strategies:**

The degree of control over risks determines the technique to mitigate the project risk (Millar and Lessard, 2001). Affect of risk event can be control or reduce by adopting the suitable risk response strategy (Shen, 1997). Further, project managers have high control over the risk of unavailability of sufficient skilled professionals and laborers and influence of risk can be reduced by taking prevention risk response strategy i.e. by hiring skilled manpower and by arranging training and development programmes for them (Yilmaz and Ergun, 2008).

Zou et al., (2007) investigate that the project managers have high control over the defective design risk so risk prevention action can be taken and suggested that to reduce the risk of defective designs, project manager can involve the specialist contractors to enable the best in accordance with the site conditions, the design team could obtain reliable design data through the proper and timely site investigation and by gathering adequate site information. (Fan et al., 2008) explored the relationship of controllability of risk event and selection of risk response strategy. For instance, management can purchase insurance against act of god (earthquake, flood etc.) as the probability of occurrence of risk event cannot be controlled. Hence, the following hypotheses are proposed.

**H3:** level of controllability of risk events significantly associated with the selection of risk response strategies.

**H3a:** minimization of low degree of risk events is association with risk adaption strategy.

**H3b:** minimization of high degree of risk events is association with risk prevention strategy.

### **CONCLUSION:**

Managing risks in construction projects, recognized as a very important process to attain the objectives of project in terms of cost, quality, safety etc. Risk response strategies play vital role in mitigation of negative impact of risk on project objectives. The situations of risk events have impact on choice of risk response strategy. Project characteristics, managers attitude towards risk and degree of controllability of risk event with choice of risk response strategy. In this study hypothesis are developed which describes the relationship among the project characteristics, managers' attitude towards risk and degree of controllability of risk event with choice of risk response strategy. For instance, project managers have high controllability over the shortage of material, and labour, to control or minimize the affect of risk of non-availability of material, and labour managers can adopt a risk prevention strategy. Project characteristics have significant affect on selection of risk response strategies. Project characteristics (project size, knowledge regarding similar projects, project complexity, weak technical skill background, complexity, large project scale, tight project schedule, environment, political, legal, regulations and economic aspects) have affect on the choice of the risk response strategy.

Selection of risk response strategy is associated with the attitude of management towards the risk and uncertainties. As the subjective knowledge gained from the past experience of the similar project, affect the attitude of project managers which ultimately influences the risk response strategy taken by them to reduce the possibility of occurrence of risk event and their effect on the project. Further, controllability of risk events is also significantly associated with the selection of risk response strategies. It is suggested that to minimize or eliminate the loss of risk event the selection of risk response strategies should be based on characteristics of the project. Further, project manager should refer to previous and ongoing similar projects, for selecting suitable

risk response strategy. Moreover, it is also suggested that the degree of control over risks will be helpful for determining the techniques to mitigate the project risk.

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