



Managing Risk in Construction Projects and Sustainability: Evidence from Malaysia

Adibah Syahirah Nasruddina^a, Mazlina Mustapha^{b*}, ^{a,b}Faculty of Economics and Management, Universiti Putra Malaysia, 43400 Serdang, Selangor, Email: ^{b*}mazlina05@gmail.com

Prior literature defines risk management as the process of identifying and analysing the project risks and choosing the appropriate actions to remove the threats from any project. It is claimed that there are many risks involved in construction projects because the construction life cycle is filled with different risks at different stages of project development. Once the risks are identified, it is necessary to develop the appropriate risk management responses to detect any ordinary causes to deal with them. Thus, this study aims to examine the technical risks involved in property development project. Specifically, this study examines the technical risk implemented by construction companies. In addition, the risk response taken by the companies are also investigated. The study employs a qualitative method, where interviews were conducted with the contractors and developers of the construction projects. The findings show that technical risks are important as they can greatly affect the completion of construction projects, such as inaccurate project design, frequent change of drawings, and a shortage of material. This study contributes to the literature related to the risk management of construction companies, and it provides information to the key project participants about the importance of adopting a systematic and effective risk management to ensure successful property development projects.

Key words: *Risk management, technical risk, construction companies, Malaysia.*



Introduction

Risk is an exposure to the possibility of economic or financial loss or gain, physical damage or injury, or delay, as a consequence of the uncertainty associated with pursuing a particular course of action (Manaf et al, 2006). This risk needs to be managed properly so that the objectives of the organisation can be achieved. Thus, risk management is introduced which involves identifying risks, and assessing them to determine the likelihood and potential impact of the risks. This includes the development of suitable strategies to mitigate the impacts and the activities involved in budgeting for risk, controlling and reporting risk status, and the management of risks until consequences are fully resolved (Al-Abbadi, 2014). Smith et al. (2014), defined risk management as a proactive approach that can determine and influence the outcome of projects and the achievement of their objectives.

Among the industries that are involved in high risk work is the construction industry. This industry is one of the most risky and challenging industries as argued by Manaf et al. (2006). This is because the risks and uncertainties largely and frequently exist in the construction industry as compared to other industries (Mahendra, Pitroda and Bhavsar, 2013), because almost every project brings enormous risks that are deemed as major risks (Dutta, 2014).

The construction industry is also perceived as essential in the development of a country (Al-Abbadi, 2014), especially in a developing country like Malaysia. The construction sector is claimed to be an important industry as it plays a vital role in providing great support to the aggregate economy (Ali Khan, Liew & Ghazali, 2014). The sector contributes to the gross domestic product (GDP) and the socio-economic development of Malaysia through revenue generation, employment creation, and capital formation (Ali Khan et al., 2014). This is supported by Wan Mahmood and Zakaria (2007), who claimed that during the late 1980s to the mid-1990s, the property development and construction sectors have contributed greatly to the development of the Malaysian economy.

A study performed by Fisher and Robson (2006) claimed that property developers and contractors need to be aware of the risks and approaches to risks in letting, investment, construction, land, and finance markets. Hence, risk management is crucial in reducing losses and maximizing productivity, as mentioned by Akintoye and MacLeod (1997). A successful risk management system would bring greater awareness towards the impacts of the risks of the industry and give better sharing of risk information among the involved parties when the implementation system focuses on a more effective and structured approach (Cheng & Abdul Rahman, 2013).

Construction projects can be extremely complex (Banaitiene & Banaitis, 2012), thus this industry is exposed to a lot of risks (Dutta, 2014). According to Dutta (2014), managing the



risk in construction contracts differ significantly because it depends on the nature of project, location of the construction work, budgeted time and cost, the current contracting climate, and the key project participants. The construction industry is also well known for its inefficiencies in dealing with construction safety (Ahmed et al., 2007). The working environment in construction projects change constantly bringing in new hazards. The construction activities and their inherent risks are also constantly changing. The construction industry also has a high workforce turnover, which significantly impacts the safety awareness of workers (Davies and Tomasin, 1996). As the construction industry is a risky business, Manaf et al. (2006) argues that it is vital to manage risks effectively and efficiently. Hence, property developers must develop and implement excellent risk management strategies throughout the development process to ensure that the development projects are successful.

