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ARTICLE

An Institutional Approach to Understanding Post-Project Reviews in the Construction Industry

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ABSTRACT

Post-project reviews (PPRs) are known to be one of the most effective tools for empowering organizational learning and to help companies gain a competitive edge in the knowledge economy. However, the use of PPRs in the construction industry has been limited, due to the temporary nature of projects and the associated barriers. A lack of research in this area has resulted in little focus on the underlying causes of the failure to implement such reviews. As a result, many companies are not benefiting from the capture and sharing of knowledge of past projects, leading to a loss in precious lessons learnt and an overall inability to learn from past mistakes. The institutional theory suggests that the factors that influence the use of PPRs may be classified into three pillars that drive organizational behaviour. This study seeks to understand the existing use of PPRs in the construction industry, and to employ the institutional theory to probe deeper into the root causes behind their lack of implementation. A three-phase research design was conducted to explore, in increasing depth, the use of PPRs. Surveys and interviews were carried out with project managers to understand the properties and extent of their use of PPRs, as well as the rationale for and effectiveness of such reviews. The factors identified were then mapped to three institutional pillars to draw conclusions about the institutional factors that affect the adoption of PPRs. In addition, a case study was conducted to examine the implementation features of a strong post-project review case. This found that strong management support and the use of formalized procedures were major drivers of post-project review implementation. Several other factors were identified that did not correspond to the institutional framework, and these are presented alongside the institutional factors as part of the strategies for organizational learning through effective post-project review reviews.

Keywords: *Post-project review; project management; construction; institutional theory; organizational learning*

1. INTRODUCTION

Project knowledge is defined as "best practices learned on how to carry out tasks in a more efficient way" (Tan et al., 2009, p. 5), and is crucial for the learning and innovation needed in a knowledge economy. Further, it is the process of learning that transfers knowledge through the accumulation of experience, and the articulation and codification of knowledge (Zollo and Winter, 2002). A useful tool in achieving knowledge capture is the post-project review (PPR), which has been widely used in many industries to capture learning and project knowledge at the end of a project. Yet, many have failed to conduct these properly, or faced barriers to their implementation (Disterer, 2002). Although the conduct of PPRs has been widely publicized in project management books and other management fields, due

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to the fragmented nature of construction projects and other barriers, PPRs have failed to achieve their maximum potential there. Given the lack of research into project reviews, especially in the Singapore context, as well as the low use of PPRs in the construction industry, this study sets out to explore the dissonance between theory and the practical application of PPRs in the construction industry. Institutional theory has rarely been used to better understand the construction industry, and therefore this study attempts to provide an institutional framework for PPRs that appear to be lagging in the construction industry. The inadequacy of existing research in this area, especially in construction, is telling of the overall lack of knowledge of the drivers and barriers of PPRs, as well as of the deeper rationale for these drivers and barriers. The aim of this study is to obtain an understanding of the use of PPRs in the construction industry, and of how firms can better implement PPRs to achieve maximum capture and retention of knowledge across projects. To do so, the following research objectives were formulated:

(1) Identify the prevalence of PPR usage in the Singapore construction industry.

(2) Understand the effectiveness of PPRs in the Singapore construction industry.

(3) Identify the factors for PPR usage or its lack.

(4) Explain the prevalence, factors, and effectiveness of PPRs through institutional theory.

(5) Propose a framework for firms to achieve effective organizational learning through PPRs.

2.0 LITERATURE REVIEW

2.1 PPRs in construction projects

The concept of PPR is fundamentally a form of drawing lessons from projects. It is broadly defined as a systematic capture of knowledge gained in the project for the benefit of other projects, especially future ones, and the organization (Anbari et al., 2008; Zedtwitz, 2002). The International Organization for Standardization (ISO) standards also provided some insight into the use of PPRs. ISO 9001:2008 advocated management reviews at specific intervals, taking into account information such as process performance and product conformity to improve the effectiveness of the quality management system and its processes (International Organisation for Standardization, 2008). ISO 10006:2003 provided more specific guidance for projects, and called for progress evaluations that could be "used to provide information to the originating organization, for continual improvement of the effectiveness and efficiency of the project management processes" (International Organisation for Standardization, 2003, p. 10). Carrillo et al. (2011) likened PPR to a process by which participants look at the outcome of the project retrospectively with the intention to learn from the project's successes and failures. The benefits of PPRs are tempting; however challenges are encountered when implementing PPRs in the construction industry given that it does not typically have a culture of innovation and learning. Keegan and Turner (2001) found that the construction industry was "very conservative" and generally did not conduct learning for projects (p. 84). The companies studied by Keegan and Turner (2001) highlighted a lack of time for meetings or sessions for PPRs. In addition, Keegan and Turner (2001) also showed that these companies were focused on capturing deviations in projects rather than project knowledge aimed at organizational learning. In a similar vein, Carrillo's (2005) study found that construction companies had differing implementation levels of PPRs. In particular, the reviews were done mainly as part of a quality process, and there was a lack of a formal structure in the conduct of the reviews, especially in having a proper system for dissemination of lessons

learnt. Additionally, Senaratne and Malewana (2011) identified project reviews done by construction companies due to ISO certification requirements, which were poorly disseminated across the organization and were primarily based on project documentation. Knauseder (2007) studied Swedish construction projects and found that learning was restricted to personal experiences or through individual networks, and there was a lack of organizational learning. This was also found by Gieskes and André (2000), who concluded that construction firms are not implementing a process of learning or using any tools to aid in organizational learning, restricting any project knowledge to an individual level without any dissemination or transfer across the organization. Fong and Yip (2006) conducted a survey of Hong Kong construction firms and found that there is no proper system in place for PPRs, and therefore organizational learning cannot take place. Furthermore, the study showed that industry professionals did not find learning from past projects important especially beyond individual learning within projects. Goodrum et al. (2003) remarked that construction projects often do not capture lessons learned during the construction phase and make use of the knowledge in future projects, and much of the knowledge is lost. It seems most construction firms fail to conduct effective PPRs and therefore forgo the benefits of such reviews (Love et al., 2004).

2.2 Drivers to PPRs implementation

Some authors have also suggested drivers that boost the implementation of PPRs. Kotnour (1999) advocated information technology tools to aid and support the sharing and dissemination of knowledge within an organization. Schindler and Eppler (2003) stated that the institutionalization of tasks, such as project debriefing meetings, lessons-learned workshops, and a final project report are strong factors in achieving the capture and use of project knowledge. They further elaborated on three ways of having such reviews institutionalized: enforcement through guidelines and procedures, training of staff, and encouragement and strategic emphasis on project learning. On this point, Williams (2003) called for a formalization of learning processes that implemented project knowledge transfer and learning to achieve organizational learning. Another possible driver is the demands of clients or other societal regulations (Ekstedt et al., 1999).

2.3 Relevance to project management

The basis of PPRs can be found in both the Association for Project Management (APM) "Body of Knowledge" (BoK) and the Project Management Institute's (PMI) "A Guide to the Project Management Body of Knowledge (PMBOK Guide)". For the British BoK, PPR is mentioned in Topic 6.6 under Project Reviews (Association for Project Management, 2006). Morris et al. (2000) found that 80% of project management professionals agreed that PPR should be included in the new version of the BoK. Wateridge (2002) expanded on PPRs to provide additional guidance on top of the APM's BoK. Comparatively, in the PMI's PMBOK Guide under Section 4.6.3.2, the statement provided is that "historical information and lessons learned information are transferred to the lessons learned knowledge base for use by future projects or phases" (Project Management Institute, 2008, p. 102). Beyond this, however, the PMBOK Guide did little to provide formal practices for the conduct of PPRs.

2.4 Institutional theory and application to PPRs

Scott (2008) identified three crucial systems or pillars as crucial ingredients of institutions and their basis, namely the regulative, normative, and cultural-cognitive pillars. These three pillars can be seen as an integrated approach, but it has been suggested by Scott (2008) that the analytical study of each component element is more important. Scott (2008) also noted that this institutional framework seeks to conceptualize the "celebrated strength and

resilience" of institutions, and each pillar supports or makes up these institutions in a specific way (p. 51).

- The regulative pillar corresponds to the mechanism for coercive pressure enunciated by DiMaggio and Powell (1983). It encompasses the regulative aspects of institutions, which "constrain and regularize behaviour" (Scott, 2008, p. 52). The key defining ingredient is the authoritative nature of such processes over organizations, in that some sort of power is exercised. It is therefore a characteristic of regulative institutions to have legitimacy based on visible and perceptible power that is legally sanctioned. Indicators of such institutions would be rules, laws, and sanctions.
- The normative pillar refers to the values and norms that guide the social life of actors. The values and norms within the collectivity essentially create roles for actors, and define actions and goals for them based on normative expectations. One of the more significant ways normative processes can manifest is in the training, certification, and accreditation of actors, whether professionals or organizations. This is usually influenced by professional bodies, which define procedures, routines, strategies, and paradigms into social beliefs.
- The cultural-cognitive pillar was defined by Scott (2008) as the "shared conceptions that constitute the nature of social reality and the frames through which meaning is made" (p. 57). The cultural-cognitive pillar emphasizes the shared or collective representations of meaning and their cognitive interpretation by actors. It is the meaning put into the cultures and social roles that makes other types of behaviour inconceivable, and empowers actors to feel competent and connected when their beliefs align with these cognitive interpretations.

The institutional theory has already been adopted to better understand how the construction industry operates, including ethics (Low, Gao, Che-Ani and Siah, 2014). Few studies have however been done on the use of institutional theory and PPRs, but certain studies do discuss factors that fit into the three institutional pillars, which may give insights as to the prevailing institutional effects in project organizations. Kotnour and Hjelm (2002) discussed organizational learning as being influenced by factors such as organizational culture, a project manager's role and behaviour, the culture of the project to embrace engagement and trust, and individual actions by project team members to actively create knowledge through routines and learning processes. Schindler and Eppler (2003) mentioned "insufficient willingness for learning from mistakes of the persons involved" and "fear of negative sanctions" as two key reasons why organizations fail in project learning (p. 221). The effect of formalization is discussed by Lilly and Porter (2003), who found in their study that formal reviews had higher success rates, were less biased, and their overall learning and dissemination process was more effective. Styhre et al. (2004) echoed this view, stating that construction projects should be formalized to effectively exploit organizational learning capabilities. They concluded that there was a need for formal knowledge collection across various parties through meetings, and across various phases of the projects.

3.0 RESEARCH METHODOLOGY

3.1 Research design

Following the literature survey, empirical studies were conducted to understand the use of PPRs in Singapore's construction industry, and the perceptions, barriers, and drivers of such reviews. A three-phase research design was proposed to investigate PPRs in increasing

depth. This design was adapted from a multi-phased research design, as described by Creswell (2013), which discussed the use of qualitative studies followed by quantitative studies for methodological rigor. Fellows and Liu (2009) used the term "triangulation" to describe multiple research methods to investigate the same thing, which can facilitate the generalization of findings and improve validity.

- Phase 1 is a survey for broadly understanding the current practices of PPRs based on descriptive and inferential statistics.
- Phase 2 is a set of in-depth interviews conducted with professionals in the industry to further understand the reasons, rationales, and implementations of PPRs, with reference to the survey results and Scott's (2008) institutional theory.
- Phase 3 is a case study to identify best practices and applications of PPRs in organizations, to provide a basis for the useful and effective conduct of PPRs.

3.2 Phase 1: Questionnaire survey

The questionnaire survey was conducted over two months from November 2012 to January 2013, targeting project managers who had authority to conduct PPRs. Survey questionnaires were sent to organizations within the building industry, based on the Building and Construction Authority's e-registry and Public Sector Panels of Consultants (PSPC) Listing, including construction firms, project management, and consultancy firms. The survey questionnaire has three parts. Section A collects basic respondent information for simple descriptive statistics, such as name, number of years of experience, and their company's role in the project. Section B and C are mutually exclusive sections, where respondents fill in Section B if they conduct PPRs for that project, or Section C if they do not. This dual design tailors specific questions to respondents to identify certain characteristics that may be present in those who performed reviews or not. Section B contains more questions, as these are used to determine the type and features of the PPRs conducted. Most questions are in the form of a Likert scale, where respondents choose a number to determine their degree of agreement or disagreement with a statement (Bell, 2010).

3.3 Phase 2: Interviews

Based on the survey results and data analysis, in-depth interviews were conducted with three senior project managers from project management and contracting firms to seek their views on PPRs and to investigate any comments on the use, effects, and characteristics of PPRs. Two of the interviewees were from project management firms (Interviewee A and Interview B) and one (Interviewee C) from a contracting firm. These interviewees all had more than ten years of experience in project management, and have experience of conducting PPRs in their companies. These in-depth interviews were carried out in a face-to-face manner at the participants' offices. The interviewees requested full anonymity regarding personal and company information, and were complied in the study. The survey results were highlighted to ask interviewees for their professional and personal insight into the underlying issues of PPRs.

3.4 Phase 3: Case study

A case study was conducted to explore the applications of PPRs by those organizations that had strong formalization and implementation of such reviews. A large company was chosen because this company has spent extensive time and efforts on creating a proper PPR system

for the documentation and dissemination of lessons learned. In addition, based on observations, the PPRs were held to be largely successful, and so the case study was conducted to examine useful traits and features that could be identified and reviewed.

4.0 RESULTS

4.1 Background of respondents

A total of 53 usable responses were collected. The breakdown by firms is shown in Table 1. 62% of participants were from consulting firms, while only 13% were from contracting firms. The spread is considered sufficient to obtain an overall representation of the parties involved in PPRs in the industry.

Table 1. Characteristics of respondents' firms and experiences in PPR

	No.	Frequency
Firm type		
Engineering firm	7	13.2%
Contracting firm	7	13.2%
Architectural firm	13	24.53%
Project management consultant	13	24.53%
Developer	13	24.53%
Firms conduct post-project reviews		
Yes	33	62.3%
No	20	37.7%
Total	53	100%

Note: in terms of their business nature, engineering firms, architectural firms, and PM consultants are all considered consulting firms.

In addition, the respondents had an average of 13 years of experience in managing projects. 55% of the projects surveyed had a budget of more than SGD 100 million. All projects were completed after the year 2000. Table 1 also shows the prevalence of the use of PPRs, with which 62.3% of respondents had experience. This result seems to suggest that Singapore's construction industry does have some emphasis on knowledge-collection and learning. The interviewees suggested that company culture or requirements might account for the low rate of PPRs in the industry. Interviewee A commented that:

"PPRs are performed by quite large companies. For us, we have a guideline for this, but smaller companies perhaps not so much."

Interviewee C provided a similar explanation saying:

"If the company says we must conduct this kind of reviews at the end of the project, then I will do it. If not, it is just a simple discussion at most, not going to be documenting them down into a file or submitting a report."

The survey also asked the respondents about a few "formalizing" characteristics of PPRs. For example, of those 33 responses associated with experiences in PPRs, 60.6% had a department specifically in charge of the design, execution, or collection of the review. This gives an indication that these companies are very serious about PPR. The survey also found

that 84.8% of PPRs were conducted at the end of the entire project, 39.4% were conducted after key milestones, and only 9.1% were conducted at regular intervals. It seems that the industry norm is skewed towards the conduct of such reviews only at post-project stage, and not many projects conduct such reviews continuously throughout the project. In terms of how PPRs were conducted, a majority (63.6%) mentioned meetings or workshops, followed by individual interviews (30.3%), and the use of learning journals or diaries for recording lessons (18.2%). In addition, 93.9% of the respondents claimed that the project management team is involved, while 66.7% and 69.7% involved the architects and engineers, respectively. The client was involved in 48.5% of the reviews, and the main contractor in 51.5%. This represents a mix of styles of PPRs, with an emphasis on project management and consultancy-type of reviews over construction management.

