

Current Practice of Risk Management in the Malaysia Construction Industry—The Process and Tools/Techniques

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Abstract—Risk and uncertainty have continuously troubled the construction industry compared to other industries due to its complexity, magnitude and time consuming characteristic. As the process of risk management involves predicting the unpredictable, it can be expressed as the most vital management tool to cope with project uncertainties. Risk management can be treated as an essential element for creating value to a project and improving project performance in terms of cost, time and quality. However, systematic risk management is not implemented in most of construction companies in Malaysia. Consequently, this situation can ultimately lead to project failure in terms of cost overruns, schedule delays and poor quality performances. Therefore, this research aims to investigate the current practice of risk management in the Malaysian construction industry and attempts to assess the process and various tools/techniques currently used and applied to handle the projects. The data have been obtained through a series of semi-structures interviews from industrial practitioners. Findings conclude that the level of risk management practices in Malaysian construction companies are relatively low and lacks in knowledge on the subject. In addition, only simple tools and techniques are used to identify, analyze, respond, and monitor the risks. Furthermore, the frequency of use of these tools is also found to be very low. Possible cooperation between the academia and industry might improve risk management practice in the Malaysia construction industry.

Index Terms—risk, management, process, tools, techniques, construction

I. INTRODUCTION

Risk management is primarily a decision to be made, rather than a predetermined outcome. Risk is present in every endeavor we stumble upon and hence, the fate of any project or plan depends decisively on how we respond and cope with it [1]. The dictionary defines the term risk as ‘the probability of the occurrence of an unpredictable outcome in the near future that could have a dangerous or an undesirable result’ [2]. The construction sector, perhaps more than others, is overloaded by risk [3] as a result of the uncertain

qualities construction projects possess [4], [5]. In addition, Raftrey [6] stated that risk and uncertainty describe settings where the outcome of an event or activity is most likely to deviate from the value estimated. Therefore, risk can have potentially disastrous outcomes on construction projects [7]. The productivity, efficiency, quality and cost of a project are all influenced by risk. Edward and Bowne [8] established risk management as a perfect tool to handle uncertainties involved in construction projects. Dey [1] also provides many cases of non-accomplishment of time, quality and cost of projects as a result of the lack of risk management tools and techniques in project management. Thus the success of a project namely, the time needed for completion, sticking with the original budget, and achieving the performance needed rests on the skill of each member in risk management. Moreover, Baker *et al.* [9] pointed out that risk management could also be beneficial in improving profits. For this reason, the success of a project depends highly on the systematic and successful handling of risks. This makes risk management a topic well deserved to be studied.

However, the main aim of risk management is not to eliminate all risks from a project. The purpose is to create a framework, to support decision-makers to handle the risks efficiently and successfully. The application of different project management tools and techniques should be implemented from the planning to the closing stages of a project, which involves handling the different risks, linked to the project at every stage. The process of risk management can be considered a vital part of project management.

Risk Management in the Malaysia construction industry is still a new concept and only a few companies and industrial practitioners utilize the tools and techniques of risk management.

According to Hamimah *et al.* [10], the construction industry of Malaysia has a bad image in managing risk. The identification stage of risk management is quite different from different projects. Primarily, it lies on the characteristics of construction projects and it must start at the most initial stage. In Malaysia, contractors apply straightforward, fast and inexpensive methods for identifying risk; such as checklists and brainstorming

discussions [11]. Risk analysis requires proper experience, training, a risk management software and specialist to advice on the appropriate response techniques needed. For contractors in Malaysia, risk response is focused on events with a high likelihood of occurrence and high impact. Yet, not all companies perform the acceptable operations of reporting, reviewing, and monitoring the ongoing risk management activity [11]. Norazian *et al.* [11] conveyed that risk management is still a fresh concept in the Malaysian construction industry. Moreover, Zultakiyuddin, *et al.* [12] agreed that the Malaysian construction practitioners should be more proactive in practicing risk management. Furthermore, Roshana and Akintoye [13] confirmed that risk management is yet a rhetorical subject in the Malaysian construction industry due to a lack of knowledge. In addition, contractors are very unwilling to apply risk management tools to reduce the operational expenses of projects. Their understanding on the advantages and impact of risk management are rather low. Norazian *et al.* [11] confirmed that risk management is practiced by companies with high reputation, stable financial status and dealing in large construction projects, although the number of practitioners in Malaysia are only a few.