Thus, this study would explore the risk management practices of construction companies in ensuring that their projects will be completed on time and within the budget. Specifically, this study would examine how the contractors deal with technical risks which would normally be related to the operation of their projects. The risk responses taken by the companies to manage the risk are also investigated. This study contributes to the literature related to the risk management practices in construction industry in particular and in developing country in general.

Literature Review

Risk is defined by Mahendra et al. (2013) as any action or event that affects the fulfilment of project objectives. Cheng and Abdul Rahman (2013), mentions that when risks are not identified and managed, they threaten the project's objectives which leads to many risks such as cost overrun and site accidents. In order to manage risks, they need to be identified, analyzed and the appropriate actions must be taken. Kuang (2011) defined risk management as the control of identifying, monitoring and limiting risks. Simu (2009) emphasizes on the additional benefits of risk management, such as the explicit focus on thinking about what might happen and how to manage the project in order to realize the opportunities and remove the negative risks.

Prior research claimed that the construction industry is one of the riskiest industries which needs attention. Zavadskas, Turskis and Tamosaitiene (2010) mention that there are many risk factors in construction business because the construction life cycle has different risks according to their type and size (Mahendra, et al., 2013). Among the most common issue in construction project is project delay. Hussin and Omran (2011) found that project delays are known to affect projects in terms of cost, quality, workers' morale, and the industry's status and reputation. Memon et al. (2012) claimed that many of the construction projects are having cost overrun issue.

Furthermore, competition among construction companies has increased since there is less demand due to the economic down turn. This brings pressure to reduce costs, improve productivity, and requirement for proper project strategies that can be done by effectively and efficiently manage those project risks (Banaitiene & Banaitis, 2012). A successful project is the project that is achieved its technical quality, followed its schedule, and remained within its budget as claimed by Memon et al. (2012). Thus, Hussin and Omran (2011), argue that it is important to deliver a project quickly as to winning a bid. When projects fail to achieve a specified quality, targeted time and budgeted cost, Hamzah et al. (2012) claimed that it can result in numerous negative impacts on the projects.

As stated by Manaf et al. (2006), risk is defined as the possibility and chance of an adverse event relying on the situations. All risks may have common and different causes and impacts, thus Kuang (2011) suggests that it is necessary to develop risk responses properly, where project teams must cooperate to detect any ordinary causes to deal with them. Cheng and Abdul Rahman (2013) mention a higher risk of cost, time and quality happen when there is a deficiency of project information in the beginning phase of construction project. Consequently, risks would affect the attainment of project objectives since the risks can shape and influence the occurrence of one another. Risk management assists the key project participants including developers, clients, contractors, consultants, and suppliers to meet their commitments and minimize bad effects on construction project performance in terms of cost, time and quality objectives as mentioned by Banaitiene and Banaitis (2012).

Risk management has some principles that must be followed when implementing it. Kuang (2011) reports that the principles that include risk management should create values, be a primary part of organizational processes and decision making, should clearly address uncertainty, and be dynamic and responsive to change. Risk management procedures also should be clear, comprehensive and capable of continuous improvement. Moreover, risk management should help to monitor factors that may affect completion of projects within quality, cost and time and to identify and quantify the possible cost of each risk in order to minimize loss and avoid poor projects. Akintoye and MacLeod (1997), found that contractors emphasize on developing risk management because contractors believe that project viability and profit can be increased when they can reduce the occurrence of risks.

Furthermore, Manaf et al. (2006) claims that a systematic risk management is a simple and practical method that can anticipate the unexpected, which helps to control risks in identifying, assessing, responding, and controlling risks. Moreover, Abdul Rahman and Cheng (2013) argue that successful risk management should both switch uncertainty to risk and shift risk to opportunity.