4.2 Effectiveness of PPRs

Table 2 shows the results of the effectiveness of the reviews through each of the nine indicators, with mean Likert scores ranging from 3.42 to 4.21. A significant test indicated that all indicators, except E9 ("the lessons learnt were effectively communicated to people outside the project (but within the same organization)"), were found to be significant at the 0.05 level, meaning it was statistically effective for PPRs to be conducted. As E9 has a p-value of 0.165 (greater than 0.05), there is insufficient evidence to show that lessons were effectively communicated to people outside the project. This could be due to a poor dissemination infrastructure beyond the project participants. For this issue, the interviewees offered their opinions. Interviewee A first mentioned his company's method of dissemination:

"There is a database system for storing all the lessons learnt by projects. In terms of disseminating to other projects, we can actually do a search, then results appear, but I don't know how many actually use it."

Interviewee B explained a similar approach:

"For this company, unless there is a special arrangement, the relevant party will file the lessons learned, and they will only get dug up if down the road there is another similar project. They will then go into that project and look at the lessons learned and what were being said and use that as a reference."

Table 2. Descriptive statistics for the effectiveness of PPRs

Indicators	Mean	S.D.	Rank	t	Sig.
E1. Clear lessons learnt/knowledge was generated	4.21	.415	1	16.77	.000*
E2. Lessons learnt/knowledge generated apply to other projects within the organization	4.21	.415	1	16.77	.000*
E3. Root cause of problems with the project was identified	4.00	.559	4	10.28	.000*
E4. Participants avoided blaming during the PPR	3.42	.751	8	3.24	.003*
E5. Participants were open to sharing	3.82	.465	6	10.12	.000*
E6. Participants' responses were truthful	3.82	.528	6	8.91	.000*
E7. Lessons learnt were effectively communicated to the participants of the review	4.09	.522	3	12.0	.000*
E8. Lessons learnt were effectively communicated to other people involved in the project	3.85	.566	5	8.62	.000*
E9. Lessons learnt were effectively communicated to people outside the project (within the same organization)	3.21	.857	9	1.42	.165*

Note: * $p < 0.05$. These indicators are assessed using a Likert scale: 1 = "strongly disagree" to 5 = "strongly agree".

Both interviewees felt more comfortable utilizing a "pull" approach of retrieving lessons learnt only when it was perceived to be needed - essentially not promoting effective dissemination of lessons learnt. Both gave their reasons for this "pull" approach, with Interviewee A citing sensitivity:

"…for some lessons learnt, maybe they don't send them out because they can be quite sensitive, there can be commercial [reasons] as well."

4.3 DRIVERS AND BARRIERS TO IMPLEMENTING PPRS

Respondents who conducted PPRs were asked to indicate the level of agreement with factors that influenced their intention to conduct these reviews. Table 3 shows the results.

Table 3 indicates the factors that had p-values of less than 0.05 with an asterisk. This means that respondents agreed these factors did influence them to conduct PPRs. One of the main factors influencing respondents to conduct PPRs was "their personal belief in the importance of PPRs" (D5). This suggests that the respondents personally recognized the value of PPRs, perhaps from past review experiences with positive outcomes that encouraged them. Correspondently, Interviewee A indicated a personal belief in PPRs:

Table 3. Descriptive statistics for the drivers of PPRs

Drivers	Mean	S.D.	Rank	t	Sig.
D1. I was required to do so by upper management	3.82	.584	3	.102	.000*
D2. I was required to do so by contractual obligation	2.58	.663	9	.115	.001*[a]
D3. I saw a need to conduct PPRs for this particular project	3.88	.696	2	.121	.000*
D4. I was encouraged to do so by upper management	3.79	.739	4	.129	.000*
D5. I personally believe in the importance of PPRs	4.30	.529	1	.092	.000*
D6. I was encouraged to do so by an association or institution	2.49	.712	10	.124	.000*[a]
D7. I was following industry-standard practice	3.03	.810	7	.141	.831
D8. I was following a competitor's practice	2.64	.653	8	.114	.003*[a]
D9. I was trained or educated in conducting PPRs	3.24	.708	6	.123	.058
D10. I felt that the respondents would be open to discussing issues with everyone	3.46	.666	5	.116	.000*

Note: *p < 0.05. a This is the case when p < 0.05 but the mean value is less than 3 "uncertain" (1 = "strongly disagree" and 5 = "strongly agree").

"I personally find it useful to do post-project reviews. Personally, the lessons learnt themselves actually make you a better project manager in managing projects down the road."

Additionally, the respondents felt that "requirements by upper management" (D1) and "encouragement by upper management" (D4) were also strong influences on their decisions to conduct PPRs. This is likely to be an influence by authority, such that the respondents felt compelled to comply with their superior's instructions or encouragement. Interviewees provided some insight into management support for PPRs, with Interviewee B saying:

"In terms of management, they have a guideline that requires us to do. We actually have a quality department that is in charge of all this."

In terms of project-specific circumstances, respondents also felt "a need to conduct post-project reviews for that particular project" (D3), and felt that "the review participants would

be open to sharing and discussion" (D10). The former suggests that project managers may be influenced by potential problems or lessons that a project may have. This may also indicate that larger and more complex projects, with more potential issues and lessons, would be better candidates for PPRs. It is also implied that a discussion environment is an important factor.

Respondents who indicated that they did not conduct PPRs were also asked to indicate which factors had influenced their decisions. Table 4 ranks their perspectives on the barriers to PPRs. Based on Table 4, seven barriers were identified as having significant impact in hindering PPRs, as their p-values are under 0.05. Meantime, two of these have mean value above 3, "There was insufficient support from upper management" (B1) and "It is not required under the contract or required by government laws" (B10). Notably, the lack of support from upper management (B1) caused respondents not to conduct PPRs, suggesting that upper management played an important role in whether or not PPRs are conducted in local construction projects. The lack of a requirement under a contract or law (B10) also played a significant role in the lack of PPRs for these respondents, as they felt that there were other more important things to do.

4.4 CRITICAL FACTORS OF PPRS

All respondents were asked what they felt was important for a successful PPR. A significance test was conducted to identify if there was a difference in perception between the two groups of respondents. As shown in Appendix I, Levene's test shows the two groups have equal variances and both groups of respondents felt similar about what was important to successful PPRs. Table 5 shows the respondents' perspectives on critical factors for successful PPRs. Also shown is the relationship between what they perceived to

Table 4. Descriptive statistics for barriers of PPRs

Barriers	Mean	S.D.	Rank	t	Sig.
B1. There was insufficient support from upper management	3.85	.587	1	.131	.000*
B2. I personally did not feel that conducting it would generate any new knowledge or lessons learnt	2.15	.366	13	.082	.000*[a]
B3. I did not think it would lead to any improvements	1.95	.605	14	.135	.000*[a]
B4. It is too difficult to coordinate PPRs	2.60	.754	9	.169	.028
B5. It is too expensive to conduct PPRs	2.20	.410	12	.092	.000*[a]
B6. It is too time-consuming to conduct PPRs	2.95	.826	4	.185	.789
B7. I feel that people would be unwilling to share their experiences in the project	2.65	.745	8	.167	.049
B8. I feel that people would be unwilling to discuss problems faced in the project	2.80	.768	5	.172	.258
B9. No other company in the industry is doing it	3.10	.912	3	.204	.629
B10. It is not required under the contract or required by government laws	3.75	.639	2	.143	.000*
B11. I lack the knowledge on how to conduct PPRs	2.55	.887	10	.198	.035*[a]
B12. There is inadequate infrastructure for the distribution and dissemination of the results	2.55	.945	10	.211	.046*[a]
B13. I do not see a need for a formalized setting or procedure for PPRs	2.70	.801	7	.179	.110
B14. I was not trained in PPRs	2.75	.911	6	.204	.234

Note: *p < 0.05; a This is the case when p < 0.05, but the mean value is less than 3 "uncertain", where 1 = "strongly disagree" and 5 = "strongly agree".

be important and what was actually implemented in their reviews. As shown in Table 5, all but three factors had a significant positive correlation between importance and implementation at a 0.05 confidence level. This represents respondents being able to implement these aspects of PPRs that they personally felt were important.

The respondents felt that "having a formal procedure for PPRs" (S1) was important for successful PPRs, indicating their preference for some form of guidelines and structure for such reviews. However, the correlation value with level of implementation ($r = -.017$, $p = .924$) show that this was a factor that respondents felt was important but were unable to implement it consistently. Interviewees offered their perspectives on this particular factor. Interviewee A mentioned that formal procedures for PPRs may be influenced by other formal procedures such as ISO requirements:

"For us we have our ISO requirements that will make our procedures more formal, but maybe other companies without these kinds of guidelines will not have so formal procedures for post-project reviews."

Interviewee B suggested a similar idea with quality systems saying:

"I would imagine that those with more established quality systems will probably have this. Of course over time as the company grows I would imagine all companies would at least have this, but it is about the emphasis basically, from the company."

Table 5. Descriptive statistics for critical factors for PPRs

Critical factors of PPRs	Perceived importance				Correlation [a]	
	Mean	S.D.	t	Sig.	r	Sig.
S1. Having a formal procedure for PPRs	3.77	.640	8.80	.000*	-.017	.924
S2. Having a specific department in charge of PPRs	3.11	.993	.830	.411	.519	.002*
S3. Conducting reviews at all stages of the project life cycle	3.72	.690	7.57	.000*	.456	.008*
S4. Conducting meetings or workshops for those involved	3.64	.522	8.94	.000*	.421	.015*
S5. Interviewing people individually	2.91	.815	-.84	.403	.547	.001*
S6. Keeping learning diaries or logs during the project	3.17	.802	1.54	.129	.699	.000*
S7. Having PPRs conducted by an external facilitator	2.38	1.304	-3.48	.001	.170	.344
S8. Having an easily accessible database for lessons learnt	3.77	.697	8.08	.000*	.145	.419
S9. Having strong teamwork between various parties of the project	4.23	.776	11.5	.000*	.571	.001*

Moreover, respondents regarded that "conducting meetings or workshops for those involved" (S4) was important, indicating that such group discussions were likely to be most effective for generating lessons learned. They also felt "conducting reviews at all stages of the project life cycle" (S3) was important, suggesting that many lessons could be generated if the project life cycle is taken into account, as it is especially useful for reducing uncertainty (Atkinson et al., 2006). This may be crucial for projects with long durations or multiple stages. If PPRs are only conducted at the end of the project, it might be difficult to discuss or remember key events that occurred earlier in the project life cycle. Respondents also felt that "having an easily accessible database for lessons learnt" (S8) was important, so that lessons could be effectively learned. This shows that the dissemination of PPRs is equally as important as the style of conducting them. Finally, all

respondents felt strongly about "having strong teamwork between various parties of the project" (S9). The successful conducting of PPRs relies greatly on having parties willing to share experiences and knowledge to achieve organizational learning beyond individual projects.

5. MAPPING OF DRIVERS OF PPRS TO INSTITUTIONAL THEORY

Following the survey and interview findings, the drivers that were identified were mapped to Scott's (2008) three pillars. The classification of drivers into institutional factors provides a structure for an institutional framework to be developed.

5.1 Regulative pillar

The use of PPRs seems to be influenced, to a certain extent, by formalized systems. The survey results identified the importance of formal procedures, which was validated by interview responses as being significant for ensuring reviews are performed. Formalized systems act as regulatory processes defining the rules, and are strongly linked to other important characteristics, such as the use of meetings and (S4) the conduct of reviews throughout the project life cycle (S3) (see Table 5). Formalized systems also provide for enforcement, which provides legitimacy to institutional process, as seen in the interview responses. Companies use formal systems as drivers for effective PPRs, and this is strongly linked to other regulatory processes, like ISO requirements. Project managers conform to these requirements, as there is an authoritative implication involved.

The survey and interview findings also show that a lack of formal requirements for PPRs leads to a poorly defined institution, where project managers are unlikely to conduct PPRs and regulatory impetus is absent. Project managers who did not conduct PPRs cited a lack of contractual or government requirements as a key factor, indicating a lack of coercive strength. The structure of formalized procedures for PPRs plays a significant contributing role to the regulatory pillar of institutionalizing PPRs. The strength of this pillar is closely linked to the extent of formalization and the level of coercive power exerted on project managers. Correspondingly, the size of the company may be a good determinant of the extent of formalization, as well as the hierarchical influence providing the coercive power that drives the regulative pillar.

5.2 Normative pillar

The organizational norm of these firms is largely defined by company policies, which many survey and interview findings link strongly to management support. This drives processes that are the goals and objectives, priorities and expectations of the project managers, with emphasis in this case on PPRs. The findings clearly show that management support is a strong driver, and this is central to the collective value system within a company. Management encouragement, which was found to be a strong driver, gives values and belief to the effectiveness of PPRs, as verified by the interview findings. A company policy that encourages PPRs will determine directly whether lessons learnt are generated through the normative pillar (formally or informally).

The guidance of PPRs through the normative pillar also encompasses the extent of training of project managers, by the company and through other associations or educational institutions. The survey results found that the training and education of respondents in conducting PPRs was a small but significant influence. Training inculcates a shared value system among project managers, which may also be reinforced and spread through word-

of-mouth or discussions. A company culture of sharing lessons learnt strengthens the collective belief in PPRs, providing a form of accreditation to the collection of lessons learnt. This may propagate itself when project managers progress higher into management, but conversely, a lack of use of PPRs may proliferate to a culture of disillusionment with the effectiveness of PPRs, until such reviews are presumed to be needless. The normative pillar is heavily concentrated on actors with strong legitimacy in the company - those with seniority, recognition, and qualification, like upper management. These actors, interacting with prevailing social values, play a significant part in the institutionalization of PPRs. As such, the role of management is crucial in forming and sustaining the prescriptive aspects of such practices.

5.3 Cultural-cognitive pillar

The cultural-cognitive pillar involves the importance of meaning in a cognitive and cultural manner. The creation of meaning is strongly observed through the expression of personal beliefs and the need for PPRs as felt by the survey and interview respondents. The internalized interpretations of PPRs as being highly useful and effective for the personal development and work of project managers shows the extent of cognitive influence on the institutionalization process. The findings seem to support a strongly defined method of work that is a representation of the environment by the actors. This is essentially the "cognitive-cultural" pillar of Scott (2008), who recognizes that the formation of objectives is shared on a cognitive level by actors. PPRs effectively become a logical outcome for the needs of project managers for knowledge retention and personal learning. This is further expressed by the survey and interview respondents' appraisal of the importance of meetings, dissemination, and teamwork, which are strategic elements that elevate the effectiveness of PPRs. The use of meetings, databases, and strong teamwork reflects a rational structure seeking to create value and provide a culture of learning. This cultural-cognitive state may seem mimetic in nature, but the underlying beliefs and factors showcase a deeper process of institutionalization at work.

The cultural aspect may be present in the notion of company size and the establishment of other systems, such as quality systems, suggested by the interview respondents. The extent of influence in the cultural-cognitive pillar is bounded by the cultural frameworks associated with the company size and the presence of these other systems. The use of better dissemination methods, like database systems and more formalized procedures, is internally recognized by the individual project managers, but these may still be perceived as not accepted by the larger actors in terms of the organization - perhaps until they grow larger and more established. The challenge is therefore the sense-making of individuals and the organization as key players in the organizational field in reaching a consensus of sorts to establish orthodoxy within the cultural-cognitive pillar.

