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Abstract — The construction industry is still plagued by poor quality, poor workmanship, poor safety and health environment, and poor practices. The current main problem in the Malaysian Construction Industry is delayed projects under the Ninth Malaysia Plan. The idea of introducing formal risk assessment among Malaysian contractors during the project planning stage is a proactive approach to achieve project objectives. Therefore, this research intends to achieve the following objectives: (1) to investigate the contractors' approaches of risk assessment techniques at the project planning stage, (2) to investigate the consequences of risk assessment techniques at the project planning stage, and (3) to determine the appropriate risk assessment techniques in dealing with the potential risk factors at the project planning stage. The research methodology applied for this research includes literature reviews and questionnaires. Findings from this research show that the application of risk assessment techniques in the Malaysian Construction Industry is still moderate. Hence, it is suggested that these contractors should try to implement formal risk assessment techniques during the project planning stage in order to achieve the project objectives.

Keywords - Risk; Risk Assessment; Contractors; Project Planning Stage; Construction Industry

I. INTRODUCTION

Risk Assessment (RA) can be classified as risk identification, risk classification and risk analysis [2]. On the other hand, RA is divided into three activities which are Risk Identification and definition, Risk Analysis and Risk Evaluation. Risk Identification and Risk Analysis outline methods and activities to produce risk management deliverables associated with work packages, while risk evaluation outlines methods and activities to evaluate risk management deliverables associated with work packages [17].

The planning stage is one of the stages in a construction project. RA should start at project planning stage [16]. These risks include the occurrence of unexpected events such as natural disasters, unforeseen site conditions, increase in material price, equipment delivery delays and equipment breakdowns. There are many parties involved in planning stage and a large number of disputes are likely to occur. However, all parties are looking for profit and each party aims to finish the job with maximum benefits and minimum risks [18].

II. PROBLEM STATEMENT

The current main problem in the Construction Industry is delayed projects under the Ninth Malaysia Plan. Twenty-two delayed projects in Penang under the Ninth Malaysia Plan will be completed by the end of 2011. Most of the projects were delayed due to land status complications and replacements of some of the contractors. However, preparations have been underway for the Tenth Malaysia Plan. There are only two such economic plans until 2020 and both would focus on achieving Vision 2020 [11]. Moreover, the industry is still plagued by poor quality, poor workmanship, poor safety and health environment, and practices and project failures which were proven by the Stadium failure in Terengganu and the MRR2 [24]. Escalating building material prices, which had increased by an average of 25% in 2011, and a serious shortage of workers would be a double blow to lead to this collapse [5].

RM has been widely used in politics, economy, environment, and engineering to reduce the probability of risk and the damage [28]. However, in Malaysia, there is still a lack of knowledge about risk factors [6]. Most of contractors deal with risks based on their own experiences to decide which type of RA to follow [25]. However, there is still a need for a systematic RA system [21]. This is also evidenced by the active government participation at both international and domestic levels [26]. Nevertheless, a systematic RA is appropriate in order to reduce its complexity in a construction project and to help in ensuring the construction projects are successfully completed on time and within budget [18]. In this context, **this study is to investigate the contractors' approaches of RA at the project planning stage.**

Among all the methodologies, the risk management process (RMP) methodology provides a logically consistent framework for managing risk. If the RMP is applied, not only will project costs be more explicitly known, but profit will also be maximized [1]. However, RA has a major weakness in terms of tools for risk rating process and unwillingness of people to enter information for the reasons of failure [9]. Moreover, RA is inherently a dynamic problem as the contractors rely on experience and judgment. Rarely, do contractors quantify uncertainty and systematically assess the risks involved in a project [1]. Therefore, **this study is to**

investigate the consequences of RA techniques at the project planning stage.

RA has been implemented in various countries [3]. The RA strategies adopted by all the international and national systems are very similar, and are predominantly based on familiarity [4]. When assessing construction risk, understanding construction exposure and the current market risk is paramount throughout the construction project [13]. RA needed to be implemented to decrease the chance of loss [8]. Nevertheless, RA is important because it helps in decision making regarding risk response planning and control [10]. In the United Arab Emirates, RA shows the significance of several risks that are present in the industry [10]. In Canada for instance, Risk Assessment shows the Robustness in the industry [29]. However, in United States, little attention has been paid to quantify uncertainty and systematically assess the risks involved in a project [1]. In this respect, **this study is to determine the appropriate RA techniques in dealing with the potential risk factors at the project planning stage.**

Therefore, the construction industry wants the government to resolve the current crisis immediately. Otherwise, its players may be forced to abandon their projects, leading to an entire collapse of the industry [23]. Thus, Formal RA can be one of the solutions to ensure problems will be minimized. It is hoped that, an active approach to the application of RA yields positive benefits particularly in the project planning stage. Maintaining an active approach, through a continuing cycle of learning and improvement, should contribute much towards ensuring that these benefits are sustained over the long term of the organization.