Apart from that, risk management should also be viewed as a helpful process as it can be part of the most creative tasks of the project manager as mentioned by Manaf et al. (2006), because it aims to create logic expectations and increase the control of the process. Furthermore, risk management can open and direct the way in discovering innovative solutions that may not have been considered before. Therefore, the successful property development projects depend on how the property developers manage those project risks.

Risk management process consists of four stages which are identification, assessment, response, and the control of risks in construction projects (Mahendra et al., 2013). Accurate and proper risk identification helps to ensure the effectiveness of risk management and is vital for the next steps as argued by Banaitiene and Banaitis (2012). Risk assessment involves a qualitative analysis, which permits the identification of key risk factors and a quantitative analysis, which evaluates the consequences and probability of the recognized risks and generates prioritized risks for additional analysis. In order to treat risks in a construction project, Banaitiene and Banaitis (2012), Kuang (2011) and Mahendra et al. (2013) suggest four different strategies of risk response which are risk avoidance, risk transfer, risk reduction and risk acceptance. The final step of risk management is risk control. Kuang (2011) states that risks need to be controlled by putting it into action after the risks have been identified, quantified and qualified, and explicit responses have been developed. In this stage, Cheng and Abdul Rahman (2013) emphasize the importance of desired effects of the completion of risk responses during the project life cycle.

Technical risks are mainly involved in construction projects. As defined by Zavadskas et al. (2010), technical risks include project risks, construction risks, physical risks, and technological risks. According to Mahendra et al. (2013), project risks or construction risks are the risks involved in construction delay and changes in the work while technological risks are risks of construction technology, such as design and documentation errors, lack of technologies, and inadequate qualified labour supply. Meanwhile, Mahendra et al. (2013) define physical risks as the risks involved in labour injuries, and damage to structure, materials and equipment. According to Abdul Azis et al. (2013), contractor's site management is the major risk in cost overrun factors in construction projects. Thus, improving site management is very important to reduce the impacts on the productivity of the project. Similarly, Memon et al. (2012), argues that the contractor's site management is vital as it can have a high impact on a construction project, because the changes in scope and poor site investigation during the planning phase may lead to construction delay.

In addition, as the construction industry involves high amounts of labour, Abdul Azis et al. (2013) argues that the volume and efficiency of the labour force affects the project's success. An effective labour management is crucial in which the needs og critical attention are needed in order to avoid cost overrun. Other than that, material and machinery also have effects on

cost overrun as they are the main sources in the construction projects. Hence, in achieving successful completion of projects, efficient material and machinery management is important as appropriate amount and quality of material and manpower used can save time and cost.

Technical risk related matters also include labour supply and site management. These factors are important and may trigger risks on construction project as claimed by Hamzah et al. (2012). Hamzah et al. (2012) stated that technical risks such as a shortage of labour supply and poor site management bring impacts on construction delays in some countries. In addition, Abdul Azis et al. (2013) also emphasizes on the design and documentation, as technical risk factors need to be considered in construction projects. Documentation assists in monitoring the progress of the project. Without proper design, such as a lack of consultants' skill in detailing the specification and providing clear working drawings, this will have bad effects on construction projects. This is supported by Memon et al. (2012) which stated that frequent design changes are one of the major factors that delay a project.

When risk management practices address and respond to the technical risks, it will reduce or eliminate the bad impacts on the construction projects. This is supported by Takim and Akintoye (2002), which claimed that quality assurance procedures carried out on the projects, efficient manpower and technical capabilities give positive impacts on the construction project performance.

Methodology

A qualitative research approach was chosen for the study because it systematically predefined how the key project participants apply and use risk management in the construction projects. In addition, it is argued that qualitative research generates a better understanding regarding the research objectives where it emphasizes on how the risk management practices address the each risks in the categories of property development projects. It would also give interviewees the opportunity to answer and respond in their own words instead of choosing fixed answers such as those in quantitative approach (Mack et al., 2011).

Developers, consultants and contractors of property development and construction companies in Johor were interviewed. This study focusses on construction projects in Johor due to the reported data from Department of Statistics Malaysia which indicated that Johor recorded the highest amount of construction work in Malaysia for the fourth quarter of 2015 ("Quarterly construction statistics, fourth quarter 2015", 2016). These interview sessions were carried out in February and March 2016.