5.4 Summary of institutional factors

Figure 1 summarizes the way the three pillars of Scott (2008) are supported in the area of PPRs in the construction industry. The institutionalization of PPRs is influenced by each of these pillars, with varying mechanisms for each. In analysing this, both the individual and the organization are taken into account, as both interact closely to produce the pressures for PPR adoption. It is suggested that special attention be paid to the formalization of PPRs, as well as to the extent of management support, which may greatly affect the adoption of PPRs and organizational learning on the whole.

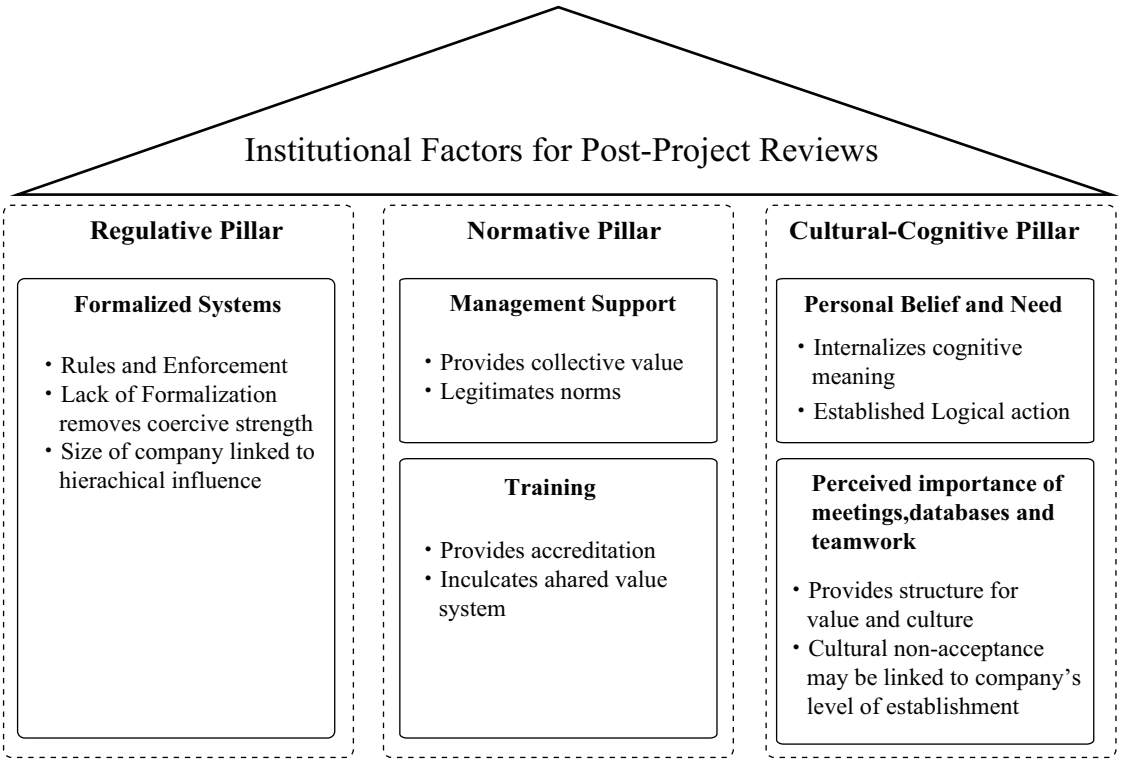

Figure 1. Summary of institutional factors for PPRs

6. CASE STUDY

6.1 Background

A case study was also conducted with a developer in Singapore, selected for its strong implementation of PPRs. Company X is a local and international developer headquartered in Singapore, involved in multiple residential and commercial properties around Singapore, with emphasis on premier-grade properties. Company X employs over 4000 employees in multiple countries, with a net profit of over SGD 1 billion in 2011. The case study includes interviews with the Head of the Department in charge of PPRs, discussions and meetings with several employees, and historical and reference data that reflect the company's implementation of PPRs.

6.2 Previous implementation of lessons learnt

Company X did not previously have any structured methods for PPRs, until there was a restructuring of departments that tasked a support department to look into the implementation of more formal procedures of all project management activities, including PPRs. Several issues with previous implementations were addressed during the restructuring process:

- The previous method of collecting lessons learnt was not structured but ad-hoc. It managed to capture some lessons learnt, but they were largely skewed towards the end of the project.

- Lessons learnt were lost when staff left halfway through projects. This sparked a realization that there were many lessons that were not being captured, as the staffs who took over were not aware of the problems and issues faced.
- The most formal measure was a yearly conference, and it served more as a highlight reel for certain innovative practices rather than as a comprehensive review of problems, challenges, and solutions.

6.3 New implementation of formalized procedures for PPRs

Company X began formulating a set of formalized procedures in 2011 for the conduct of PPRs, to govern the project manager's use of such reviews. This new set of formalized procedures was developed based on the experiences of project managers and management, with emphasis placed on ensuring the readability and easy understanding of the lessons learnt and on the comprehensiveness of the guidelines. Additionally, the standard operating procedures (SOP) for the PPRs were generated with five principles (see Table 6).

Table 6: Examples of procedures for PPR associated with 5 principles under SOP

Principles	Examples
1. Recording good ideas and practices, as well as issues and problems.	• A register or log is used throughout the project to record lessons learnt and other discussions that would be relevant for future projects. • This log includes templates, structured to cover the entire project life cycle, which help the project manager record issues in a systematic and useful manner.
2. Identifying and determining the root cause of problems.	• The project review meetings are focused on identifying the root cause of problems early when the information is fresh in the participants' memory. • All the contributing and mitigating factors are adequately recorded in the log to provide a holistic representation of the issues.
3. Focusing on information that will help future projects, rather than mere explanatory reports.	• An interim PPR report is mandated to be generated once the project is completed. • This report provides a holistic view of the key issues that were present in the project and allows the reader to gain an understandin of the entire project delivery process, as well as lessons learnt, so that the context and knowledge can be effectively recorded within the report.
4. Enforcement of teamwork, honesty, and openness.	• Open and effective dialogue during the PPR. • Encourage the use of photographs and verbal explanations for better communication.
5. The importance of utilizing lessons learnt for future projects.	• The final report is a complete collection of key lessons learnt throughout the project, structured by individual stages and categories. • This report is later published on the database system, to be easily shared with all staff.

6.4 Execution of PPRs

Based on the observation of a PPR session and the minutes of meetings, Company X's execution of PPRs was seen to be comprehensive and organized. Participants include the project team, architects, and consultants. The issues raised are to be discussed in details and recorded, to understand the underlying causes of the problems. The use of photographs and verbal explanations by various parties helps communicate the nuances of each situation to every participant, and open and effective dialogue was observed throughout the session. Emphasis is given to the solution that was agreed upon. For each issue raised, two or more solutions were often provided: one as a solution should the problem resurface, and the other to prevent such problems from recurring in future. Reports were neutral and did not single out any party as the cause of any issue. The use of the word "we" to describe many actions resulted in the issues showcasing strong teamwork between the participants of the PPR.

6.5 Storage and dissemination of lessons learnt

The formalized procedures also included instructions on the storage of the lessons learnt in Company X's database system, which is available to all staff. In the system, projects are categorized into types, and both lessons learnt and PPR reports can be easily accessed. All the background information on the project is stored together with lessons learnt, and the final report is compiled to provide an easy reading experience. Due to the standard format used by all projects, lessons learnt can be easily filtered and quickly browsed through, or referred to in details to more deeply understand the root causes and the circumstances behind key issues. In addition to the database system, PPR reports are also reviewed in a final meeting with management and other relevant project managers, so that the organization as a whole can appreciate the key lessons learnt in the project and ask questions to clarify further issues. This provides a more personal experience of the lessons learnt to all project managers, and also promotes a culture of learning and openness.

6.6 Objectives, compliance, and management support

Three key objectives, essential to the success of PPRs, were set in designing the formal procedures:

- Ensuring lessons learnt are picked up at all stages. For example, most previous lessons learnt occurred during construction, but the department is encouraged to look beyond construction, to include preconstruction, where there were some lessons that could be shared and some issues were encountered.
- Obtaining information while it is still fresh. As the departmental head put it, "if you wait 3 years and ask the person what were the lessons learnt during the design phase, the majority will say I can't remember, I have to go back and look at the records".
- Ensuring all relevant parties, especially project managers, are involved, contribute, and learn.

These three objectives were achieved mainly through the emphasis of conducting lessons learnt at all stages. Central to this was the formalization of procedures to ensure compliance with these interval reviews for achieving the objectives. The departmental head also explained that project managers are bound to have time constraints, but the conduct of PPRs at each stage would not be compromised:

"If we found that, it is a requirement and it is not being done, then it will actually be in the report, and the report will actually be circulated back to the project manager, and their

supervisors and the copy even go all the way to the senior management. So then, they will be given a certain time to rectify. So if they miss out the PPRs of one or two stages, they will be asked to make sure they do it before the next stage ends."

It is clear that Company X has significant management support for achieving this level of compliance for PPRs. In fact, Company X's management has consistently emphasized organizational learning through PPRs, showing that management support is important in achieving successful capture and learning of project knowledge. These three key objectives drove the whole department to develop the formalized procedures that have proven to be successful in ensuring effective PPRs are conducted and disseminated throughout the company.

7. CONCLUSION

This study identified the use and implementation of PPRs combined with the factors that influence them through a survey questionnaire. The results found that PPRs were generally effective, and had significant formal characteristics. The use of PPRs hinged mainly on "upper management support", but was also highly related to "personal belief", and identified the need for such reviews, training, and contractual and legal requirements. The survey also addressed several issues, such as a lack of effective dissemination to people outside of the projects, a need for better dissemination, execution, and guidelines, a lack of correlation between importance and implementation for having formal procedures, and having easily accessible databases. The case study showed an example of strong implementation of PPRs in a firm from the construction industry. Central to this was the use of formalized procedures by the company to achieve a structured layout and clear guidelines for project managers, so as to ensure compliance and effective results. The procedures focused on recording lessons, conduct of meetings, the timeframe of reviews, and the storage and dissemination of lessons learnt. In addition, strong management support and an effective database for lessons learnt were also observed in the case company's implementation of PPRs. The case study shows the value of PPRs when executed successfully in achieving organizational learning, and provides a good foundation for which a framework of PPR implementation can be adopted.

In terms of its contribution to knowledge of PPRs, this study provides insights into the factors and the deeper facets of a successful PPR. Based on the three pillars of Scott (2008) and other key findings from the study, a brief framework (see Figure 1) is proposed that encompasses what should be implemented if companies are to achieve successful PPRs. The successful implementation of PPRs is proposed to be influenced by drivers in the form of institutional factors. Scott's (2008) three pillars determine five areas that have traditionally been thought of as institutional factors: formal procedures, management support, training, personal belief and need, and company culture. These five areas have been corroborated through the survey, interview, and case study findings as being significant areas that must be present for PPRs to exist in a functional form. In closing, it is worth noting that the findings of this study are largely based on the temporary and fast-paced nature of projects in the construction industry. Hence, the results of the study are generally limited to such projects managed by project managers. However, it is plausible that the proposed framework may be applicable to other project practitioners. Moreover, the sample for the survey questionnaire had limited participation of contractor firms, while the interviews were largely from consultant firms. Likewise, the case study involved a developer firm, and this may limit the validity of the results to non-contractor firms. Contractor firms may have a slightly different focus and a separate set of factors for the conduct of PPRs, and thus the results of this study should be interpreted as taking into

account the smaller participation of contractor firms. The generalizability of the findings could be increased by future studies on larger samples of participants from diverse industry sectors and cultural backgrounds. Another area that may be worth looking into is the use of information and communication technologies (ICT) as key enablers of organizational learning (Carrillo et al., 2004; Kotnour, 1999; Newell, 2004). Since Building Information Modelling (BIM) technology has been largely promoted in Singapore's construction industry, the use of BIM for PPRs should be explored to see if it influences any of the factors proposed in a positive or negative way, and to examine the extent to which BIM can be adopted by firms in the construction industry to achieve organizational learning.

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ARTICLE

Causal Factors and Impacts of Schedule Revisions: A Case Study of the Penang Second Bridge Project (Sultan Abdul Halim Muadzam Shah Bridge)

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ABSTRACT

The Penang Second Bridge is the longest bridge in Malaysia and Southeast Asia, and was completed in March 2014. There were two major schedule re-adjustments throughout the project duration: (1)revision of commencement date, and (2)changing of the bridge's opening day. The published factors of schedule revisions were design matters, land acquisition and increased costs of building materials. There could ostensibly be more factors causing such revisions, which have not been divulged, which prompted the interest to conduct an academic investigation. This study also includes the investigation on the effects subsequent to the project schedule revisions. Qualitative research method using in-depth interviews was conducted to collect the data, and respondents approached had been involved in the planning, design and construction stages of the project. The results showed that contractor-related factors have the highest impact on the project schedule, followed by client related factors and external factors, and also revealed additional factors like changes to the concessionaire and ramp collapse incident, further contributed to project delays. The impacts of schedule revisions included acceleration, cost increases and negative reputation from the public. To prevent issues of delays in the construction industry, actions and solutions should be implemented by practitioners by taking into account the different nature, culture and regulations of each project.

Keywords: *Penang Second Bridge project, factors, effects, schedule revision, delay, construction industry, infrastructure*

1. INTRODUCTION

Infrastructure construction is one of the vital categories which contributes to the well-functioning of economic activities. A key driver of economic productivity and social well-being depends on the modern and efficient infrastructure (Russell, 2013). Transport infrastructure such as roads, highways and bridges can be one of the services and facilities to attract foreign investors in their investment decisions. Poor infrastructure obstructs the growth of nation's economic and international competitiveness (Dr. Jeffrey Delmon, The World Bank 2006). Besides, insufficient infrastructure also reflects the reduction in comfort and quality of life, health and death of the people in a country (Willoughby, 2002). It therefore becomes an essential component in the economy which can boost the development of a country.

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Penang is one of the highly industrialised and urbanised states in north peninsular Malaysia. It is not only one of the economically most well-developed state of the country, but also a thriving tourist destination. The perception towards Penang still remains as an attractive location for investments and tourism (Nathaniel, 2014). However, the rapid development and traffic congestion are concerned issues to the state (Himanshu and Looi, 2015). In the International Conference in Civil Engineering and Geohazard Information Zonation 2012, Dato' Prof. Ir. Dr. Ismail bin Mohamed Taib, the Managing Director of Jambatan Kedua Sdn Bhd mentioned that traffic demand on the existing widened Penang Bridge has been increasing yearly, and the traffic projection without the second crossing is expected to reach 163,400 vehicles per day in year 2020. This projected that the first Penang Bridge and ferry services are inadequate to satisfy the demand on infrastructure connecting Penang Island to the mainland in the near future. Consequently, the Penang Second Bridge, a transport infrastructure which was completed last year will be an essential element in the future development of Penang.

The Penang Second Bridge project faced several problems that necessitate revision in project schedule. According to the fifth Prime Minister, Tun Abdulah Ahmad Badawi (2008), the project was delayed by nine months owing to the land acquisition, design problems and rising cost of construction materials. The original plan to complete the construction of the bridge and to be opened to public in 2013 was deferred until 2014. Another crucial issue was the collapsed of one of the ramps at the Batu Maung interchange during the construction stage. Therefore, the focal point of this paper is to meet the following objectives:

- To study causal factors of revising the schedule of the Penang Second Bridge project.
- To investigate the impacts arising from revising the schedule of the Penang Second Bridge project.