III. SAMPLE SIZE

The targeted respondents involved professionals in the construction firms which had a PKK Class A license, for instance contractors, engineers, quantity surveyors, architects and other consultants. There are 2279 PKK Class A licensed contractors registered with PKK in Malaysia. Questionnaires were distributed to two hundred (200) respondents out of the 434 PKK Class A licensed contractors in Selangor which is equivalent to 46 %. Out of the two hundred (200) respondents, only 60 questionnaires were returned to the researcher. The response rate was 30 percent.

IV. DATA ANALYSIS

A. Demography

The results showed that 100 percent of the organizations were contractor's companies. From the 60 respondents, 5 of them or 8.3 percent were involved in construction for less than 5 years, 14 of them or 23.3 percent were involved in construction for 5 to 10 years, 24 of them or 40 percent were involved in construction for 11 to 20 years, while 17 of them or 28.3 percent were involved in the construction industry for more than 20 years. Consequently, the nature of work for the construction companies was more towards civil and building work. From the 60 respondents, 31 construction companies were involved in civil work, 24 of them in building work, 2 of them in Mechanical and 3 of them in Electrical work. The

results from the survey also indicated the responsive person in managing risk. From the 60 respondents, 25 of them or 41.7 percent were Project Directors, 30 of them or 50 percent were Project Managers, 3 of them or 5 percent were internal Audit Managers. The findings from the questionnaire clearly showed that the results corresponded to that in the literature review, in which the highest percentage of contractors involved in RA consisted of the most experienced contractors. Overall, the findings showed that the contractors among civil and building work were more familiar with RA. These findings were in line with that in the literature review as construction was a high risk industry and the process of analyzing risks in construction was paramount because it provided an understanding and awareness of the impact of risk to the construction project as well as to the business.

B. Contractors' Approaches of Risk Assessment at the Project Planning Stage

Table I lists the four identified contractors' approaches of RA variables at the project planning stage in Malaysia. The level of significance was defined as high for a mean of 4.00 to 5.00, moderate for a mean of 3.00 to 3.99 and low for a mean of less than 3.00 [3]. The table ranks the contractors' approaches to RA at the project planning stage.

TABLE I. APPROACHES OF RISK ASSESSMENT

Approach of Risk Assessment	Mean	Ranking	Level of Significance
Consider risks when dealing with the project	4.47	1	High
Agree that construction is a high risk industry	4.18	2	High
Organization assess risk	3.95	3	Moderate
Familiar with risk assessment	3.85	4	Moderate

The highest mean for the RA approach involved the consideration of risks when dealing with the project with a mean of 4.47. The second highest was to agree that the construction was a high risk industry with a mean of 4.18, followed by the statement that the company assessed risks with a mean of 3.95 and finally the familiarity with RA with a mean of 3.85. From these results it could be concluded that the level of knowledge for RA was high because two of the moderate variables were close to 4.00. This contradicted with that in the literature review which indicated that the level of RA was still low in the construction industry [15].

RA can be classified as risk identification, risk classification and risk analysis [2]. Table II shows the RA element variables which are: Risk Identification and Definition, Risk Classification and Risk Analysis. During the project planning stage, applying the RA elements will help the contractors to have a better management of the potential risks that might occur and consequently enable them to manage the risks effectively [19].

TABLE II. RISK ASSESSMENT TECHNIQUES

Risk Assessment Techniques	Mean	Ranking	Level of Significance
Risk Analysis	3.80	1	Moderate
Risk Identification and Definition	3.78	2	Moderate
Risk Classification	3.75	3	Moderate

The findings from the questionnaire clearly showed that the results corresponded to that in the literature review as the highest mean in RA techniques was risk analysis, followed by risk identification and risk classification. Overall, the findings showed that the level of significance for RA techniques was moderate. The findings were in line with that in the literature review as risk identification, risk classification and risk analysis were very useful and very important in order to identify the likelihood of the risk occurring and the impact of the risk occurring in terms of its cost, schedule, quality and other impacts on the project objectives.