The construction industry of Malaysia, still require a better understanding of the risk factors and although the risk management approach has been established, the majority of them are not well structured and are not being applied in a formal manner. As a result, high risks are still present in the Malaysian construction industry. Therefore, the objectives of this research are:

To identify and assess the current practice of risk management including the process and various tools/techniques in the Malaysia construction industry.

To investigate the limitations/barriers for using risk management in the Malaysia construction industry.

II. RESEASRCH METHODOLOGY

Extensive and intensive literature review has been conducted on the process of risk management to understand the tools and techniques used in risk management. For the investigation, qualitative approach was selected for data collection. Since this research aimed at discovering the process of risk management, tools and techniques practiced in the Malaysia construction industry, and considering the level of risk management in the industry, a quantitative approach to generalize the trends was not appropriate. Open-ended questions were presented in an effort to acquire information from interviews. Further, the qualitative approach uncovered a deeper aspect of the current practice of risk management process, tools/techniques and also the major risks faced in construction projects in Malaysia. The questions formulated were semi-structured, so as to enable the easy understanding of the interviewees. The semi-structured interviews enable recipients to provide their own answers and opinions to the questions [14]. The first section of the questionnaire focused on the demographic information.

The second section consists of a total of 10 questions for risk management in the Malaysia construction industry.

After designing the questionnaires, a pilot study was conducted in order to verify if different respondents understood the questions in the same way. At the start of the interviews, the interviewee was assured of confidentiality and that any information given would only appear in the research paper and not elsewhere. A total of six interviews were conducted. During interviews, notes were taken and a tape recorder was used to capture all the information. Before recording any information, the respondent had to grant permission to have an audio recording. After the data collection, data analysis was followed. The non-quantifying methods were used when analyzing the collected data from interviews.

III. LITERATURE REVIEW

A. Defining the Term 'Risk'

In the wider societal perspective, risk can be viewed and defined in general terms:

- Ansel and Wharton [15] define risk as 'a measurement of the chance of an outcome, the size of an outcome or a combination of both'.
- Franklin [16] adds that 'there has always been a contingent edge of life and we use the word risk to examine this contingency'.

However, when it comes to projects, there is a level of agreement that risk is seen as a potential unfavorable effect as mentioned below:

- The Concise Oxford English Dictionary [17] describes risk as a 'loss, chance of hazard, bad consequences etc.'

More suitable definitions for risk involved in construction projects are provided by more specialized sources as follows:

- The HM Treasury [18] states that 'risk is the uncertainty of a result, within a range of likely exposures, resulting from a combination of the impact and probability of likely events'.
- The BS 6079 [19] outlines risk as an uncertainty that can affect the prospects of achieving business or project goals due to the doubt present in plans'.
- The Association for Project Management [20] defines risk as 'the combination or frequency of the occurrence of an unfavorable outcome or opportunity and the magnitude of that occurrence'.
- Smith [21] deduced that 'risk can possess both positive and negative effects due to its unfavorable nature'.

This cluster of definitions delivers a better understanding of the nature of risk than any single definition. By paraphrasing and combining these definitions, it is evident that there are sources of risk that can be evaluated using the probability of occurrence and their adverse impact on the project's objectives, and genuine unknowns exist as to whose outcome could be favorable or detrimental to the objectives of a project.

B. Risk Management

Buchan [22] mentioned that to account for risk management, there are three different processes – risk identification, risk analysis and risk response. Obviously, different companies will have different attitudes and perceptions on risk, therefore the steps can vary. The three-step process identified by Buchan (1994) for risk management can be increased to a five-step process as stated in Eloff *et al.*'s paper [23] and the British Standards BS 8444 [24]. It is the five-step risk management process that is applied in this study. By using this terminology from BS 8444, the five steps involved for a complete risk management process are given as:

1. Risk Identification
2. Risk Estimation
3. Risk Evaluation
4. Risk Response
5. Risk Monitoring

Risk Identification: Risk identification is a process by which an understanding of the type and effect of the risk is developed for an organization. The following Table I gives examples of typical risks that can be confronted during a large construction project.