Since the performance of transport infrastructure is inter-related to the national economy, the most basic goal of practitioners in the construction industry is to achieve the timely completion of projects within the estimated budgets. The apprehension in terms of quality of transport infrastructure construction should be addressed among players in the construction industry. The findings of this study will reflect the current major problems faced by practitioners in Malaysia's construction industry, and will be useful reference for industry players in comprehending the factors causing time overrun in a project, especially Malaysian bridge construction projects. Moreover, it is expected to draw attention to the construction community on the impacts of time overrun to the construction project so that they can put efforts to minimize and mitigate problems of delay for future infrastructure projects.

2. LITERATURE REVIEW

2.1 Factors Causing Time Overrun In Construction Industry

2.1.1 Owner-related Factors

Owner-related factors in time overrun problems are events which the client is responsible for. Changes in orders or designs, late approvals of design documents and shop drawings, client's financial difficulties and delays in payments to contractors are some of the most common owner attributed causes extracted and entified from several sources (Ahmed et al, 2003; Sambasivan and Soon, 2006; Alaghbari et al, 2007; Hamzah et al, 2011).

In the construction industry, variation is a change in design aspects and specification, construction work, project schedule or other aspects caused by modifications to pre-

planned conditions, requirements or assumptions (Sun and Meng, 2009). These delay factors are quite common in other countries either in developed or developing countries like Saudi Arabia, Jordan, Kuwait, United Kingdom (UK), United States (US) and others. Sweis (2007) stated that numerous changes in designs and orders are viewed as one of the most critical delay causes from the perspective of consultants and contractor.

In order to allow the contractor to carry out works related to changes in designs, a formal approval has to be delivered to the contractor by the client or through client's representatives, architect or engineer. However, the client or his representatives were always late in approving design documents and shop drawings (Ejaz, 2010; Chan and Kumaraswamy, 1996; Alaghbari et al, 2007). Based on the observations, Chan and Kumaraswamy (1996) found that the majority of contractors blamed client's slowness in authorizing the design documents and shop drawings. Ejaz (2010) defined this factor as the fourth ranked cause of project delays.

Owners may face financial problems or difficulties during the construction stage due to excessive alterations in a project. In Malaysia's construction industry, financial problems is defined as the main factor from the client's internal side (Alaghbari, 2007; Sambasivan and Soon, 2006). Besides, the reason may also be due to other factors like unpredictable site conditions and sudden increases in material costs. This will vary the original budget to a higher cost, and clients without contingency plans will inevitably cause the project to be delayed for a certain period, or may totally abandon it, in future. Financial difficulties of clients trigger other factors which will influence the whole construction process. The most obvious inter-related factor is the delay in payments to contractors.

The essential of payment is magnified because construction industry usually involves long periods, huge amounts of money and the commonly used credit payment terms in purchasing of materials to complete the project (Ameer, 2005). Delays in payments will invariably lead to critical cash flow problems for contractors. According to Frimpong et al (2002) from a Ghana case study, monthly payment difficulties from agencies of government or client were the most important delay factor from the point of view of contractor and consultant. Among the five most vital factors of delays in Uganda's public sector projects, delay in payments was one of them (Henry et al, 2013).

2.1.2 Contractor-related Factors

Poor contractor site management and supervision are some of the delay elements due to the shortage of competent construction managers in the industry. Hemanta et al (2011) forwarded the reason of lack of management skills among the site managers, who were most probably with high education and working experience; but lacked formal training. Furthermore, local contractors have little experience in management because they are seldom involved in large and complex projects, which are virtually limited to large contracting firms or international contractors (Odeh and Battaineh, 2001). Another management failure among the contractors was due to poor coordination of subcontractors (Bramble and Callaham, 1987).

A research about Malaysian construction projects by Alaghbari et al (2007) supported the findings in the Ghana case study, which not only showed the high ranking of poor contractor administration as the vital factor in time overrun problems, but also pointed out that this is a major issue in developing countries (Frimpong et al, 2002). The chairman of the Public Accounts Committee (PAC) supported the statement of weak management which was a "systemic" problem in government public projects such as the National Feedlot

Centre (NFC) (The Malaysian Insider, 2011). However, this factor was not ranked in the top five factors of time overrun in developed countries (Vidalis and Najafi, 2002), highlighting the difference between developed and developing countries.

The study of Sambasivan and Soon (2006) was agreed by Sweis (2007), where most clients and consultants blamed that contractor's inadequate planning and scheduling caused the time overrun. Bertin (2011) stated that one of the vital factors of time overrun in Cameroon was lack of project planning or programming. One of the reasons was local contractors were unwilling to apply scheduling techniques to update schedules on a regular basis (Doreen, 2006).

Financial problems which caused delays in a project not only emanated from the client, but also from the contractor (Alaghbari et al, 2007). Within the contractor's range of problems, financial difficulty still ranked as the highest in regards to problem of delay (Sweis, 2007; Akintoye 2014). All three groups, namely consultants, contractors and clients agreed that financial crisis was among the most critical delay factors in the residential construction sector in Jordan. Financial burden results in contractors to be incapable of hiring skilled workers; thus they may hire unskilled workers which are cheaper to carry out the works (Sweis, 2007). This phenomenon will lead to poor workmanship in the construction works. As a result, the project may be delayed when the contractor has to take extra corrective action to recover the construction defects arising from poor workmanship.

Lack of labour supply was positioned as the third most vital factor in time overrun for residential projects in Jordan (Sweis, 2007). It is hard to prevent the problem of worker shortages during the construction process because labourers tended to quit and join other companies during the construction stage of a project (Sambasivan and Soon, 2006). This situation caused the disruption of work which will further the delay of the project.

2.1.3 External Factors

Most contracts share the risk for delays caused by unpredictable conditions or called as "acts of God", which are not under the control of the owner, consultants or contractor. The findings in a study of Indian construction projects revealed similar situation with the Malaysian construction industry where shortages of material was one of the main elements causing time overrun in a project (Hemanta et al, 2011). Mansfield et al (1994) investigated the factors of delay in Nigerian construction projects and the results indicated that shortage of materials was one of the delay factors. From the perpectives of clients, contractors and consultants from Gaza Strip, one of the indicated factors of delays was lack of materials in the market (Adnan et al, 2009). Moreover, delay in material and equipment procurement had delayed the highway projects in Nepal (Manavazhi and Adhikari, 2002).

Unforeseen site conditions are the unexpected, unpredicted or unanticipated conditions occurring on project sites. An earlier study mentioned unforeseen site conditions as the second most critical factor that caused the delay in construction projects in Hong Kong (Chan and Kumaraswamy, 1996). After a few years, Chan and Kumaraswamy (2010) conducted the third phase of investigation on factors of construction delays. They found that unforeseen site conditions still remained as one of the critical delay factors. Researchers from Malaysia had the same opinion with the previous researchers. Unforeseen site conditions like soil obstruction and ground situation will delay the schedules of construction works as planned in early (Alaghbari et al, 2007).

2.2 Effects Of Time Overrun

Time overrun or the revision of project schedule in construction projects has many impacts which affect the performance of the construction industry. Delay problems in construction can precipitate numerous changes in a project like acceleration, lost of productivity and loss of efficiency, construction disputes, and cost overrun. Moreover, time overrun may sometimes contribute to the formation of other delay problems (Arditi and Pattanakitchamroon, 2006).

One of the impacts of time overrun is the acceleration in the construction project. According to dictionary of construction, acceleration means a faster rate of ordered or voluntarily expedited performance of construction work than expected in the original schedule to recover project delay. When works are ordered to accelerate, the contractor may have to hire additional number of workers, work extra time, quicken the schedules of material delivery, use additional equipment and machinery (Bramble and Callahan, 1987). These actions can cause a rise in the construction costs which has to be borne by the contractor.

The acceleration phenomenon may lead to the loss of productivity and rear the problems of inefficiency in a project. According to Michael (2004), there will be an average of 30% loss of efficiency when making changes in a project. It is however possible to perform the changes without loss of efficiency. To clients, delays signifies loss of revenue because there will be lack of production facilities and rent-able space or dependence on current facilities. In contractors' circumstances, delay means increase in overhead costs due to longer working duration or increase in building material costs because of high inflation (Asnaashari and Knight, 2010). If there is delay in a project, the construction inputs will become more expensive throughout the delay period, leading to increased project costs. When delay occurs, contractors will incur extra expenses for job trailers, administration, supervision and utilities charges. Owners may need to extend the rent for the use of present facilities, financing charges, maintenance expenses, additional designer fees and lost income for the facility and increased interest rates (Bramble and Callahan, 1987). Besides, depreciation of projects assets may happen due to long periods of delay, necessitating expenses on replacements, maintenance or repairs.

2.3 Overview Of Penang Second Bridge Project

The objectives of constructing the Penang Second Bridge were to improve the transportation system, support balanced economic development and provide smooth and safe traffic services to users. The types of contract involved were design and build contract and conventional contract. In the Civil Engineering Seminar 2011, the managing director of Jambatan Kedua Sdn. Bhd (JKSB), stressed that a fast track strategy was utilized in major project scopes due to the stringent project time frame. However, some of the packages were still let under conventional contracts so that opportunities were given to the smaller contracting firms to participate in such a prestigious project. Table 1 shows the main contractors and types of contract for each package in Penang Second Bridge project.

The project went through two major revisions of schedules. Initially, the project supposes to commence on January 2008 and complete in 2011; this was revised and postponed until November 2008. This readjustment of project schedule attracted public attention. It was

Table 1: Summary of Contractors and Types of Contract

Packages	Project Description	Contractors	Types of Contract
1	Main navigation span, substructure and foundation works for approach spans	Contractor A	Design and build contract
2	Superstructure works of approach spans	Contractor B	Design and build contract
3A	Batu Maung Interchange	Contractor C	Conventional contract
3B	Batu Kawan expressways	Contractor D	Conventional contract
3C	Batu Kawan trumpet interchange	Contractor E	Conventional contract
3D	Toll plaza and administration building	Contractor F	Conventional contract
3E	Toll collection system	Contractor G	Design and build contract
3F	Traffic control and surveillance system	Contractor H	Design and build contract
3G	Electrical installations	Contractor I	Conventional contract
3H	Landscape works	Contractor J	Conventional contract

claimed that the revision of commencement date was due to land acquisition, design matters and the increasing costs of building materials (The Online Star, 2008). Another revision of date was on the opening day of the bridge. The reason behind rescheduling the opening date is unclear. Table 2 shows the timeline of the bridge project from planning until completion stage.

Table 2: Timeline of Penang Second Bridge Project

Date	Events / Activities
1995	Idea to build second bridge proposed by 4th Prime Minister of Malaysia and 3rd Chief Minister of Penang.
Aug 2006	Federal government unveiled a plan to build the Bridge in the Ninth Malaysia Plan.
Nov 2006	Groundbreaking ceremony by 5th Malaysian Prime Minister.
Jan 2008	Contractor A and Contractor B announced that the project was expected to begin in January 2008 and completed in 2011.
Apr 2008	Government announced the project was to be delayed by 9 months due to land acquisition, design issues and rising costs of building materials.
Nov 2008	Commencement of construction works by Contractor A.
Oct 2012	Media reported the bridge was 84% completed and predicted to be completed approximately two months ahead of deadline of September 2013
Apr 2013	Final closure of the cable stayed bridge at the main navigational span was completed & indicated prior completion of the construction.
June 2013	Collapse of Span 6 Ramp 2 of the Batu Maung interchange which was built by the Contractor C.
Nov 2013	Originally expected for completion and planned to be opened to public at the end of November 2013.
Mar 2014	Officially opened by the Sixth Malaysian Prime Minister.

3. SAMPLING AND DATA COLLECTION

With the aim to investigate the factors and impacts from revising the project schedule in the Penang Second Bridge project, a qualitative research method with the use of in-depth interview was conducted. The purpose of selecting this research method was to obtain first-hand responses from the interviewees, and by utilising in-depth interview technique, accurate and detailed information can be acquired directly. The respondents approached have been involved from the beginning until the completion of the project. The Penang Second Bridge project was divided into 10 packages and each package was constructed by a different contractor. To make the data collection more comprehensive, the respondents were selected from different parties, representing the client, main contractors and consultants. Client refers to the concessionaire, main contractors refer to the involved constructing companies and the consultants, the designers. The respondents were approached via letter, email and phone to make the interview appointment. The interview session was conducted from 25th January 2015 to 11th March 2015. In total, 6 respondents were obtained. Every interview was audio-recorded and transcribed. The data in the transcripts was then interpreted and analysed, and finally concluded via the findings. Table 3 shows the types of respondents involved in this study.

Table 3: Types of Respondents

Respondents	Types of Respondents
Respondent A	Client's representative
Respondent B	Contractor
Respondent C	Client's representative
Respondent D	Consultant
Respondent E	Contractor
Respondent F	Contractor

4. DATA ANALYSIS

Discussion on data analysis is divided into two sections: (1) causal factors of schedule revision, and (2) impacts of schedule revision.

4.1 Causal Factors Of Schedule Revision On Penang Second Bridge Project

Causal factors are discussed under three heading: (1) client-related factors, (2) contractor-related factors, and (3) external factors. Table 4 shows the ranking of client related factors through the calculation of mean from the questionnaires filled by the respondents.

Table 4: Mean Scores for Client-related Factors

Client-related factors	Mean	Rank
Changes in orders or designs	4.33	1
Late in approving design documents and shop drawings	4.33	1
Delays in payments to contractor	3.67	2
Financial problems or difficulties	3.50	3

Changes in orders or designs were the most critical causal factor of schedule revision for the Penang Second Bridge project under client-related factors, and this is consistent with the argument by Sun and Meng (2009) and Sweis (2007). Both client and contractors revealed that changes in structural design had forced the client to revise the completion date because the process involved numerous changes in the project's schedule and the cost of original design is higher.

"When client take over the concession, the bridge design is 16 modules (engineering term). We then changed to 6 modules because the initial concept will cost a lot of money to us".

(Excerpt from interview report of Respondent C)

This factor is supported by another respondent. When the contractor was asked whether they faced any problems of revising the construction schedule, it prompted the following response:

"Yes there were some changes to the original design proposed to minimize the budget of the project. That is revision of construction schedule due to revision of Package 2 design from "16 Span Module" to "6 Span Module".

(Excerpt from interview report of Respondent E)

Four out of six respondents indicated that slow approvals from client had caused the Penang Second Bridge project facing to revise both the commencement date and opening date several times. Respondent B supported the statement made by Chan and Kumaraswany (1996), claiming that client's slowness in approving the design documents and shop drawings affected the project schedule. Poor commitment by the client in approval matters will inevitably put the contractor in a difficult position to get the information on time.

"This situation has caused the late supply of information and drawings to us. We need the drawings to carry out the works. When we don't have drawings, we cannot carry out the works. Sometimes, the issue is not only in giving late information to us, but also the details of drawings were insufficient. Then, we had to make queries, so they take time to response to us".

(Excerpt from interview report of Respondent B)

Although the mean score for client's financial problems and delay in payments to contractors was high, the respondents expressed that they were not in the appropriate position to discuss these issues.

Table 5 shows the mean scores of the contractor-related factors. Contractor's inadequate planning and scheduling were ranked first, while poor site management and supervision of contractor ranked second, shortage of manpower ranked third and the last is contractor cash flow problems. This phenomenon revealed clear similarities between the result and previous studies which was mentioned in the literature review (Alaghbari et al, 2007; Frimpong et al, 2002; Sambasivan and Soon, 2006; Sweis, 2007; Bertin, 2011).