About twenty developers, contractors and consultants in Johor were selected for the interviews. The snowball sampling technique was used, where the initial respondent was

randomly selected and the subsequent respondents were suggested by this first interviewee. For example, the first respondent was a developer; he would recommend consultants or contractors as the next respondents. In the interview sessions, the interviewees needed to answer questions regarding the risk management practices in their organization.

The interviewees chosen were among those who have high managerial positions in the construction companies and have the authority to make decisions. They make decisions regarding project planning, risk management processes, and the appointment of third parties such as consultants, suppliers and contractors. They also must have wide experience in construction projects.

This study focuses on the technical risk in construction projects as this risk is claimed to be a very important risk in construction projects. This study adopted Zavadskas et al. (2010)'s and Abdul Azis et al. (2013)'s definition of technical risk which include project risks, construction risks, physical risks, and technological risks and involve contractor's site management, labour and material management, design, and documentation. Examples of this risk are lack of proper design, inefficient/inadequate labour and low-quality material used. These activities are important technical matters that need to be carefully evaluated to ensure the smooth completion of the projects.

Results and Discussion

Descriptive Statistics

Respondents of the study were selected based on their position in these construction companies. Initially, the researcher hoped to interview 20 respondents, however, only 11 contractors/developers/consultants were available to be interviewed. Out of 11 of the interviewees, four are directors, five are head of the project department, one is an architect and another one is a quantity surveyor in charge of the projects. All the respondents are important persons in their companies' construction projects where they are involved in the decision making and risk management processes. The respondents have between 15 to 36 years of experience in construction industry. Eight of them are male and three respondents are female.

The construction companies which the respondents work are companies which have been in operation for more than 10 years in construction industry. Two of the companies have their own risk management unit, while the other companies assigned special risk officers or an internal auditor to take care of the risk management matters in their companies.

Interview Results

Understanding and implementation of risk management practices

Respondents were asked about their understanding and importance of risk management in their work. The interview results appeared to indicate that all respondents understand the importance of risk management in their jobs. They viewed risk management as a tool to reduce and control risks that are probable to occur during construction activities. Among the responses were:

“Risk management help us to access and evaluate the risk involved in implementing a project beforehand. It helps to foresee any obstacle or the disadvantages and advantages for a particular project.” (Project Manager, Developer company 3).

“From my understanding, risk management is correction and prevention tools in any construction project. It is very important to ensure future profits of our projects.” (Project manager, Developer company 11).

“Risk management is implemented from the very start of the project..... that is from the pre development until the last stage... that is the end of defect liability period of the said project. Risk management is very important to ensure premises are handed over in good condition to the purchaser.” (Project Manager, Developer company 1).

Meanwhile, two consultants and one contractor emphasized on how risk management helps to ensure that the projects are kept within the budgeted costs. This is important because improper financial management has large impacts to the construction projects. This is supported by Akintoye and MacLeod (1997), who claimed that risk management helps to monitor factors that may affect completion of projects within the stipulated cost and time as well as identifying and quantifying the possible cost of each risk in order to minimize loss and avoid poor projects. Among the responses were:

“Risk management acts to control cost of overall development cost. This is because financial can affect construction project in many different ways such as delay, abandoned project, and lower the profit margin of the project.”. (Quantity surveyor, Consultant company 5).

“Risk management helps to control and reduce the risks as small as possible. This is because risk management acts as precaution strategies to minimize extra costs.” (Project architect, Consultant company 7).

“Risk management is to prepare and manage any issue that may happen and cause problem on financial and construction. It can reduce the impact on financial liability of the company” (Managing Director, Contractor company 10).

From the interviews, all respondents have implemented risk management practices in their construction companies. Two of the respondent companies have their own risk management department which are managed by the main office of the companies. Among the responses were:

“... Risk management is implemented under corporate office where there is a special department to identify, monitor and prevent risks in projects. Any approval of activities needs to be scrutinized by this unit.” (Project Manager, Developer company 4).