The planning stage is one of the stages in a construction project. RA should start at the project planning stage. Table III shows the variables of the RA stage which are: planning, design, construction and handover phases. The results from the questionnaire indicated that RA should start during the project planning stage followed by the construction, design and handover phases as summarized in Table III. The levels of significance for the RA stages were high for planning, construction and design phases and moderate for the handover phase. This corresponded with that in the literature review as RA should start at the project planning stage.

TABLE III. STAGES OF RISK ASSESSMENT TECHNIQUES

Stage for Risk Assessment	Mean	Ranking	Level of Significance
Planning stage	4.43	1	High
Construction Phase	4.42	2	High
Design Phase	4.26	3	High
Handover Phase	3.63	4	Moderate

The fact that RA should start during the project planning stage for contractors in Malaysia indicates the pro-active approach for crisis prevention in the construction project which can help managers to determine their decisions throughout the construction stage [22].

Table IV shows the variables for the lack of RA for contractors in Malaysia. The variables are: do not understand, not practical to implement, not so useful, lack of expertise, expensive, and time consuming. The findings showed that the highest mean for the lack of RA was lack of expertise, time consuming, expensive, not practical to implement, not so useful and do not understand. Overall, the level of significance for the lack of RA was low because two variables had a mean of less than 4.00 and four variables had a mean of less than 3.00. Most of the contractors claimed that they implemented

RA and the variables for the lack of RA were not applicable. Hence, sufficient knowledge for RA is very essential to control many factors that influence the project's results especially for three major constraints which are time, cost and quality.

TABLE IV. LACK OF ASSESSMENT

Lack of Risk Assessment	Mean	Ranking	Level of Significance
Lack of expertise	3.33	1	Moderate
Time consuming	3.12	2	Moderate
Expensive	2.80	3	Low
Not practical to implement	2.74	4	Low
Not so useful	2.74	4	Low
Do not understand	2.67	5	Low

There are several definitions of RA according to the literature review. The definition variables of RA are summarized in Table V. From the questionnaire, the highest percentage for the RA definition was RA as a foundation of Risk Management and crisis prevention which was 63.3%, followed by tools and techniques to identify two important factors namely the occurrence and its consequential effects which was 13.3%. For the definition of RA as statistical assessment techniques to assess the probability of various possible outcomes and RA as tools and help managers to determine decision the frequencies were 11.7% and 10% respectively.

Most of the literature review defined RA as potential impacts and the likelihood those impacts would occur. From the researcher's point of view there is no right and wrong for the definition of RA. The definition of RA varies according to the understanding of the respondents and how they interpreted it.

TABLE V. DEFINITION OF RISK ASSESSMENT

Definition of Risk Assessment	Percentage	Ranking
Risk Assessment is the foundation of Risk Management and crisis prevention	63.3	1
As tools and techniques to identify two (2) important factors namely the occurrence and its consequential effects	13.3	2
A statistical assessment technique to assess the probability of various possible outcomes	11.7	3
Risk Assessment as tools and helps managers to determine a decision	10	4

TABLE VI. LEVEL OF KNOWLEDGE IN RISK ASSESSMENT

Level of Knowledge	Percentage	Ranking
Moderate	48.3	1
High	41.7	2
Low	8.3	3
Very High	1.7	4

Table VI shows the level of knowledge and percentage of each level based on the results from the questionnaire distribution.

The results indicated that the levels of knowledge were divided into very low, low, moderate, high and very high. The result showed that the highest ranking for contractors registered with PKK Class A in Selangor for levels of knowledge was moderate. It contradicted with that in the literature review as according to the Ninth Malaysia Plan, there is still a lack of knowledge of the risk factors and there is still a need for Risk Management services. These results might have focused on contractors in Selangor only, as Selangor is more developed than the other states in Malaysia. Therefore, further research is needed on the other contractors in Malaysia. Hence, the knowledge on a systematic RA is appropriate in order to ensure the construction projects are successfully completed on time, within budget and with the expected quality. Thus, knowledge and understanding of construction exposure and the current market risk is paramount throughout construction project.