Table 5: Mean Scores for Contractor-related Factors

Contractor-related factors	Mean	Rank
Inadequate planning and scheduling	4.50	1
Poor site management and supervision	4.33	2
Shortages of manpower supply	4.17	3
Contractor cash flow problems	3.83	4

For contractor related factors, the critical problem was raised from package 3D. According to the Respondent C, the agreement between the contractor for package 3D had a lot of obstacles. There was termination of contract with the first selected contractor due to their financial problems which caused the particular contractor to delay the works for a period of time. The client's representative explained that the contractor was only able to complete the

piling works during the agreement duration. However, another issue arose when the another contractor was engaged to carry out the works of package 3D. The new contractor had poor management and supervision in this bridge project despite the fact that they had showed their excellent background and previous record during the tendering process. The client's representative stressed that the biggest problem of this particular contractor was due to their failure to manage their own subcontractors, and thus caused the construction works of package 3D to be delayed. In addition, the client's representative also reported that the contractor was facing a minor financial problem during that time.

"We awarded package 3D to the first contractor, but the contract had to be terminated because the contractor faced some financial problems along the period of agreement. Then, we engaged another contractor whose background and history record were very good. But, when the project started, they failed to manage their subcontractor. They also said they have some financial problems".

(Excerpt from interview report of Respondent C)

Respondent F supported the statement made by the above respondent and mentioned that the delay in opening of the bridge for the public was due to poor performance of the respective package contractor during the construction stage. The poor performance of the contractor was related to poor management and inadequate planning.

"There was delay in award of contract and construction of the toll plaza and the administration building which was under package 3D. The previous contractor of package 3D was terminated because of poor performance".

(Excerpt from interview report of Respondent F)

Table 6 shows the mean scores of the external factors.

Table 6: Mean Scores for External Factors

External factors	Mean	Rank
Shortages of materials, equipment and tools	3.67	1
Unforeseen site conditions	3.50	2
Third party: approval of documents, land acquisition	3.33	3

From the data extracted from interviews, it was found that shortage of materials were one of the problems that affected the schedule of the Penang Second Bridge project. All of the practitioners involved in the project agreed that this issue is not under the control of any party (See, for example, James, 2000). Although the client's representative disagreed shortages of materials were one of the factors because they had considered this issue during the planning stage, but Respondent B informed that the project was having difficulties in resource supply by the government at that time.

"At that time, the government not only has Penang Second Bridge which is a mega project, but also other big projects like the double track in Northern Region. Although the double track project is supposed to complete before the bridge construction started, they failed to do so. Moreover, Penang government also took the opportunity to develop their land in Batu Kawan at that time. This situation caused the shortage of material, and the biggest shortage was the material for land fill".

(Excerpt from interview report of Respondent B)

Although the unforeseen site conditions were ranked second among the external factors, the respondents were not opened to explaining it. However, the interesting part in this research was the additional factors that were given by the respondents. From the overall interviews, client's representatives, contractors and consultants revealed that the revision of commencement date in the Penang Second Bridge project was mainly because of the change in ownership of the concession company. This statement is supported by the following excerpts when the respondents were being interviewed about the reason of rescheduling the commencement date from January 2008 to 8th November 2008.

"So, basically the main reason is actually the formation of the concession company. The project owner is not really clear".

(Excerpt from interview report of Respondent D)

"Starting from July 2008, the concession of 2nd Penang Bridge has been taken over by Government of Malaysia and formed a special purpose Concession Company named, Jambatan Kedua Sdn Bhd (JKSB) to manage and deliver the project. The government decided to take over the concession and manage by Khazanah".

(Excerpt from interview report of Respondent C)

The client's representative mentioned that the changing of the concessionaire lead to the problem of land acquisition from the land owners because there was no authority in charge to go through the land acquisition issues at that time. When JKSB took over the position of the concessionaire, they need a period of time to solve the problems and go through the procedure with different land owners, and the most difficult to handle was the individual-owned land due to disagreements on the reparation fee.

One of the remarkable, if somewhat unfortunate, events in the Penang Second Bridge project was the collapse of Span 6 Ramp 2 of the Batu Maung interchange. All respondents agreed that the incident caused the project to be delayed. The main reason was the project received an order to stop work, sent from the safety authority for investigation purposes. The related authority took more than one month to carry out all the investigation works to find out the actual reason of the incident. Consequently, the original scheduled opening day on November 2013 was delayed.

"DOSH (Department of Occupational Safety and Health) gave a stop work order, so that has delayed the work. They stop everything to let the authority do the investigation".

(Excerpt from interview report of Respondent C)

Respondent F revealed that the completion of package 3A were delayed by two months because of the collapse incident. The contractor had to rebuilt the collapsed ramp with an accelerated programme by increasing the resources to ensure minimal delay which can influence the progress of the whole project.

"The collapse of ramp had delayed the work of package 3A by two months and the contractor rebuilt the ramp with an accelerated programme so that the delay was minimal".

(Excerpt from interview report of Respondent F)

4.2 Effects Arisen From Revising The Schedule Of Penang Second Bridge Project

Delay in schedule will lead to acceleration in a construction project as stated by Bramble and Callahan (1987). All the respondents agreed that the revision in the schedule of the Penang Second Bridge project had brought up the impact of acceleration. Two respondents revealed that the numerous schedule revisions had caused the client to lose some potential

profit. Respondent D further added that the project cost was increased due to the additional overhead required to recover project delay. Respondent D agreed with the cost which has to borne by the contractor was the overhead expenses like job trailers, administration, supervision and utility charges before the official commencement. Respondent F supported the statement of Respondent D and added that the impact was not only faced by the contractor, but also the consultants, who needed to increase supervision costs to ensure compliance with the revised schedule. The feedbacks were stated below when the respondent was being asked about the effects of revising the schedule.

"I think the impact to the contractor was the overhead expenses before the official commencement. This is because we already agreed to pay fixed lump sum, but the official awarding was delayed and the completion date remains the same. So, the delay is actually extra cost to the contractor in terms of overhead expenses".

(Excerpt from interview report of Respondent D)

"Because of the revision of dates, the consultants supervision costs increased".

(Excerpt from interview report of Respondent F)

The project cost was increased as the result of revising the schedule of Penang Second Bridge. This situation resonated with the comments of Asnaashari and Knight (2010). The client's representative indicated that time and cost were inter-related. When the project schedule has to be revised, the cost of project will increase as well, and the reasons mostly point toward the overhead expenses involved to continue the construction works.

Another impact of revising the schedule of Penang Second Bridge project was the negative reputation it garnered from the public. Respondent B explained that society does not understand the whole process and procedure of this project, and blamed the contractors' without any evidence and understanding on the actual causes. The scenario is obvious when the collapse at Batu Maung has caught the attention of the public and social media. Some contractors mentioned that their reputation was affected due to the collapse incident, although their packages were not related to the collapse package.

5. FINDINGS AND CONCLUSION

Construction of the Penang Second Bridge project is a significant event to the development of Malaysia. With its importance in the development of country, it is hoped that the contribution of this research is significant. The purpose of investigating the factors and effects from revising the project schedule is to provide reference and guidance to the practitioners in the construction industry when planning and constructing similar types of projects. From the overall analysis, contractor-related factors were the most critical factors to cause the project schedule to be revised repeatedly. Among contractor-related factors, the contractor's inadequate planning and scheduling with the highest mean score of 4.50 ranked as the key factor in this project. In terms of client-related factors, changes in orders and designs were the major problem in this bridge project. The mean score of this factor is similar as the contractor's poor site management and shortages of manpower supply, which are 4.33. For external factors, shortages of materials were one of the risky factors to the bridge project. Without sufficient materials, the project will inevitably be delayed. Interestingly as well, additional factors were obtained through the interviews. The extra and serious issues regarding the formation of the concessionaire and related ownership matters, as well as the collapse incident which lead to other problems, were openly divulged and discussed as well. This study can serve as a keen reminder to all parties to be alert and aware of the possible consequences that can arise in a construction project.

To conclude, more efforts are required to find out about other critical factors that can cause a construction project to be rescheduled. Several recommendations are discussed below with the aims to increase the awareness on project delay issues as well as the quality of a construction product:

i) The practitioners in construction industry have to be aware with the highlighted issues and avoid the problems to be repeated again in future construction projects.

ii) Although every construction project may have different nature, culture and regulation, gross project rescheduling invariably lead to the same effects. Every party in the construction industry must be conscientious and take full responsibility and complete ownership to prevent problems associated with delays.

iii) All practitioners in the construction industry should investigate and implement the appropriate solutions to solve common delay problems in the industry.

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ARTICLE

A Preliminary Study on the BIM Competencies Required to the Quantity Surveying Education Programme

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ABSTRACT

BIM has been in the limelight in the recent years, which caused a demand in BIM software and tools due to the construction industry's adoption of BIM practice. However, the supply of BIM-ready graduates may not be able to meet the demand of the industry at this point of time. Majority of the Higher Education Institutes (HEIs) have yet to include BIM into their course programmes, this research aims to identify BIM content to be included to the Quantity Surveying (QS) course curriculum in order to produce BIM-ready graduates. The main objective of this paper is to bridge the gap of the supply and demand of BIM-ready graduates. Survey questionnaires were obtained from various members of the construction industry. The difference in the respondent's Self-Perceived Maturity Level and their actual maturity level is compared, the deficiency of BIM competencies is then identified. Hence recommendations on implementation of BIM competencies into the QS curriculum will be provided.

Keywords: *Building Information Modelling, Quantity Surveying Course Curriculum, Quantity Surveyors.*

1. INTRODUCTION

Quantity Surveyors are often involved in a range of activities such as advising client of the feasibility of the development, preparing cost appraisals to set a budget for the construction project, estimating the rates for a particular work to be carried out, advising the client on the procurement methods to be implemented, producing Bills of Quantities, conducting the tendering process on behalf of the client, administer contractor's claims and preparing final account.

As stated by Cartlidge (2011), the RICS report in 1971 depicted that the Quantity Surveyor was primarily a producer of Bills of Quantities; in 2003, the RICS Quantity Surveying and Construction Professional Group reported that measurement still had an important part to play in the procurement of buildings. Rundell (2006) stated that quantification requires 50% to 80% of a Quantity Surveyor's time on a project. Similarly RICS Research (2011) found that one of the top three highest workloads in the industry is quantification and costing of construction works. The recent National BIM Report (2013) reported that 55% of users found that BIM brought cost efficiencies, 50% agreed that it increases the speed of delivery, and 46% agreed that it increased profitability. With the proven benefits of BIM it is inevitable that QS will work its way towards the BIM direction.

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Sacks and Barak (2010) stated BIM-skilled personnel will be in a high demand and the lack of adequately trained personnel is hindering the use and adoption of BIM in the industry. Evidently, the BIM Academic Forum (BAF) (2013) commented that the HEI in UK are already experiencing the demands from the industry for BIM-ready graduates. It is the role of the HEI to introduce a person with these skills, to fill up the needs of the construction industry (Kymmell, 2008). It is essential for HEIs to keep undergraduates on par or ahead of the demand with the industry trend, however most of the times it is of the opposite pattern whereby the industry acts as a catalyst to the academic sector.

By acknowledging that BIM is the current 'market trend', HEI has to act as a vehicle to produce BIM-ready graduates in the construction industry. The aim of this research is to bridge the gap of the supply and demand of BIM-ready graduates. The objectives of this research are:

(1) To identify the type of competencies to be included into the BIM curriculum learning framework.

(2) To find out the gap between the respondents Self-Perceived Maturity Level of BIM understanding and the actual maturity level.

2. INTRODUCING BIM IN THE ACADEMIC SECTOR

The lack of exposure to the essential BIM workflow and managerial aspects of delivering BIM projects is a major drawback of the existing HEI's BIM curriculum and undermines students' learning outcomes (Wu and Issa 2013). The current QS course structure is developed more towards the traditional way of Quantity Surveying works. Take the measurement subject for instance, perhaps it may be sufficient enough to equip undergraduates with knowledge of taking-off from CAD measure or its equivalent software; and to produce Bill of Quantities. Cartlidge (2002) stated that the advancement of technology cannot be ignored or repulsed, and it is inevitable that some traditional skills will become redundant in the process.

Back when Sustainable Development (SD) just started to be popular, McKeown and Hopkins (2004) suggested that to include SD in the university's programme, one should increase the awareness and link it to the existing issues and to have an idea on how to structure and place SD into the course curriculum. Likewise, for BIM to be included in an undergraduate programme, these steps should be considered to be implemented. Therefore, one must find ways to increase the awareness of both the educational community and the practitioners on what BIM is and what can it achieve, in order to show them that reorienting education towards BIM is essential.

Apart from QS fundamental technical knowledge, it is important for QS students to acquire soft skills to help them carry out their work in a competent manner (Said, I., Shafiei, M. and Omran, A., 2010). The competencies to be taught to the students should consist of several groups of skills in order to produce a well-rounded BIM-ready graduate.

What is competence?

There are several schools of thoughts on the definition of competence. Boyatzis (1982) are more interested in the 'individual' aspect of competence, in which it refers to the set of skills that an individual must possess in order to be capable of satisfactorily performing a specified job. Hamel and Prahalad (1990) referred competence to an integrated set of core technologies and core skills that provide an organisation with its competitive advantage. The competence is more organisationally driven rather than individually focused. Holmes

and Joyce (1993) defined competence as action, behaviour or outcome which a person should be able to demonstrate, or the ability to transfer skills and knowledge to new situations within an occupational area. Roggema-van Heusden (2004) defined competence as the ability to perform well in a professional situation that involves the accomplishment of a certain task or the dealing with a problem, in a manner that can be observed and be judged by others. According to Caupin et.al (2006), a competence is a collection of knowledge, personal attitudes, skills and relevant experience needed to be successful in a certain function. A similarity can be drawn from these definitions, whereby the competence consists of a set of skills that mainly covers both practical skills and soft skills.

Building Academic Forum (BAF) (2013) published in the initial BIM learning outcomes framework that the framework covers three types of need: strategic, management and technical. Kymmell (2008) categorised the skills sets required for creating and managing BIM into tool-related, process-related and role-related skills. While Caupin et. al (2006) has a different range of competencies grouping: contextual, behavioural and technical.

The technique on categorising the competencies into the strategic, management and technical group was not elaborated by BAF (2013). Referring to Kymmell (2008) categories of skills, each skill set is described as below:

> *"(i) The tool-related skill set is typically technical. It involves the ability on visualisation of the modelled objects (and concepts), the accuracy of the represented objects, and the organisation of the model parts.*
>
> *(ii) The process-related skill set is chiefly conceptual. It involves working with a new form of communication emerged from process based on collaboration work which introduces a certain degree of complexity that requires care; managing of concentration of information which can be space-, location- and time-related information and address the hierarchy of coordination.*
>
> *(iii) The role-related skill set is primarily psychological and social. In a fully- functioning team, all members will support one another and understand their mutual interdependence."*

On the other hand, the categories of competencies grouped by Caupin et. al (2006) in IPMA Competence Baseline (ICB) are as below:

> *"(i) The technical competence range: to describe the fundamental project management competence elements. This range covers the project management content, sometimes referred to as the solid elements.*
>
> *(ii) The behavioural competence range: to describe the personal project management competence elements. This range covers the project managers' attitudes and skills.*
>
> *(iii) The contextual competence range: to describe the project management competence elements related to the context of the project. This range covers the project manager's competence in managing relations with the line management organisation and the ability to function in a project focused organisation."*

The competencies categorisation method used in ICB will be adopted in this study, as it covers both soft-skills competence and practical skills competence, whereby in ICB soft-

skills competence are referred to behavioural competence, and practical skills covers both technical and contextual competence.