“Risk management is governed by headquarter office in Kuala Lumpur. Our main office sets up special unit for risk management to identify the efficiency of risk strategies and procedures through internal audit, and SIRIM audit which are held every year. Currently, the risk management unit is in progress to make manual quality handbook that adheres to ISO 9001:2015.” (Project Manager, Developer company 11).

In addition, findings from the interviews shows that the other companies which do not have risk management unit practice risk management by adhering to the risk management procedures specified in ISO 9001 requirement. Among the responses were:

“Yes, we apply ISO 9001:2008 in our company in order to manage the project risks. The ISO risk management procedures support us to avoid and prevent risks that may occur.” (Project Manager, Developer company 2).

“Our company have special officers and internal auditors who are responsible on risk management. We adhere and refer to ISO 9001: 2008 in managing risk management where it covers jobs procedures.” (Quantity Surveyor, Consultant company 5).

Technical risk in construction projects

The respondents were asked about the technical risk that they encountered during the construction activities. They highlighted that among the technical risk which they would normally have to deal with, were those related to inaccurate drawings, frequent changes of designs, shortage of labor, low quality materials and safety issues. The interview results appeared to indicate that the companies would assign person(s) to monitor the situation and various meetings were conducted regularly to solve any problem that had occurred. They commented that:

“Technical risks occur when there is problem with design when the architect did not check the design properly.... major site problem and risk of dispute between architect and consultant such as different specification and view. To avoid this, we would normally assign a civil engineer to check the drawing before approving it and before construction activities begin.” (Director, Consultant company 8).

“...Site meetings and consultant meetings are conducted regularly, before and during the start of a project in order to reduce this risk.” (Project Manager, Developer company 2).

“... Technical risks usually related to how construction activities are being conducted that may harm the project. (Project Manager, Developer company 1).

“When there is a problem during site inspection, we may need to redo the works. We need to have site meeting and consultant meeting.” (Project Manager, Developer company 4).

In addition, two developers mentioned that technical risks are also related to the construction site and the supervision at the site, such as safety issues that can harm the construction progress. The interview results indicated that the respondent companies appoint safety officers at the construction sites to monitor and assess the unsafe situations at the construction sites. These officers were also responsible to develop measures to ensure safety of the construction workers. This finding is consistent with a prior study by Al-Abadi (2014), which found that the contractors assigned competent safety inspectors to conduct daily inspections based on schedules and a checklist to ensure adequate site safety inspection and supervision. In addition, the workers were also covered with insurance. They commented that:

“We appoint safety officers especially for projects or contracts that valued to RM10 million and more.” (Director, Contractor company 9).

“We employ Quality Engineer or Project Manager to minimize the work delay.” (Managing Director, Contractor company 10).

“Our workers are all covered with insurance which we renew every year.”(Project Manager, Developer Company 1)

Another risk associated with property development projects is the issue of cost overruns. This is supported by Abdul Azis, Memon, Abdul Rahman and Abd. Karim (2013), which found that cost overrun in construction projects typically arise when there is a poor cost performance in projects. The key reasons of extreme cost overruns in developing countries

are escalation of material prices and the inefficiency of labour force as claimed by Abdul Azis et al. (2013). In order to tackle the risk of labor shortage and un-skilled workers which may affect the construction activities, the contractors came up with a few solutions to solve this risk. They employ extra workers and at times have to hire foreign workers and appoint more sub-contractors. Those unproductive workers were fired and the hardworking ones went through on-the-job-trainings. The workers also were tightly supervised to ensure the jobs were correctly executed. Having experienced and skilled technicians are especially important and necessary in installing and dealing with expensive materials and equipment. A skilled technician would understand the specification and know how to do inspection testing plan. The responses were:

“We will standby at least 25 workers when necessary.” (Director, Contractor company 9).

“We need to get more foreign workers and more sub-contractors.” (Managing Director, Contractor company 10).

“We engage new skilful staff and fire unproductive staff.” (Director, Contractor company 9).

“Project Manager must give training to the technician. We also must acquire and appoint experienced technician.” (Project Manager, Developer company 2).