C. Consequences of Risk Assessment Techniques at the Project Planning Stage

Consequences of RA can be seen throughout the construction process. Thus, RA needs to be implemented to decrease the chance of loss and to help in decision making. Therefore, sufficient knowledge on RA during the project planning stage is essential to control the many factors that influence the project's results. Due to the three major implications during the project planning stage which are time, cost and quality, these constraints need to be considered when dealing with the project [20].

The stand of the construction company on RA was to improve the performance of the construction project which could be divided into moderately agree and totally agree. The highest percentage was for the respondents who agreed that RA could improve the performance of the construction project (61.7%), followed by moderate (26.7%), and totally agree (11.7%). This corresponded to the literature review as RA needed to be implemented to reduce the chance of loss and it helped in the decision making. RA on the other hand could improve the performance of a project in terms of time, cost, and quality [12].

The analyses of consequences of RA were carried out based on some group categories. An observation of Table VII showed RA could improve the performance of a construction project in terms of time, cost and quality. Consequently, RA could help in reducing the negative consequences in the construction project. This was in line with [8], whereby he argued that RA needed to be implemented to decrease the chance of loss. The results demonstrated that most of the construction companies in Malaysia had an awareness of the importance of RA techniques to the construction project. However, there were still some weaknesses of RA such as require more training, time consuming and increase cost. These findings contradicted with [9], whereby he contested that RA had major weaknesses in terms of tools for risk rating process and unwillingness of people to enter information about reasons of failure. Besides, RA inherently relies on the

contractor's experience and judgment. Hence, the researcher suggested that the RA techniques should be implemented in a transparency point of view in a way the contractors need to reveal the right information in order to get the right output of the consequences in the implementation of RA techniques. The other suggestion was to produce a hands-on method or procedure for RA techniques.

TABLE VII. CONSEQUENCES OF RISK ASSESSMENT TECHNIQUES

Consequences of Risk Assessment	Mean	Ranking	Level of Significance
Improve the project performance (time, cost and quality)	4.10	1	High
Reduce the negative consequences	4.05	2	High
Require more training and formal course	3.58	3	Moderate
Time consuming	3.55	4	Moderate
Increase cost of the project (consultancy, training, etc)	3.03	5	Moderate

There are several types of risks that influenced the project's expected profit. It is well known that, risks will happen during the lifetime of a project and some of these are able to seriously damage the project. Table VIII demonstrates the types of risk variables which are: Force Majeure, Financial, Political, Social and Technical Risks. In Malaysia, risks can be classified into environmental / political, market / financial, technical / functional and hazard / safety risk [25]. The questionnaire survey showed that the highest mean to influence the project's expected profit was financial risk which was 3.88, followed by technical risk with 3.73 and political risk with 3.59. Overall, the levels of significance for the types of RA that influenced the project's expected profit were moderate. Therefore, the idea of assessing risks was introduced to convince others that the project should spend money today to avoid risks that can happen in the future.

TABLE VIII. TYPES OF RISKS WHICH INFLUENCE PROJECT EXPECTED PROFIT

Type of Risk	Mean	Ranking	Level of Significance
Financial (Cash flow, bank loan, price fluctuation)	3.88	1	Moderate
Technical/Functional (Availability of material, equipment or labour, changes of design etc.)	3.73	2	Moderate
Political (Regulation by government, requirement for permit and approval)	3.59	3	Moderate
Force Majeure (Flood, inclement weather, riot)	3.34	4	Moderate
Social (Public complaints etc.)	3.19	5	Moderate

D. Risk Assessment Techniques in Dealing with Potential Risk Factors at the Project Planning Stage

Construction risks in Malaysia arise from a variety of sources which can be considered as an environmental or political,

market, technical or functional and hazard or safety. These varieties of sources have an adverse effect on the achievement of the project objectives. Table IX shows the types of risk variables which are: Force Majeure, Financial, Political, Social and Technical Risk. Findings from the questionnaire survey demonstrated that the highest mean for potential risk factor at the pre-construction planning stage was technical risk which was 3.93, followed by financial with 3.73, political risk with 3.43 and social risk with 3.10. Overall the level of significance for the potential risk factor at the pre-construction planning stage was moderate. However, force majeure demonstrated a lower mean of 2.98 during the pre-construction planning stage. Therefore, the researcher suggested that force majeure needed to be taken into account when assessing risks during the pre-construction planning stage because the probability of this risk to happen was low, but the impact was high. Hence, by ignoring these types of risks, it will give a significant bad impact on the project performance [27].