TABLE I. EXAMPLES OF TYPICAL RISKS IN CONSTRUCTION PROJECT

Types of Risk	Examples For Each Type of Risk
Financial	Bankruptcy/insolvency of project partner; Price fluctuations due to inflation rates; Price fluctuations due to interest rates; Price fluctuations due to exchange rates; Inaccessibility of extra funds/funding sources if needed; Low credibility of shareholders and lenders; Changes in bank formalities and regulations; Insurance risk; Change of scope unrecorded; Technical issues; Errors in estimate; Delays in the project; Overheads; Environment etc.
Technical	Shortage of skillful workers; Shortage in the supply of water; Shortage in the supply of electricity; Shortage in materials; Accidents on site; Changes in Design; Equipment failure; Errors present in design drawings; High degree of complexity/difficulty in construction; Low quality of procured materials; Unknown physical conditions of the site; Theft of materials at the site; Wastage of materials by the workers; Surplus handling of materials; Architect vs. structural engineer disputes; Site distance from the city/town; Following government standards and codes; Problems due to partners different practices; Obsolesces of building equipment; Difficult conditions of the environment; Absence of security etc.
Operational (Logistical)	Transportation risk (loss or damage): Physical injury to workers; Unsatisfying planning/controlling of maintenance; Safety training; poor management; Increased constraints of access; High visibility; Reporting of accidents; Failing to follow procedures by groups; Loss of export systems e.g.; pipeline damage/tanker weather issues etc.
Time	Meeting overall construction program; Meeting design program; Late delivery of important equipment by supplier; Overrun of period of contract; Delay due to weather; Project duration; Evaluation of the complexity of the work; Late decisions of choices; Timing of response to events/planning for contingencies; Possibility of

	causing delays to other contractors etc.
Environmental	External: Global Warming; destruction of the ozone layer; greenhouse effect Internal: Unfavorable impact on the project due to climatic conditions; Impact on the residing environment due to the project; A healthy working environment for all employees; Acts of god- heat wave, rain, wind, heat, cold, humidity etc.; Radioactive contamination; Explosion risk to life etc.
Political	Cost variations due to changes in government policies; Corruption and bribery; Loss due to bureaucracy for late approvals; Political changes; Tax changes; Nationalism, Physical danger to the public; Relations of client; Rationalization; Government intervention etc.

Hence, the stage of risk identification is where all the probable or expected risks are recognized, as well as trying to find out the future risks. Some even argue that this stage is the most crucial and beneficial out of all the five stages of risk management. Thus this requires complete knowledge of the variables and how they will perform; meaning risk analysis is an impossible task if the risks have not been identified first. He also added that ‘the most severe risks are undetermined and unexpected and fall outside the analysis spectrum’. Furthermore, Schumacher *et al.* [25] added that successful risk management lies in the improvement of risk identification, and therefore risks can only be controlled if the risks are identified in the first instant. Any unknown risks can only be controlled by pure luck.

The tools and techniques presently available to identify risks are simple, but require much skill for organizations to obtain the necessary results. Methods include Brainstorming, Workshops, Interviews, Questionnaire surveys, Feedback from similar projects, Use of specialists and previous experience are among the few techniques available for risk identification.

Risk estimation: There are various methods available to cater for risk analysis. They can be categorized into two different methods: Qualitative and Quantitative. Qualitative methods usually include finding the probability of a risk happening and the dangers of that risk in a linguistic approach. These methods are normally employed at the start to identify and categorize the risks. Qualitative methods used are often subjective and relies highly on the proficiency of the analyst, linked to engineering judgment, and hence is prone to be subjective. Therefore, these methods can be susceptible to variations but also can be quite valuable as an analytical process in the planning and controlling phases of a project. On the other hand, Quantitative methods can be utilized when analyzing high or intermediate ranked risks. Qualitative analysis becomes quite dominant (also subjective) when little data is known on the risk. However, if further information becomes accessible, then the qualitative analysis forms the basis for a more detailed quantitative approach. Quantitative analysis often uses mathematical or statistical approaches and provides probabilities or frequencies of the dangers and the possibilities of the identified risks [26]. The figures used in quantitative analysis are often received from either historical records or approximations but still

includes some sort of uncertainty due to the use of subjective data [27]. Often the results using quantitative analysis are compared to the criteria of the company and then decisions are made accordingly on accepting the risk or not.

Risk evaluation: Risk evaluation is first initiated after the risks have been analyzed qualitatively. It is a procedure where information and findings of experienced personnel are gathered and evaluated based on the degree of the consequences and frequencies of the probable risks. After doing so, they are categorized into different classifications. Risk matrices are often used in identifying and ranking the more critical risks, thus more focus can be paid on the more critical risks by subjecting them to quantitative methods. By providing sufficient quantitative data, a re-evaluation of the risks could be achieved. The risks are evaluated based on the criteria of the company in order to find out if the frequencies of the existence of these risks are to be accepted or not. After evaluation, depending whether the risks are tolerable (acceptable) or not, choices are made as to which approach the company should take to encounter the risks.