3. RESEARCH METHODOLOGY

The purpose of this study is to identify the BIM competencies that are currently lacked of in the existing HEI's curriculum. A survey questionnaire is conducted by sending out questionnaires to various members of the team in the construction industry. A list of BIM competencies are obtained from the Initial BIM Learning Outcomes Framework by BAF (2013). ANOVA test was conducted to understand the results obtained. The difference in the respondent's Self-Perceived Maturity Level and their BIM understanding computed from the survey is identified and compared.

Table 1: Demographics of the respondents

Demographics of Respondents (N=100)	
Variable	Frequency, %
Workplace	
Africa	4
America	9
Asia	47
Australia	7
Europe	1
Middle East	5
United Kingdom	24
Not Stated	3
Nature of Business	
Developer	3
Architect	4
Project Manager	19
Civil and Structural Engineer	2
Mechanical and Electrical Engineer	1
Quantity Surveyor	56
General Contractor	9
Process Engineer	1
Specialist Contractor: Interior	1
Design Contractor	
Government	4
Working Experience	
Less than 2 years	27
More than 2 but less than 5 years	17
More than 5 but less than 10 years	14
More than 10 but less than 20 years	23
More than 20 years	

FINDINGS

The survey questionnaire was sent to members of the construction team from various countries, 156 responses were obtained, however only 100 respondents completed the survey questionnaire.

Table 1 above shows that majority of the respondents are from the Asian region (47%), second largest group of respondents are from United Kingdom (24%), followed by respondents from America (9%). There are only one respondent from Europe who participated in this survey.

From the 100 completed survey questionnaire, a total of 56 out of 100 respondents are Quantity Surveyors, followed by the Project Managers in which 19 out of 100 responses were received. While the third largest group of respondents are General Contractors, 9%. The other remaining 16% of respondents consist of Architects, Government employees, Developers, Civil and Structural Engineer, Mechanical and Electrical Engineer, Process Engineer and Interior Design Contractor.

The distribution of the respondent's working experience consists of respondents from the

'Less than 2 years' category, 27%, while 23% are from the category of 'More than 10 but less than 20 years', 19% has experience more than 20 years, while 17% has more than 2 but less than 5 years of experience, and the category 'More than 5 but less than 10 years' has the least respondents, that is 14 out of 100 respondents.

From the 52 BIM competencies obtained from the Initial BIM Learning Outcomes Framework, the 3 main categories: Strategic, Management and Technical competences is remapped and grouped into 3 other different categories of competences: Contextual, Behavioural and Technical as mentioned in the literature review. Below is the list of BIM competencies in their respective categories.

A) Contextual Competence

1) BIM can be applied into the whole life inter-disciplinary design, construction and the use of building and infrastructure developments.
2) BIM will bring a positive effect towards the client and supply chain relationships.
3) The consideration on strategic issues required on BIM adoption.
4) The importance in developing the business case, investment and return model upon BIM adoption.
5) The need for engagement of business stakeholders upon BIM adoption.
6) The development of business goals and plans upon BIM adoption.
7) Aware of the legal implications and requirements posed upon BIM adoption.
8) The frameworks and guidance involved in developing an execution plan for projects upon BIM adoption.

B) Behavioural Competence

1) BIM promotes the role of executive leadership.
2) BIM is able to assist in achieving productivity and efficiency improvements.
3) The user is aware of the need of gaining commitment upon BIM adoption.

4) The need for collaboration in the management of people, communications and teams upon BIM adoption.

5) The need to communicate the impact and being able to relate to it upon BIM adoption.

6) The need to compare examples of successful BIM implementation.

7) The need to openly discuss issues associated with BIM adoption.

C) Technical Competence

1) The changes required to information deliverables, procurement conditions and skills demands upon BIM adoption.

2) The investment required for up–skilling, systems and process management upon BIM adoption.

3) The need for engagement of organisational stakeholders upon BIM adoption.

4) BIM is able to assist organisational and project applications.

5) Aware of the benefits of the BIM adoption.

6) BIM is able to provide visualisation and spatial coordination.

7) BIM is able to assist in achieving sustainable design.

8) BIM is able to assist in scheduling and estimating.

9) BIM is able to assist in reducing the risk of projects.

10) BIM is able to assist in facilities management.

11) The executing of plans and referencing of examples upon BIM adoption.

12) The liability implications posed upon BIM adoption.

13) The implications of identifying and managing risk upon BIM adoption.

14) The data deliverables for clients and the supply chain required upon BIM adoption.

15) The impact on internal and external roles posed upon BIM adoption.

16) The need for internal stakeholder engagement at strategic, management and delivery levels upon BIM adoption.

17) The need to define the common language and terminology associated with BIM adoption.

18) The requirements for governance of information and process management with BIM adoption.

19) The implementation of data and process standards upon BIM adoption.

20) The principles of interoperability in terms of adherence to standards and managing compliance upon BIM adoption.

21) The hardware, software and network infrastructure requirements upon BIM adoption.

22) The processes for evaluation and selection of software and technology upon BIM adoption.

23) Aware of the methods to identify project requirements upon BIM adoption.

24) Able to utilise BIM to visualize the project and understand the relationships of the various components to one another.

25) Able to utilise BIM to assess contextual data affecting potential developments.

26) Able to utilise BIM to build 3D models and construct virtual model.

27) Able to utilise BIM to develop the model into an acceptable representation of what is visualized.

28) Able to utilise BIM to develop design solution.

29) Able to utilise BIM to manage design information.

30) Able to utilise BIM to implement procurement processes.

31) Able to utilise BIM to analyse and plan construction and installation work processes and resources.

32) Able to utilise BIM to coordinate and control construction and installation operations.

33) Able to utilise BIM to manage project handover and facilities information.

34) Able to utilise BIM to assess the condition of existing assets.

35) Able to utilise BIM to assess the energy performance of buildings.

36) Able to utilise BIM to manage the use and maintenance of facilities.

37) Able to utilise BIM to manage and operate technical information systems.

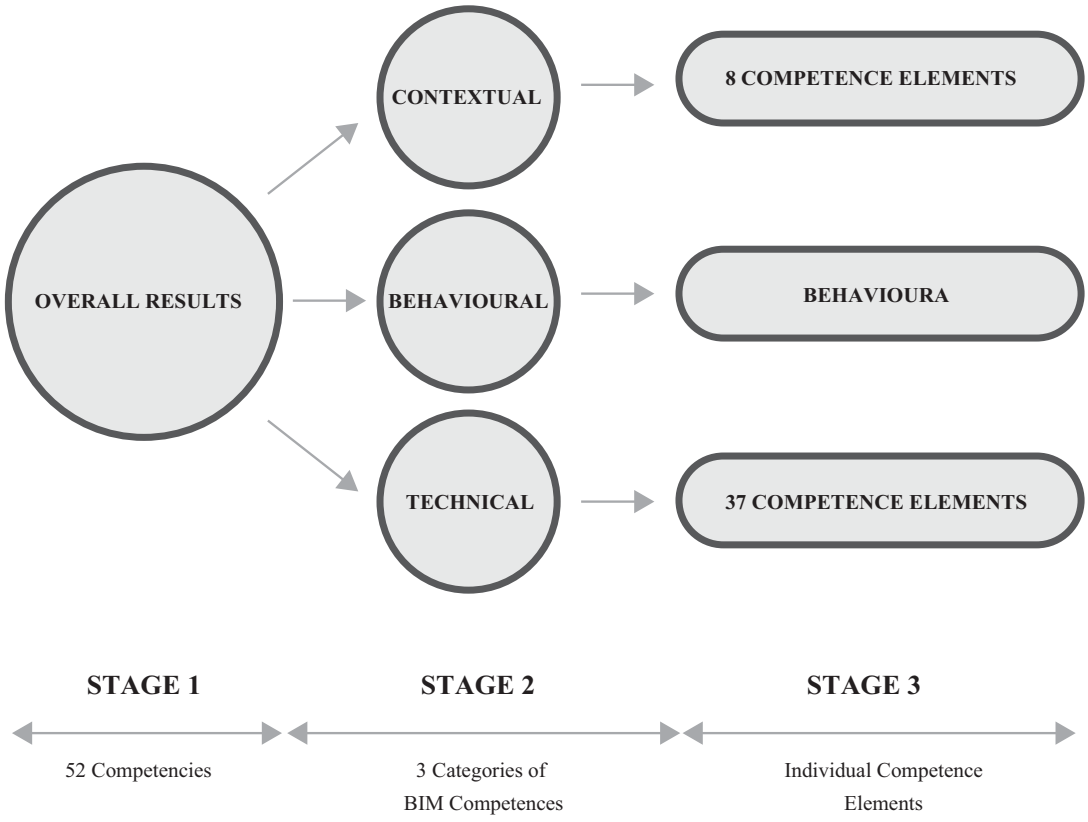

Figure 1: Three stages of analysis

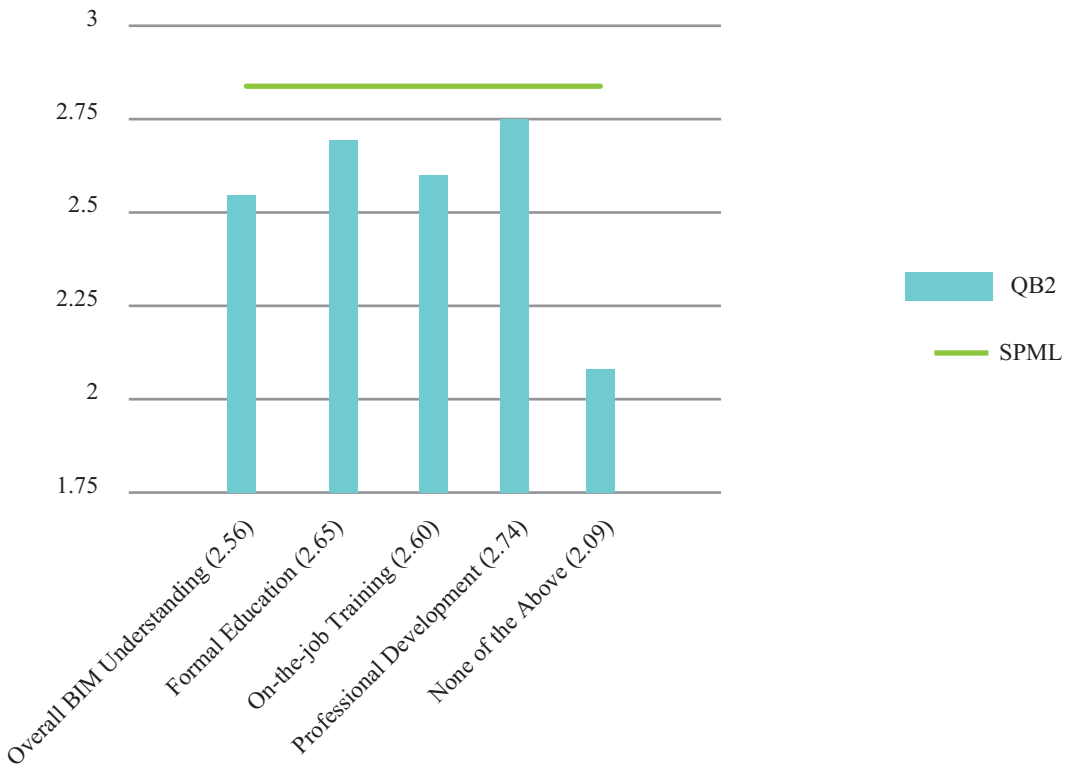

Figure 2: Comparison of Level 1 Mean of QB2

This survey questionnaire is analysed in 3 stages. Stage 1 is analysed as a whole, by finding the overall BIM understanding mean from the 52 competencies, then the overall BIM understanding mean is taken as a dependent variable against the independent variables to be tested. Subsequently, Stage 2 was analysed by first grouping the 52 competencies into the 3 categories of BIM competences: Contextual, Behavioural and Technical competence, the overall means of each category are then taken as a dependent variable to test against the independent variables. Similarly, Stage 3 was analysed by taking the overall means of each competence elements grouped under each competence category. This process is illustrated in the figure below.

The mean for Self-Perceived Maturity Level (SPML), 2.82, is obtained from the question

'How do you rate your overall BIM understanding?', in which respondents has to rate themselves from the score of 1 to 5, the choices of answer are listed in the following order: unaware, aware, understand, apply and advise. This SPML mean will be used as a benchmark against the other variables to compare the level of BIM understanding of the respondents.

As illustrated in Figure 2, the question, QB2:

'I know most of the information about BIM through:

- Formal Education
- On-the-job training
- Professional Development
- None of the above'

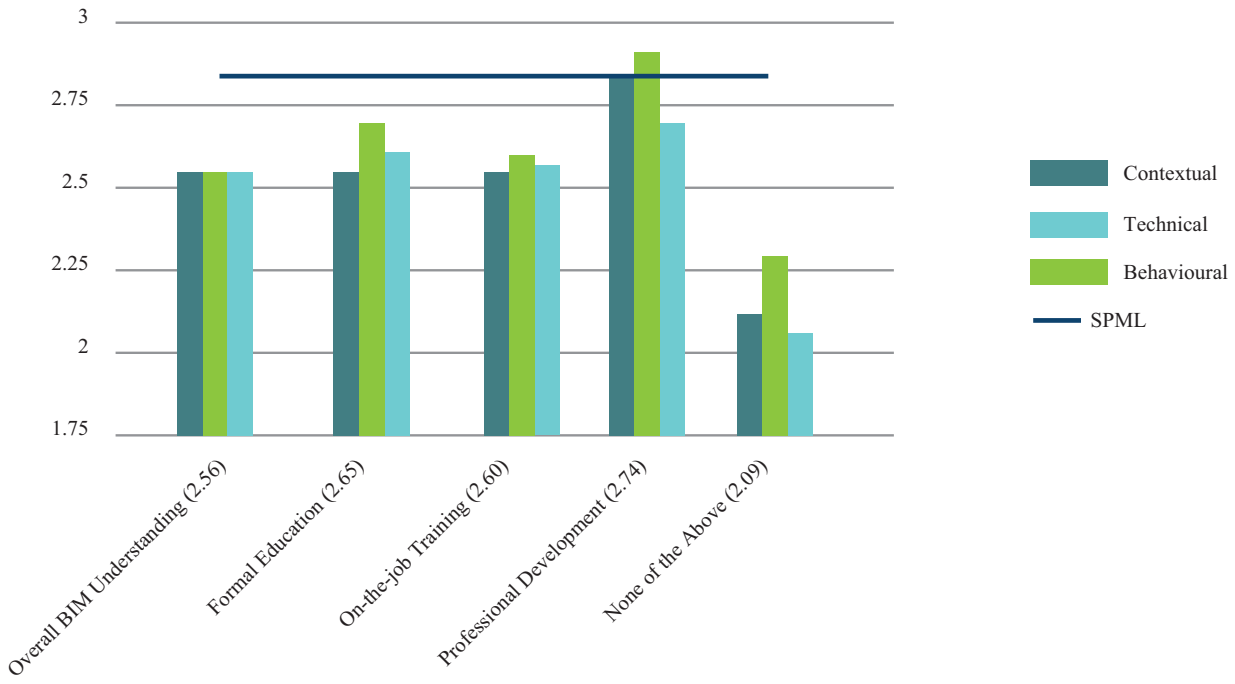

Figure 3: Comparison of Level 2 Mean of QB2

was analysed, by filtering the question 'Does your university teaches BIM?' according to the respondent's answer.