TABLE IX. POTENTIAL RISK FACTORS AT THE PROJECT PLANNING STAGE

Potential Risk Factors	Mean	Ranking	Level of Significance
Technical/Functional (Availability of material, equipment or labour, changes of design etc.)	3.93	1	Moderate
Financial (Cash flow, bank loan, price fluctuation)	3.73	2	Moderate
Political (Regulation by government, requirement for permit and approval)	3.43	3	Moderate
Social (Public complaints etc.)	3.10	4	Moderate
Force Majeure (Flood, inclement weather, riot)	2.98	5	Low

Table X lists the three types of RA technique variables which are: risk identification, risk classification and risk analysis. The results illustrated that the highest mean was risk identification with 4.02, followed by risk classification with 4.00 and risk analysis with 3.88. The levels of significance for risk identification and risk classification were high whereas for risk analysis was moderate. Risk Analysis showed the lowest mean because from the researcher's observation, most of the contractors in Malaysia still lacked knowledge and understanding of the techniques available such as sensitivity analysis, Monte Carlo Simulation, Mean-end chain, decision matrix and decision trees. The results showed that risk identification was the highest mean and the most crucial element in RA. The contractors in Malaysia were more familiar with risk identification as compared to risk analysis [7].

TABLE X. TYPES OF RISK ASSESSMENT TECHNIQUES

Risk Assessment Techniques	Mean	Ranking	Level of Significance
Risk Identification and Definition (brainstorm, interview, checklist, assumption and process diagramming techniques)	4.02	1	High
Risk Classification (identifying the consequence, type and impact of risk)	4.00	2	High
Risk Analysis (The techniques available are sensitivity analysis, Monte Carlo Simulation, Mean-end chain, decision matrix and decision trees)	3.88	3	Moderate

It can be suggested that the contractors need more training on RA in order to enhance knowledge and understanding on it and to improve the project's performance. Thus, the impacts in terms of monetary, technical or human impact criteria can be reduced tremendously [17].

Table XI shows the improvement on RA in a construction project. The highest mean was for training and education which was 4.17, followed by encouraging improvement of all levels of an organization with 4.10. Consequently, improvement on RA should be undertaken by the senior management with 4.05 and communication with 4.03, were also essential components to improve the RA in a construction project. However, introducing Audit and giving rewards were moderate with 3.62 and 3.03 respectively as compared to the others. From the survey, it is clearly shown that the highest mean was for training and education with 4.17. Therefore, the contractors need more training and education on RA in order to enhance their knowledge and understanding on it and to improve the project performance [16]. On the other hand, most of the construction companies in Malaysia do not practice and consider the internal Audit for their organizations and the levels of significance were moderate. Giving rewards was also very minimal with 3.03 and this was very subjective in a way as it involved dollars and cents. It can be argued that the strategic management is very important in an organization. The organization should play its role in dealing with its employees because the employees will only do things that will benefit them. Hence, by giving rewards, promotions and appreciations, people will do things better and this is one of the strategies in improving the RA in a construction project.

TABLE XI. IMPROVEMENT OF RISK ASSESSMENT TECHNIQUES

Improvement	Mean	Ranking	Level of Significance
Training and Education	4.17	1	High
Encouraging involvement of all levels of an organization	4.10	2	High
Undertaken seriously by senior management	4.05	3	High
Communication	4.03	4	High
Introducing Internal Audit	3.62	5	Moderate
Giving rewards	3.03	6	Moderate

V. CONCLUSION

This article discussed the overall findings of the research obtained from the questionnaires. This article also explained the objectives of this research which were to investigate the contractors' approaches of RA at the project planning stage, to investigate the consequences of RA techniques at the project planning stage and to identify the appropriate RA techniques in dealing with the potential risk factors at the project planning stage. The survey showed that the level of awareness in the implementation of RA was high. Most of the respondents agreed that RA should begin at the project planning stage as a proactive approach for risk prevention. However, there were still some obstacles in implementing RA such as increase cost of a project, time consuming and require more training and formal course. On the other hand, most of the respondents agreed that RA could improve the performance of a construction project in terms of time, cost and quality. The findings thus indicated that the level of exposure to implement a risk assessment in the local construction industry clearly illustrated that it was still at a moderate level. Therefore, the implementation of RA techniques in the local construction industry was paramount and justified.