“Supervisors at a site must understand the specification and have good communication with consultants to ensure the materials and equipment follow the contract.” (Project Manager, Developer company 4).

“We have tight supervision where we handle and monitor workers frequently.” (Director, Contractor company 9).

“To avoid or reduce the possibility of dispute and increase workers’ productivity, we need to employ skilled workers and provide them training.” (Managing Director, Contractor company 10).

The respondents also highlight the problem of low quality and the shortage of materials in the construction processes. A respondent stressed on managing material and equipment because both can slow down the construction activities. This finding is consistent with a study by Abdul Azis et al. (2013), which found that material and machinery have effects on cost overrun as they are the main resources in the construction projects. The respondents shared their views that this problem can be avoided by not depending on only one supplier and finding more suppliers with quality materials. In addition, there must also be a proper record and control of material distribution to their sub-contractors to avoid any dispute with them later. In addition, they also assign a person in-charge to monitor the purchases and distribution of materials to the construction sites. Among the responses were:

“Risk management minimizes the wastages by controlling the material and equipment in order to avoid loss. For example, proper recording of material at site, purchasing control, labour management which must match to construction’s activities and period of the projects.” (Director, Contractor company 9).

“Insufficient materials must be added and must be charged to the sub-contractors. In order to ensure the materials are used efficiently, we control the distribution of the material to the head of subcontractor with a proper record.” (Project Manager, Developer company 2).

“It is important for us to get more suppliers with good quality of material and equipment so that we are not at the disadvantage when our materials are running low.” (Managing Director, Contractor company 10).

“Consultant is responsible to check and approve the materials to be used.” (Project Manager, Developer company 1).

Another technical risk which frequently disrupts and delays the construction processes are incomplete or errors in drawings, frequent changes in the designs and disputes between the consultants and contractors regarding the drawings. The respondents stressed that proper checks are important to ensure that no problems will arise, and they would normally assign a person to monitor and check the drawings. In addition, a check list must be filled up to ensure all is included, and all discrepancies must be corrected before the start of the projects. Among the responses were:

“... We would make it a procedure for a civil engineer to check the drawing before approving it and before construction activities start.” (Director, Contractor company 9).

“A design checker has the responsibility to check the preliminary design and preliminary drawing before the designer finalize their works.” (Director, Consultant company 6).

“Before commencing the construction work, we check and verify the construction drawing and make sure the documents are complete.” (Managing Director, Contractor company 10).

“We have to ensure nothing is missing, procedure has specified that a checklist on design must be fulfilled by the consultants when submitting the drawing to us.” (Project Manager, Developer company 3).

“... When there is discrepancy in drawing between architectural, civil and structural, and mechanical and electrical, we need to inspect the inaccuracy in the detail drawing and correct it before construction activities start.” (Project architect, Consultant company 7).

Besides managing the internal affair of the company, respondents also need to take care of other external matters which may not be within their control. This includes the selection of sub-contractors and consultants to assist them in some part of the construction processes. Disputes and disagreements with these parties may cause a delay to the projects and have financial implications if they are sued by the house purchasers. Thus, the respondents stressed on the importance of proper screening and selecting processes of the consultants and sub-contractors. They evaluated the risk of association with these parties before they really get to engage with them. Factors such as prior success projects, qualifications and commitment of these parties are thoroughly investigated by the risk committee team before the decision is made. They commented that:

“Risk management is very important as it may affect the construction activities. For instance, it helps in the process of appointing the contractors, the background of the contractors need to be analysed,..... one way to reduce this risk, we must appoint and select contractors and panel consultant which we already knew their work performances.” (Project Manager, Developer company 2).

“Risk management also assist in ensuring the appropriate contractors are selected. The high quality of past projects, good management of time and budget and good financial positions are seriously considered by the risk committee. This is because good contractors will produce good result on projects.” (Director, Consultant company 8).

“The risk management procedures will assist to check performance of consultant and person in charge. The consultant must have a good knowledge, experience and commitment. The consultants also should be aware of any new regulation by authorities.” (Project Manager, Developer company 11).