The 'Overall BIM Understanding' mean, 2.56 is lower than the means for 'Formal Education',

'On-the-job Training' and 'Professional Development', while 'None of the Above' has a mean of 2.09. It is shown that the overall means of the four multiple choices given fall within the SPML of the respondents. This shows that there is a gap of understanding between what the respondents perceived and their actual maturity level. Another radar chart is plotted to identify the pattern of the gap between the SPML and the 3 categories of competences.

Table 2: Contextual Competence on QB2

	BIM Competencies							
	A1	A2	A3	A8	A17	A18	A21	A34
Mean score	2.73	2.68	2.55	2.64	2.61	2.46	2.06	2.45
Rank	8	7	4	6	5	3	1	2

From Figure 3, it is observable that the gap between the Behavioural competence and the SPML is closer compared to the Contextual and Technical competence. It can also be seen that only the Behavioural competence for 'Professional Development' has the highest mean score, in which it exceeded the SPML mean score of 2.82. Generally, it can be observed that the trend of the competences from the closest to the furthest from the SPML is Behavioural, Contextual then Technical competence. In which among the four choices provided, 'Professional Development', 'Formal Education' and 'On-the-job Training' are the closest to the SPML.

Table 2 shows the major deficiency of BIM Contextual competencies, the rankings are given in an ascending order, from lowest average mean score to the highest average mean score as below:

1 Aware of the legal implications and requirements posed upon BIM adoption.
2 The frameworks and guidance involved in developing an execution plan for projects upon BIM adoption.
3 The development of business goals and plans upon BIM adoption.
4 The consideration on strategic issues required on BIM adoption.
5 The need for engagement of business stakeholders upon BIM adoption.
6 The importance in developing the business case, investment and return model upon BIM adoption.
7 BIM will bring a positive effect towards the client and supply chain relationships.
8 BIM can be applied into the whole life inter-disciplinary design, construction and the use of building and infrastructure developments.

A similar exercise was carried out on the Behavioural Competence and Technical Competence respectively. Competencies that were below the SPML's mean are listed in accordance to its rankings as below:

Behavioural Competence:

1 BIM promotes the role of executive leadership.
2 The need to compare examples of successful BIM implementation.
3 The need to communicate the impact and being able to relate to it upon BIM adoption.
4 The user is aware of the need of gaining commitment upon BIM adoption.
5 The need for collaboration in the management of people, communications and teams upon BIM adoption.
6 The need to openly discuss issues associated with BIM adoption.

Technical Competence:

1 The liability implications posed upon BIM adoption
2 Able to utilise BIM to assess the condition of existing assets
3 Able to utilise BIM to assess contextual data affecting potential developments

4 Able to utilise BIM to assess the energy performance of buildings

5 The implications of identifying and managing risk upon BIM adoption

6 Aware of the methods to identify project requirements upon BIM adoption

7 The processes for evaluation and selection of software and technology upon BIM adoption

8 Able to utilise BIM to manage and operate technical information systems

9 Able to utilise BIM to implement procurement processes.

10 The principles of interoperability in terms of adherence to standards and managing compliance upon BIM adoption

11 Able to utilise BIM to manage project handover and facilities information.

12 Able to utilise BIM to manage the use and maintenance of facilities.

13 The impact on internal and external roles posed upon BIM adoption.

14 Able to utilise BIM to analyse and plan construction and installation work processes and resources.

15 Able to utilise BIM to coordinate and control construction and installation operations.

16 The data deliverables for clients and the supply chain required upon BIM adoption.

17 The hardware, software and network infrastructure requirements upon BIM adoption.

18 Able to utilise BIM to visualize the project and understand the relationships of the various components to one another.

19 Able to utilise BIM to build 3D models and construct virtual model.

20 Able to utilise BIM to develop the model into an acceptable representation of what is visualized.

21 The need for internal stakeholder engagement at strategic, management and delivery levels upon BIM adoption.

22 The executing of plans and referencing of examples upon BIM adoption.

23 Able to utilise BIM to manage design information.

24 Able to utilise BIM to develop design solution.

25 The changes required to information deliverables, procurement conditions and skills demands upon BIM adoption.

26 The requirements for governance of information and process management with BIM adoption.

27 The implementation of data and process standards upon BIM adoption.

28 The need for engagement of organisational stakeholders upon BIM adoption.

29 BIM is able to assist in facilities management.

30 The investment required for up–skilling, systems and process management upon BIM adoption.

31 The need to define the common language and terminology associated with BIM adoption.

32 BIM is able to assist organisational and project applications.

33 BIM is able to assist in achieving sustainable design.

The list is longer for the Technical competence as there were 33 competence elements out of 37 that were below the SPML's mean. Overall, it is observable that Technical competence has the biggest gap, thus those means obtained from the individual competence elements from the Technical competence at Stage 3, that shows a big variance compared to the SPML mean such as the individual competence elements identified in the findings: the liability implications posed upon BIM adoption, able to utilise BIM to assess the condition of existing assets etc. have to be prioritised during the implementation of BIM competencies exercise is carried out.

CONCLUSION

In a nutshell, this study shows that the overall respondent perception is higher than the average score on the 52 individual BIM competencies. Respondents perceived that they understood what BIM is, yet in actual fact their BIM understanding is quite a distance apart from the perceived understanding. Amongst the 3 categories of competences, Technical competence is found to be the furthest away from the SPML mean, while Behavioural competence is shown to be the closest to the perceived mean. In order to narrow down the gap between a person's perceived understanding and the actual understanding, it is recommended to first focus on implementing BIM competencies which have the biggest differences of mean into the course curriculum. The next step of this research would be to identify ways and means to incorporate the competencies into the course curriculum, i.e. by matching the BIM competencies identified into the related competencies listed by the professional bodies. One of the assumptions made in this study is that all respondents are assumed to have obtained a tertiary education level.

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ARTICLE

Malaysian Public Listed Companies Diversifying into Property Development - Rationale and Challenges

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ABSTRACT

Property development remains a lucrative industry gauging from the increase in the number of non-property related public listed companies diversifying out of their core businesses and venturing into property development. The fact remains that property appears to be an attractive proposition considering its low entry level with minimum obstacles and a good sector to venture into provided the companies are able to seize the available opportunities and optimistically view this as a good strategy to move into. However, there will always be risks in a new venture. A slowdown may just have an adverse effect on new players and are likely to be the most affected. Thus this study is aimed at identifying the rationale and challenges faced by non-property related listed companies diversifying into property development. By way of a qualitative analysis approach, in-depth interviewing techniques were applied entailing the collection of data from five separate respondents which were later transcribed verbatim. It was observed that market growth, decision of top executives and entering into a new market territory were the main reasons behind the diversification move. Findings obtained from the interviews also revealed that the acquisition of prime land in mature locations remains the main challenge for new property players as the location of land may affect the viability,value of the assets as well as future transactions of properties. The outcome provides good insights to new property players in assessing the property industry and to enhance their participation in the property development business by tackling the challenges.

Keywords: *Diversification, property development, non-property related, public listed companies, rationale, challenges*

1.INTRODUCTION

SP Setia Bhd, Mah Sing Group Bhd and IOI Properties Bhd have one thing in common – besides being the biggest property players in the country, they were previously not involved in property development but diversified into the sector. S P Setia Bhd was first established as a construction company, Mah Sing Group Bhd began as a plastic manufacturer while IOI Corp Bhd started off as a plantation Company and later converted their available land for the purpose of property development (Risen et al., 2013). Diversification is seen as a good strategy as it would be an advantage in terms of the types of businesses; sometimes a slowdown of a particular industry may occur and the other industry diversified into would be unaffected over various economic cycles and changes in market conditions. However,diversification is not a good move if the diversification strategy fails and ends up with bad investments (Liew, 2013)

As a topic of research, diversification has been widely studied in the management literature over the past decades(Rumelt, 1974, 1982; Hoskisson and Hitt, 1990; Wan and Hoskisson, 2003). Despite the breadth of its scope, no comprehensive review of this literature related

to property is available.The research topic focuses on the explicit relationship between diversification and property development, a field considered scarce and therefore definitely valuable to be researched.

This paper seeks to identify the factors or reasons governing non-related companies in the industry to focus or diversify into property development on a full scale basis although they may already have several other contributing divisions besides property development under their core business operations. Moreover, this paper also aims to find out the challenges the companies endured from the start up point up to the current scenario with regards to the property division. The objectives of this study are outlined as (1) to review the reasons the company venture into property development and (2) to access and get to know the challenges faced by a company going into property division. The findings from this study will be useful in developing better understanding on the relationship between the diversification and property development that a company would have taken over the years.

2. LITERATURE REVIEW

2.1 Property diversification trend in Malaysia

The expanding property markets in Malaysia have indeed caught the eye of many more than just buyers and sellers but also developers who have not been in the property line before (Property Report, 2010). In early 2010, several non-core property players, several non-core property players such as Fitters Diversified Bhd, Caely Holdings Bhd, Sanichi Technology Bhd (details as per table 1 below) made their foray into the property sector, a sign that the property cycle is at its peak when too many non-property related public listed companies jumped on the property bandwagon (Liew, 2013). It is a fact that registered property developers already number more than 1,000 comprising listed township developers, boutique ones including small and medium enterprises (SME) (Sharen, 2014). However, industry experts say the trend of non-core property players for example construction firms turning to property development is not a new phenomenon (Asiabuilders, 2011). As the competition in their respective core businesses intensifies, more non-property related companies could be pushed to venture into property development. Over time, some of these companies could even turn into pure property developers as its core activities are phased out to focus on growing its more lucrative property division where the profit margin is good and not be distracted by core activities. For example, Encorp Bhd is seeking to slow down their construction unit and move to a full-fledged property development in line with the attractive property prospects and the available opportunities to leverage on a sizeable land bank located in prime areas (Gurmeet, 2015). However, certain public listed companies has no intention to be a full-fledged property player, as their own respective core business remain the mainstay of the group with property as its new income stream (Cecilia, 2013, Yvonne, 2015).

Significantly, the nature of the property business gives plantation and construction companies an advantage to diversify into property development. As reported by a MIDF analyst, many plantations owned companies possess cheap land secured over the years strategically located near to town and prime areas (Liew, 2013). The options available for these firms are to convert their land for the purpose of property development. By doing so the land could be put to good use while generating better revenues from development than putting up for outright sale of the land or for cultivation activities (Liew, 2013). In the 1990s many of the country's largest plantation companies diversified into property development, thus opening more agriculture lands for conversion into housing development due to the government policy to

promote home ownership (Syafiee, 2008). For example, Sime UEP Properties Berhad and IOI Properties Berhad over the years have placed their interest and focus in residential development and making full use of their available land bank located in many prime areas in the Klang Valley as provided by their parent companies. These were readily available through originally plantation land in nature and later converted for residential purposes. Indeed, these companies provide the example of the benefits in having a steady supply of development land (Ting, 2002).

Table 1: List of companies diversifying into property development for the last 5 years

Company	Core Business	Year of entry into property development	Maiden property project
Fitters Diversified Bhd	Fire-fighting equipment	2008	Zetapark, Setapak
Caely Holdings Bhd	Lingerie products	2011	Gombak, Selangor
Digistar Corp Bhd	Information technology provider	2012	The Heritage Apartments, Malacca
Sanichi Technology Bhd	Information technology provider	2014	Marina Point, Klebang Malacca

2.2 The Motives of Diversification into Property Development

Diversification may lead a company through hard and challenging times but has never disappeared from a group director's agenda to drive a company's plan to expand the group's earnings base and also to strengthen its financial position (Daniel, 2009). According to Chua (2010), no matter the conditions of the property industry among the big major property players, there remains a place for smaller ones to fill certain market sections still available or yet to be filled by the former. Many non-property players share the view that the business of property development and the related investments do offer steady growth coupled with an alternative source of revenue. The perception is reinforced and extended to realise the fact that this would be the sector needed to be added to its existing core business. This explain why non-property players jumped on the property bandwagon and started off as small property developers (Kobay, 2013). Furthermore, diversification is always good because funds are not restricted into one single industry unless the company create an over-diversified portfolio (Liew, 2013). When one sector is doing badly, especially if a company's long-established business is considered a sunset industry, it may want to seek new business opportunities that would provide a more robust growth (The Edge, 2014). Going into the property sector is one of the options that they have (Liew, 2013). Moreover, driven by external requirements from investors such as the pressure to grow or to invest idle cash on the one hand and internal motives on the other, many corporations seek their fortune in diversification and show that there is no favouritism towards the sector they are most adept at (Knop, 2007, Welge& Al-Laham, 2007).

Malaysia as a growing nation means demand for housing will increase over time and with the stricter regulations imposed by the Government and related authorities, the housing industry should continue to improve over time (Risen, 2013). According to the demographics,

Malaysia has a high number of young adults aged between 25 and 35 who are starting families and will need a place to stay and those who are having children will become upgraders (Chai, 2015). This clear demand is one of the reasons why many non-properties related companies diversify into the lucrative property development. From the buyers' view, "a property is a person's biggest wealth creation asset" and property ownership in Malaysia reflects personal achievement; hence, such sentiments should spur people to buy houses regardless of what the nation's economic climate may be (Liz Lee, 2014; Chong, 2007).

Besides the favourable demographics, a sustained rate of urbanisation is expected to continue for a long time, increasing demand for modern housing as well as migration to urban cities (HLIB Research, 2012). Since the early 1990s, Malaysia has undergone rapid urbanization due to the nation's unabated economic growth (Syafiee Shuid, 2010). Significant changes in economies, transformation in the property/housing sector and increasing urbanisation rates have both increased the demand for housing and created potential opportunities for property developers.The property sector will invariably remain a long term and sustainable industry. Unsurprisingly, this has resulted in many businesses turning their attention towards this industry, so as to not be left behind in a sector considered lucrative and financially rewarding.

The residential property for many years has been the money-making portfolio for most investors surveyed (Ibrahim et al., 2005). Anwar (2014) reported the sharp rise in house prices and developers producing properties to meet the demand were observed during the boom period of 2011 and 2013. The house demand was supported by the various government incentives then had drawn non property related companies to diversify their business into property development (Anwar, 2014). The diversification trend is further supported based on Liew's (2013) study that revealed the uptrend in local house prices had partly contributed to the sudden surge in diversification among the new players. The residential property in Malaysia during the property boom period between 2011 and 2013 stand out to be a major contributor to the property market registering more than 50 per cent of the recorded property transactions.

As reported, property development can be a highly lucrative business and the available opportunities and desire to be part of the success story simply not to be missed by many (Realedge, 2006). Upon the crystallization of the company's intention to diversify their business into property development barring any unforeseen circumstances, property development business is expected to contribute more than 25% of the net profit of the company moving forward (Anggi, 2014).

2.3 Risk Factors In Relation to the Diversification Move

Building a career as a housing developer is not as easy compared with that in other sectors (Mastura, 2014). Diversification into property development will expose company to risks inherent in the sector. Non-property companies principally involved in their core business and have not been directly participating in property development business in the past will somehow be affected. Hence, the companies will face new challenges and risks arising from property development business in which the company does not have track record to ensure the success of the venture in property business (Risen et al. 2013). Besides that, smaller developer feels sidelined when it comes to bidding for attractive land parcels as compared to stronger bidders from larger financially sound property developers (Jo, 2011). Ultimately, failure in acquiring the right price of lands that offer competitive pricing may just cause the development project to be sluggish (Kobay, 2013). Moreover, one of the drawbacks of this property business is its requirement of a significant finance and time investment without a guaranteed return (Browman & Thompson, 2009; Buttimer, Clark, & Read, 2008). In

addition, majority of property developers use external finance to fund their projects as they could secure bridging loan from the bank (Ng, 2007). In order to obtain bridging finance from the bank, the developers must be able to sell 60% of the project; only then the bank will release bridging loan to the developers. Indeed, at times property developers find it hard to achieve more than 60% of the take-up rate of the units they offered for sales in the first twelve months after the official launch of the property project (Ng, 2007). Failure to secure financing means that the developer will be unable to undertake the development and higher cost of funding could hamper the return on investment or achieving the desired profit margin (Aizat, 2012).