REFERENCES

- [1] **Ali, R.** (2005). The Application of Risk Management in Infrastructure Construction Projects: Morgantown. *Cost Engineering*. Vol. 47, pp. 8 - 20.
- [2] **Australian / New Zealand Standards AS/NZS 4360** (1999) Risk Management, Standard Australia, Homebush News.
- [3] **Bajaj, D.** (2001). Corporate Risk Assessment in the Construction Industry, An Australian Perspective. pp.1-11.
- [4] **Bommer, J.J.** (2002). Deterministic vs. probabilistic seismic hazard assessment: an obstructive and exaggerated dichotomy. *Journal of Earthquake Engineering*, special issue 1, pp 43-73.
- [5] **CIDB**, (2011). <http://www.cidb.gov.my>. Assessed on 10th January 2011.
- [6] **(CIMP 2006–2015)** (2006), Construction Industry Master Plan 2006–2015.
- [7] Construction Industry Development Board (CIDB) Malaysia, December 2006, Kuala Lumpur
- [8] **David S. B.** (2007). Tolerable Risk for Dams: How safe is safe enough?. To grapple with this topic requires that we cross the boundary from the technical world of dam safety engineering into the far more subjective world of values and value judgements. US Society on Dams Annual Conference, March 2007: Pennsylvania
- [9] **Dikmen, I., et.al.** (2008). Learning from *risks*: A tool for post-project risk assessment.
- [10] **El-Sayegh, S.M.** (2007). Risk assessment and allocation in the UAE construction industry. Civil Engineering Department: United Arab Emirates.
- [11] **Filmer, A.,** (2009) Delayed projects in Penang to be completed by end of 2010. <http://malaysianbar.org.my>. Assessed on 15th September 2009.
- [12] **Flanagan, R. & Norman, G.** (1997) Risk Management and Construction. Boston : Royal Institution of Chartered Surveyors.
- [13] **Girden, R.,** (2007). Local Focus Essential to Builders Risk Strategies. November Vol. 41 pp.30.
- [14] **Globalised Harmonised System,** (2007). Compliance and Risk Management.
- [15] **Infrastructure and Utility Ratings,** (2003) Construction Risk (January). Rating agencies Malaysia Berhad.
- [16] **JKR** (2009a). JKR Project Management. <http://www.jkr.gov.my>. Assessed on 11th September 2009.
- [17] **JKR** (2009b). Pembangunan Budaya Keselamatan Dalam Industry Pembinaan. <http://www.jkr.gov.my>. Assessed on 11th September 2009.
- [18] **KLIUC** (2007). Construction Management Skills for the Global Market. <http://www.kliuc.edu.my>. Assessed 20th January 2007.
- [19] **Loosemore, M.** et. al. (2006). Risk Management in Projects. United States : Taylor & Francis Group.
- [20] **Project Management Institute,** (2000). Project Management. A Proven Process for Success. Imagination. Chicago, USA.
- [21] **SIRIM,** (2007). <http://www.sirim.my>. *Strategic Planning, Intelligence & Management, Enterprise Risk Management, and Business Process Management*. Assessed on 23rd July 2009.
- [22] **The Star online** (2009a). What happen to our 9MP Projects? <http://thestar.com.my>. Assessed on 6th September 2009.
- [23] **The Star online** (2009b). Delayed projects in Penang, to be completed by end of 2010. <http://thestar.com.my>. Assessed on 6th September 2009.
- [24] **The Star online** (2008c). Government to Probe MRR2. <http://thestar.com.my>. Assessed on 15th September 2009.
- [25] **The Star online** (2008d). More info needed on mid-term review of 9MP. <http://thestar.com.my>. Assessed on 15th September 2009.
- [26] **USECHH Regulations,** (2000). Occupational Safety and Health. Use and Standards of Exposure of Chemicals Hazardous to Health Regulations 2000.
- [27] **Wideman** (1986). Risk Management. *Risk Management Project Management Journal*. Project Management Institute. pp 20-2--*+--*6.
- [28] **Xiao, H.J. (2010).** Determinants of Efficient Risk Allocation in Privately Financed Public Infrastructure Projects in Australia. *J. Constr. Engrg. and Mgmt.* Volume 136, Issue 2, pp. 138-150.
- [29] **Zayed, T., Amer, M., Pan, J.** (2007). Assessing risk and uncertainty inherent in Chinese highway projects using AHP. *International Journal of Project Management*. Volume 26, Issue 4, May 2008, Pages 408-419.