Risk response strategy: The theory behind risk management can be easily misinterpreted due to its complex nature. Therefore, it is a must to define the techniques available when responding to certain risks. Four possible approaches can be used when responding to risks, which are: risk avoidance, risk transfer, risk retention and risk reduction. Risk Avoidance: Also known as risk elimination. It includes not undertaking an activity, which may carry risk. However, avoiding risks may also mean losing out the potential gain which accepting the risk may have allowed.

- Risk Transfer: Risks are assigned to other parties by using contracts or insurances.
- Risk Reduction: Search for methods to reduce the likelihood and/or severity of the risk.
- Risk Retention: The loss/benefit of gain of a risk is accepted when it occurs.

Risk monitoring: Once the risks have been identified, estimated, evaluated and responded to, risk monitoring takes over control and plays a dominant role in reviewing the status of the risks. This step concludes the risk management process (i.e. given that the risks under observation do not require re-analyzing). The monitoring stage should be continuous and should often be subjected to annual/biennial reviewing, which could subsequently improve communications amongst employees, and departments, increase disaster recovery planning, develop management skills and more efficient budget planning.

C. Risk Management in the Construction Industry

Risks often have a significant impact on the project budget and thus play an important role in the total costs of a project [28]. Further, construction projects in general carry a lot of variation and uncertainty, as projects are often open systems, rather than closed systems [29]. Unfortunately, proper risks management has still not been tuned into the cooperative atmosphere of construction projects. The construction industry until now have a bad

habit of relying on contracts to manage risks and consequently possess a bad name in becoming caught up in many claims and arguments [30]. Promoting the concept of risk management can be one of the main improvements that could be done to the present construction industry. Hence, the process of risk management should always be applied to all of construction projects. Contracting the risks to other participants however does not always guarantee that the risks are managed appropriately but rather adds up to the final costs of a project. Contracting clauses can increase the total project costs by up to 20% [31]. Aside from contracts, it is proven that most construction risks are typically handled through human judgment, assumptions and experience [29]. The downside of this method appears when the expert information is not documented and the information is not transferable. However, professional judgment delivers enough means of risk management. Brainstorming and team analysis provide similar methods for identifying risks and these are considered to be one of the most frequently used techniques. On the other hand, computer aided methods are the least frequently used [32]. In most cases risk management is limited only to the identification level of the whole process. Events can be identified at an early stage but their magnitude is not measured. Risk management is viewed as a process that only uses resources, and the benefits are hard to be determined in monetary terms. Insufficient knowledge on risk management restricts the proper use of risk management techniques and therefore only a few key people are familiar with this subject. Further, Ford *et al.* [33] concluded that positive risks are often concealed in a project and are not actively searched for even though they might have great project value. In a similar finding, Floricel and Miller [30] stated that project managers seldom try to explore for the possibilities of positive risks.

IV. FINDINGS AND ANALYSIS

The six-participant of the interview include four project engineers, one project manager, and one contractor engineer. Five of them graduated from universities. One of them has experience of more than 20 years, one between 11 and 15 years, two between 6-10years, and two between 1-5years. The following shows the interview questions and generalized answers.

Question 1: Are you familiar with the term 'Risk Management'?

The first question emphasized mainly on the familiarity of the term risk management. The results proved that nearly all the interviewees are familiar with the term 'risk management'. When asked how they got familiar with the term, five out of the six interviewees stated that they came across the term through experience. In addition, five out the six interviewees also agreed that they learnt the term 'risk management' during their time in university. A follow up question was brought up to all the interviews, which aimed at finding out if the

companies they work for had ever implemented risk management. Five out of the six interviewees claimed that they had never used the process of risk management for any of their projects.

Question 2: Are you also familiar with the whole process of 'Risk Management'?

The findings for this question proved that all the interviewees knew a certain amount about the process of risk management. In addition, the interviewees were also asked if they had ever implemented the whole process from start to finish. Four out of the six agreed that they had never executed this process for any of their projects. The rest of the interviewees said that only parts of the process were used for projects. When asked why the process was so rarely used, most of the interviewees (5 out of 6) claimed that they did not know how to apply it and they lacked in knowledge on the subject. In addition some (2 out of 6) also claimed that it might be time consuming.

Question 3: How familiar are you with the following terms: Risk Plan Management, Risk Identification, Risk Analysis, Risk Response and Planning, Monitor and Control Risks?

The third question was exercised to go deeper into the interviewee's familiarity on the subject. Most of them (4 out of 6) agreed that they were well aware of the terms. The other two said they never learnt the terms.