“Risk management team assist us in the selection of consultants with good skills to ensure they can provide clear drawings. This is very important as it can trigger bad effect on construction projects.” (Project Manager, Developer company 3).

The results of the interviews appear to indicate that the ISO procedures helped the respondents in solving some of the risk. The respondents stressed that adherence to risk management procedures greatly assisted them in ensuring only quality materials are used in the construction processes, that the equipment is properly installed as specified in the drawings and a specification test is carried out. The procedures help to rectify any problem(s) in the processes and reduce the impact of this risk. The responses were:

“Supervision must be done according to Standard Operation Procedure and endorse by Project Manager.” (Project Manager, Developer company 1).

“We must do specification testing such as if the materials are not installed according to the procedure, then we need to rectify. Testing must be conducted after the rectification.” (Project Manager, Developer company 2).

“Standard Operating Procedures must be followed by all persons in charge at site.” (Project Manager, Developer company 11).

The respondents were also asked about how they monitor the performance and risk of their projects. They claimed that they conduct a post-mortem for each completed project, and a customer satisfaction survey is also done. Customers can also file a complaint to voice their dissatisfaction. In addition, some companies also have a monitoring system which looks into this, and they claimed that they learn from their previous mistakes and try to avoid doing it again. Their responses were:

“Our company has a proper data of complaints and good monitoring system. We have post-mortem for each completed project for our reference. We also have customer satisfaction survey to analyse defective works for future projects.” (Project manager, Developer company 1).

“Defect things can be reduced as we learn from previous project before beginning new project.” (Project Manager, Developer company 3).

“Our risk management unit will monitor the risk of our projects from the start of the projects, throughout the processes until the houses are handed over to the purchasers.... if new risk emerges, meetings and discussion will be conducted to address them.” (Project Manager, Developer company 4).

Conclusion

The objective of this study is to examine how risk management practices address the technical risks in property development projects. The interview results appeared to indicate that all respondent companies apply the relevant risk management practices in their construction activities. In addition, all respondents agreed that risk management is important in construction projects as it can help to ensure the projects are completed within the stipulated time and budget.



Technical risks which occur at the construction sites are important as they greatly affect the construction projects. Technical risks may delay the progress or provide defects to the construction projects if they are not well managed and handled. They may even cause a financial loss to the respondent companies if they are not properly addressed. In term of risk response, the respondent companies tend to transfer (such as buying insurance for workers) and reduce the risk (such as assign an engineer or supervisor to monitor, having site meetings) rather than accepting the risks.

This study has its limitations. It collects data from small group of respondents and cannot be generalized. The sample companies were chosen only from construction companies in Johore. Future studies may collect data from a bigger sample which may include construction companies from other states in Malaysia. This will give a better insight about the risk management practices in construction companies in Malaysia as a whole. This study only focuses on technical risk, future studies should include other categories of risks related to the construction industry.

This study provides information to the key project participants such as developers, contractors, clients, consultants, and suppliers to recognize, understand and manage the risk factors that assist the property developers to achieve its projects' objectives. Thus, organizations are more prepared in managing those risk by adopting a systematic risk management to ensure successful property development projects.

In addition, this study also provides useful information to the Ministry of Housing and Local Government and National Housing Department to take additional actions such as providing guidelines and training to the key project participants in conducting risk management practices in their organizations. The results of the study provide evidence to the ministry about the importance of risk management practices in construction projects in Malaysia in order to reduce the problems in construction projects.

Acknowledgement: The authors would like to acknowledge the support received from Universiti Putra Malaysia (Grant Nu. 5524888) in realizing this study.