Question 4: Can you identify the most common risks in construction projects?

The top five most common risks in the Malaysia construction industry identified from the interviews are (in the order):

1. Price Fluctuations due to Inflation Rates.
2. Delay in the Project.
3. Shortage of Skillful Workers.
4. Weather.
5. Wastage of Materials by Workers.

Question 5: What tools are often used for 'Risk Identification'?

This question was raised to reveal the certain techniques used to identify the risks in construction projects. Findings demonstrated that four out of the six interviewees used brainstorming as the most common tool to identify risks. In addition, three out of the six interviewees agreed that checklists were also used in identifying the risk. Consulting professionals and other tools were inferred to be the least used out of the others. The question was further elaborated by asking the interviewees why these tools were used. Four out of the six interviewees answered saying that these were easy methods and didn't require much knowledge to carry out this process.

Question 6: What tools are often used for 'Risk Analysis'?

It was determined that consulting professionals and joint evaluation by main participants were the most employed tools for analyzing risk. In addition, two out of the six interviewees did not use risk analysis at all. Furthermore, four out of six interviewees stated that joint evaluation by main participants was the most likely choice as it was easier to carry out. In addition joint evaluation allowed them to save both costs and time.

Three out of the six interviewees also vouched for consulting professionals. The reason given was that the professionals could deal with analyzing the risk better as they had a better knowledge in the subject.

Question 7: What tools are often used for 'Risk Response'?

The data obtained revealed that four out of the six interviewees used 'Avoid', 'Reduce the Probability of Occurrence', 'Reduce the Consequences' and 'Transfer' as their preferred choice of responding to risk. The interviewees were also asked why these tools were used. They claimed that these tools were used to reduce the impact of the risk and eventually, eliminate the risk.

Question 8: What tools are often used for 'Risk Monitoring'?

Three out of the six interviewees declared that they were not familiar with any of the risk monitoring tools and had never used them in any of their projects. Moreover, when asked why these tools were not used, they simply said that once the risks are responded to, there was no need to further monitor the risks. On the other hand, the three remaining interviewees agreed that the risk monitoring tools were used to a certain degree. 'Periodic Document Reviews' were considered the most popular one.

Question 9: Do you think it is important to apply the process of risk management in a project?

Nearly all interviews (5 out of 6) agreed that risk management was highly beneficial and considered extremely important for construction projects. Moreover, the interviewees stated that carrying out this process could save both time and money. Furthermore, the interviewees suggested that the process could also affect the performance positively and create a risk free environment, thus increasing the quality and operation of the project.

Question 10: What do you think are the limitations/barriers for risk management?

The majority of the Interviewees affirmed that there was a lack of knowledge in the industry on the subject and the initial costs for implementing the process were too high. Therefore, it was not possible to carry out the whole process. Apart from lack of knowledge and initial costs, many other limitations were mentioned during the course of the interview. The limitations are given as follows:

1. Lack of knowledge
2. Initial costs
3. Time consuming
4. Prefer experience rather than following risk management.
5. Staffs are not skilled enough to perform risk management.
6. Education Level.
7. Professionals are needed.

V. CONCLUSION

The top 5 major risks in the Malaysia construction industry have been identified. These are (in the order):

1. Price Fluctuations due to Inflation Rates

2. Delay in the Project
3. Shortage of Skillful Workers
4. Weather
5. Wastage of Materials by Workers

The survey results also showed that for risk identification, the most common methods used were 'checklists' and 'brainstorming'. For risk analysis, the preferred tools used were "Consulting Professionals" and "Joint Evaluation by Main Participants". For Risk response, respondents stated that the tools "Avoid, Reduce the Probability of Occurrence, Reduce the Consequences and Transfer" were the most common methods used when responding to risk. For risk monitoring it was found that the minority of the interviewees used 'Periodic Document Reviews' whereas the majority did not use any tools at all.

The limitations/barriers of using risk management in the Malaysian Construction Industry were also identified. These are:

1. Lack of knowledge
2. Initial costs
3. Time consuming
4. Prefer experience rather than following risk management.
5. Staffs are not skilled enough to perform risk management.
6. Education level.
7. Professionals are needed.

To conclude, the Malaysia construction industry is still at an initial stage of risk management. There should be more active approaches of risk management in the industry especially for the process, tools/techniques. Theoretical studies and practical applications can be conducted at the same time if the academia and industry can cooperate together to produce progressive outcomes. This will be a good research area for the Malaysia construction industry.

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