REFERENCES AND NOTES

- Abdul Azis, A. A., Memon, A. H., Abdul Rahman, I., & Abd. Karim, A. T. (2013). Controlling cost overrun factors in construction projects in Malaysia. *Research Journal of Applied Sciences, Engineering and Technology*, 5(8), 2621-2629.
- Ahmed, A., Kayis, B. & Amornsawadwatana, S. (2007). A review of techniques for risk management in projects. *Benchmarking: An International Journal*, 14(1), 22-36
- Akintoye, A. S. & MacLeod, M. J. (1997). Risk analysis and management in construction. *International Journal of Project Management*, 15(1), 31-38.
- Al-Abadi, I. S. (2014). Risk management for safety improvement on building construction sites in Qatar. Unpublished master thesis, Qatar University.
- Ali Khan, R., Liew, M. S., & Ghazali, Z. (2014). Malaysian construction sector and Malaysia vision 2020: developed nation status. *Procedia – Social Behavioral Sciences*. 109, 507-513
- Banaitiene, N. & Banaitis, A. (2012). Risk management in construction projects (chap.19). Retrieved on October 30, 2015, from <http://dx.doi.org/10.5772/51460>
- Cheng, S. G. & Abdul Rahman, H. (2013). The identification and management of major risks in the Malaysian Construction industry. *Journal of Construction in Developing Countries*, 18(1), 19-23.
- Davies, V.J. & Tomasin, K. (1996). Construction safety handbook (2nd Edition), Thomas Telford Publishing, London.
- Dutta, E. A. B. (2014). Study of risk in construction contracts. *International Journal of Research in Engineering & Technology*, 2(2), 21-26.
- Fisher, P. & Robson, S. (2006) The perception and management of risk in UK office property development. *Journal of Property Research*, 23 (2). 135-162.
- Hamzah, A., Khoiry, M. A., Arshad, I., Badaruzzaman, W. H. W., & Tawil, N. M. (2012). Identification of the causes of construction delay in Malaysia. *International Journal of Civil, Environmental, Structural, Construction and Architectural Engineering*, 6(12), 104-109.
- Hussin, A. A. & Omran, A. (2011). Implication of non-completion projects in Malaysia. *ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering*. IV, 29-38
- Kuang, Z. (2011). Risk management in construction projects. Unpublished master thesis, University College, Horsens Campus, Denmark.
- Mack, N., Woodsong, C., MacQueen, K. M., Guest, G., & Namey, E. (2011). Qualitative research methods: A data collector 's field guide. Family Health International. North Carolina.
- Mahendra, P. A., Pitroda, J. R., & Bhavsar, J. J. (2013). A study of risk management techniques for construction projects in developing countries. *International Journal of Innovative Technology and Exploring Engineering*, 3(5), 139-142.



- Manaf, Z., Razali, M. N., & Eni, S. (2006). The management of property development risks in Malaysia – Risk management and the property development process: A review. Unpublished manuscript, Universiti Teknologi Tun Hussein Onn, Johor, Malaysia.
- Memon, A. H., Abdul Rahman, I., & Abdul Azis, A. A. (2012). Time and cost performance in construction projects in southern and central regions of Peninsular Malaysia. *International Journal of Advances in Applied Sciences*, 1(1), 45-52.
- Quarterly construction statistics, fourth quarter 2015. (2016, February 11). Retrieved October 17, 2017, from https://www.statistics.gov.my/index.php?r=column/cthemByCat&cat=77&bul_id=RIBvVUUwNVZnb0NL2I2UnBjOUZhUT09&menuid=OEY5SWtFSVVFVUpmUXEyaHppMVhEdz09
- Simu, K. (2009). The construction site manager' impact on risk management performance. Unpublished Doctoral Dissertation, Luleå University of Technology, Sweden.
- Smith, N. J., Merna, T., & Jobling, P. (2014). *Managing risk in construction projects* (Third Edition). United Kingdom: John Wiley & Sons, Ltd.
- Takim, R. & Akintoye, A. (2002). Performance indicators for successful construction project performance. In Greenwood, D. *18th Annual ARCOM Conference, University of Northumbria*, 2, 545-55.
- Wan Mahmood, W. M. & Zakaria, R. (2007). Profitability and capital structure of the property and construction sectors in Malaysia. *Pacific Rim Property Research Journal*, 13(1), 92-105.
- Zavadskas, E. A., Turskis, Z., & Tamosaitiene, J. (2010). Risk assessment of construction projects. *Journal of Civil Engineering and Management*, 16(1), 33-46.