With no track record and limited experience in the property sector, the newcomers will face challenges in the start up of the property division and to be on level terms with big property players like SP Setia Bhd, UEM Sunrise Bhd and Mah Sing Group Bhd. According to Liew (2013), latecomer needs to build up a strong brand name which takes time as compared to existing players already having an edge based on their established brand name and reputation in the industry. Besides that, most house buyers are encouraged to look out for large & established property developers with a better resource of technology and financial management, and nowadays home buyers have more options with the introduction of many small to medium developers (Wong, 2014, Liew, 2015). Inevitably this poses a challenge for newcomers to differ themselves from the property players by setting new benchmarks in terms of quality standards that can be applied by the industry to measure the quality of construction projects objectively (Phoon, 2009).

Risen (2013) also reported that newcomers to property could be facing challenging times due to increasing raw material prices. Any significant increase in the costs of raw building materials and fluctuation in prices would bring an adverse effect on the profit margin of the project or force the project to be sold at higher selling price which would eventually affect the project sell out rate (Kobay, 2013). Furthermore, what goes with the sale of property is also linked to risks and uncertainties. Risks will have a direct impact on the return in investment and purchase price as development usually spread over a considerable period of time hence is likely to affect stability of the property market (Aizat, 2012). An industry player reckons that some of the new players will naturally suffer in consequence to the slowdown in the property sector and the adverse effect that it has on the sale of property. Property development entails a lengthy process and involves an extensive start-up capital and may just work to the disadvantage of many not related to the industry (Risen et al. 2013).

3. SAMPLING AND DATA COLLECTION

This research seeks to identify the reasons governing non-related property companies diversifying their business into property development and the challenges faced in the startup of the property division. Qualitative research approach was being utilized in this research. Personal and email interviews were applied to obtain required responds to meet the objectives of this research. As property development are very subjective, personal interview approaches will be more responsive and flexible towards the interviewees' understanding, expression of opinions and also experiences with respect to the topic in question. Respondents will have the added opportunity to respond more elaborately and in greater details with such approach. The presence of the interviewer has facilitated respondents in providing a more reflective and accurate answers to questions asked. Mp3 recordings and written notes were then made by the interviewer of the entire interviews. As an alternative to face to face interviews, e-mail approach had also been used in this study.

The targeted companies' respondents were identified from newspapers, online articles and online media such as Bursa Malaysia website. The sources of information on a particular company such as from a construction background diversifying into property development are sourced through these avenues. Altogether, the targeted sampling size was 15 interviews for this study. Interview questionnaires were based on the literature review of diversification into property development. Out of the 15 firms, only 5 responded while the rest declined and cited tight respond deadline being the main reason. The respondents (as per table 2 below) were represented by the Group President, General Manager, Chief Financial Officer, Group Financial Controller and Senior Quantity Surveyor. Interestingly, all the respondents were key persons directly involved in the diversification process and responses were indeed based on first-hand knowledge rather than hearsay.

Table 2: Duration of Interviews

Company	Core Business	The respondent's position in the company	Duration of interviews (m/s)
A	High-precision engineering	General Manager	1 h 40 m 57 s
B	Data collection and solutions	Group President	1 h 14 s
C	Furniture webbing	Chief Financial Officer	46 m 43 s
D	Wood base manufacturing	Group Financial Controller	Email interview
E	Construction	Senior Quantity Surveyor.	1 h 3m 20s

4. DATA ANALYSIS

4.1 Rationale behind diversification move

tIn yet another sign that the Malaysia's expanding property market is red-hot, a handful of small firms are venturing out of their core businesses to make big bets on real estate development. Based on the data extracted from the interviews (as per table 3 above), all the companies agreed that property development business is a lucrative market and is very demanding wherethe companies would seize every opportunity to diversify into property development due to the market growth in this industry. As discussed in the literature review, property development can be a highly lucrative business and the available opportunities and

Table 3: The purpose of diversification

Respond-ent	The purpose of diversification				
	Market growth	**Decision of top executives**	**rise in local house prices**	**Enter new market**	**Concession agreement with Malaysia Government**
A	✓	✓	X	✓	X
B	✓	✓	✓	✓	X
C	✓	✓	✓	✓	X
D	✓	✓	X	✓	X
E	✓	✓	X	✓	✓

desire to be part of the success story simply not to be missed by many. (Realedge, 2006). Henry Butcher Malaysia director, Lim Eng Chong reported that Malaysia as a growing nation, demands will increase over time and in tandem with the projected population growth. Supporting this, Risen (2013) reported that the housing industry should continue to improve over time. Ultimately, this caught the eye of developers who have not been in property before (Property Report, 2010). Besides that, decision of top executives also played a major part in the diversification into property business. Respondent C relayed the idea of diversifying into property development had always been the main priority with the aim of seizing any viable opportunities at a suitable time for business enhancement and sustainability. For the record, the company diversify in the year 2008. In this case, Nancy (1997) prior findings verified that top management makes the diversification decision in the context of considerable controversy over the relationship between firm performance and firm diversification. Moreover, the result appears to be consistent with the existing literature review from Aizat (2012) where the timing of the developments is crucial and is known to impact the real estate options.

For respondents B and C, the reason for diversification were attributable to the continuous rise in local house prices and this matches with the literature review above (Liew, 2013). In recent years, rapid economic development has resulted in an increased demand for residential housing among urban areas in Malaysia. A review on the housing prices in Malaysia revealed that it has indeed appreciated significantly namely in the urban cities or

outskirts of the town areas and it is very much dependent on the specific location (Tze, 2013). A prominent Group Executive Vice Chairman supported the fact that the price of properties will still continue to rise, unless when the country is facing internal or other problems (Hong, 2012). In fact, the trend of companies diversifying into property development is only good as long as property prices continue to rise, MIDF Research senior analyst, Syed Muhammed Kifni was quoted by Malaysia's Business Times Property Report (2010) as saying.

As observed, companies A, B, C and D have the same view and purpose on the benefits of entering a new market where opportunity to expand revenue sources and reducing reliance on existing core businesses could be achieved. Brostdn Kleiner (1995) prior findings verified that diversifying into other business can maintain the revenue or reduce risk for the company. According to respondent B, the company has been under a lot of pressure from its stakeholders to put the money to good use after paring down its stake in its Thai technology company. The company decided to use part of the cash it earned from the Thai technology company stake disposal to acquire a stake in a small developer firm to venture into property development business. The company expects their core business (IT sector) to enter a challenging phase that will last for the next two to three years. This statement can be enlightened by previous findings in the literature review above (Knop, 2007; Reed & Luffman, 1986; Welge& Al-Laham, 2007).

Respondent E, describes it was the Bukit Jalil National Sports Complex Malaysia as a breakthrough for the property division.The company was responsible for the construction of the national sports complex as a Contractor. Unfortunately, the construction project was delayed and slowed down due to the 1997 Asian financial crisis. The project was no longer bankable and it needed a massive infusion of internal funds from the Malaysian Government. As a solution, a concession agreement provided for the cost of the project to be recovered with property development was signed between the government and the company. As a result, the government alienated a total of 154 acre freehold land to the company for property development. That was the reason the company diversifies into property development.

4.2 Challenges that faced by the new property players when they diversify into property development

All the companies interviewed acknowledge that the property business is a highly challenging one. The main concern is the acquisition of prime land, which has become increasingly harder to find. According to Company B, land in Klang Valley has becoming scarce with more developments springing up in the Klang Valley. Thus when land is to be acquired for developments, the right type of land is hard to come by as the available land in the Klang Valley will diminish. There would be a loss of opportunity especially when the market is hot and the land is scarce. Whenever there is a good piece of land and whoever is able to provide a down payment stand to secure the land fast. This statement can be enlightened by previous findings. "Many developers were unable to replace their landbanks and carry on doing business. One reason was the shortage of available land near urban growth centres, which pushes prices beyond the reach of these developers," (MPI Report, 2011). Studies conducted by Abdul-Aziz and Ho (2006), Abdul-Aziz et al. (2006) and Ho (2006) reveal that location is the key indicator of a housing project's competitiveness as location is always important to attain the full potential of property investments (Business Today Magazine, 2014). For example, Company C mentioned that the major key considerations made by the company in the diversification decisions were the location of

the proposed housing development, the type of houses to be developed and its pricing. The statement above appears to be consistent with the previous finding by Mastura et al. (2014) that related developers faced with the risks of re-starting their business in a new location and coupled with the rejection of the housing designs by the local community and uncertainty on the selling prices have indirectly affected the stability and prosperity of the firm.

For Company E, the main challenges faced in the start-up of the property division were dealing with challenging bank financing and interest rates, securing bridging finance for projects as well as getting new homebuyers to commit in such uncertain times. Further claimed that it was due to one of the bank requirements limiting the granting of the bridging loan at 60% of the property sold. It means that the developers have to find end financiers (house buyers) for the bank before they can obtain the bridging loans (Goh 1997) and this finding on bank's requirement is consistent with the existing literature review above (Ng, 2007). Company B rated financial capability of the company as the second important challenge as fortunately for the company, their financial footing was relatively strong after paring down its stake in its Thai unit and venture into property development. Company C on the other hand noted that bigger firms will have a better financial resource management due to their in-depth knowledge of the property market and better diversified plans. Considering the circumstances, small size developers tend to be ignored by bankers. Without such funding, some of the smaller developers unable to acquire land unless they resort to borrowing. Hence, firms with better resources and strong financial background are normally more capable and have the competitive advantages (Ng, 2007).

According to Company A and E, one of their biggest challenges when the company diversifies into property development was public perception. Certain people perceive them as a new kid on the block with Company A being an IT solution provider while Company E principally a construction company. Moreover, Company B mentioned that the public would not know about the company if the company have no reputation in the property industry. The finding is consistent with the previous study of Mastura et al. (2014) where it indicates that the public tends to recognize only big names in the industry and ignores small and newly established companies. Company E further highlighted that most house buyers tend to have more confidence in pure property players with strong financial resources, experience and reputation as quality developers. Homebuyers are smarter now and will do background checks on the property developers before they buy a property. This statement provided support for the existing literature review above (Wong, 2014; Liew, 2013).

While property development is an interesting business, Company E finds it a challenge to get approvals from the time the land is procured till completion of the project as developers have to submit many applications just to get projects started. This process alone can take more than five years for a medium-size development and this makes property development a tedious process. A study conducted by Balen (2006) has concluded that "obtaining planning permission has always been a lengthy and bureaucratic process. Moreover, the statement given by Company E also matches the findings of the previous literature review (Sharen, 2014).

4.3 How the company cope with the challenges when they diversify into property development

Malaysia's expanding property markets have not just pushed existing property players to expand but also caught the eye of developers who haven't been in property before. To continue to do well and cope with the challenges in the property industry, the new property developers need to have readily accessible financial capital, apart from the loans provided

by banks and finance companies to ensure the smooth running of their daily operations (Mastura et al. 2014). Company C are open to options on financing a particular project and consideration could be made from the capital market, financial banking institutions or other credit facilities. Whatever option that the company may decide, careful cash flow and taking on debt would remain to be their priority. Moreover, the Chief Financial Officer of Company C added this was the reason the company started off with joint ventures for its maiden property venture as it will save the cost of landownership rather than buy land while it waits for another upcycle in the property market. According to Company E, once the concession agreement was signed between the company and the government, the company quickly launched the low-cost housing development to reduce the holding costs of the land bank and allow for sufficient time to generate revenue from property development during the Asian economic crisis. This statement clearly matches the previous finding as it showed that positive cash flow is essential for a company to venture into property development as the property market is cyclical in nature and companies need to have the holding power to last through down cycles (Yang, 2009).

Based on the findings, the location and size of the owned land bank that one may have determined the success of a project and this explain why property developers differ from each other and why they hardly compete on equal terms (Ng, 2004). According to Company A, the property development business is something very special because there would be no other similar piece of land for development in the same location. The location can only fit in one project and it depends on the company luck whether the location is attractive enough to attract the buyers to acquire their property. In regards to the size of land, unlike the big boys in the industry that often buy vast tracks of land to be developed over a long period; Company B is widely known for its pocket-sized land development that is well-designed where the company is trying to embark on the quest to become a niche property developer catering to the market needs and demands according to the Managing Director. The statement above is contrary with the findings of Realedge (2006) that the new entrants may be at a disadvantageous position compared with the more established players in terms of land resources which have had years to build up their land banks. In other words, small parcels of land can yield a quick returns (Yang, 2009) compared to huge land bank as nowadays the land is so expensive and it is not easy to acquire huge land bank to build townships.

As the property industry is a highly competitive market and poses a lot of challenges, new property beginners find themselves pitting against the more established developers by adopting and pursuing more aggressive marketing strategies and also to build up a company to take advantage of an expected opportunity (Yang, 2009). According to MARC(2012), for a property developer to be on a strong footing and able to command a premium in their launched products one may have to be creative and innovative in their housing projects (eg. selling a lifestyle instead of mere selling houses). Based on the data analysis findings, Company C positioned itself as a niche property developer by looking at all aspects of the company's product offerings from product features to styling, design and layout to meet the needs of today's home-buyers. Company A emphasized the need to be innovative in all aspects of operations in order to be a successful property developer. Moreover, they are learning a thing or two from the major property players like SP Setia and Mah Sing. Factors such as how to produce products that can be considered as in a niche market by observing their property business strategy plan for one and two knowing how much they sell and what they give to the market which differ themselves from other property developers. As for

Company D, focussing on building residential houses remain the main priority as the residential segment has a lower barrier of entry and it is not as specialized as office retail. This supports the findings of Yang (2009) where residential houses have lower capital requirements and lower risk levels.

One of the ways to cope with the challenges to increase the confidence of the prospective buyers and enhance the reputation of the company is to acquire a competent management team with the right track record, expertise and know how in the sector (Business Today Magazine, 2014). This further supported by the fact that housing development is speculative investment in nature and businessmen have to depend on a competent team of management to address the challenges (Mastura et al. 2014). For Company A, although property development may be unfamiliar and unexplored areas it remains in the company's agenda in the pursuit of property development. The General Manager of Company A further reiterated their seriousness where indication pointed towards their efforts in strengthening its competency in property development by engaging experienced management team to run the new activities.

5. FINDINGS AND CONCLUSION

This study is designated to study the diversification of public listed non-property related companies into property development. Having analysed the data, several findings have emerged which bears similarity or differ from the predicted circumstances.

This study provides the rationale behind the diversification moves. It is suggested that diversification into property development can be considered a good move in general as long as the companies view opportunities to venture into this profitable business. The finding from the data analysis indicates that the non-property players believe that the diversification of the group's business to include property development has an attractive growth prospects. Furthermore by doing so, it will significantly reduce the group's sole reliance on its core business for its growth as well as providing the group with another profit avenue and earnings growth in the future. In addition, the findings also revealed that majority of the companies believe there will be a long-term sustainable demand for its new business given the country's macro picture and demographics reveal a largely young population who will continue to fuel the sector.

Diversification into property development brings some barriers to the new property players especially when their original core business is of different background. Property development is a speculative investment in nature and the possibility of non-developers creating an oversupply of wrong products in the market is high. The failure in conducting due diligent study of the market and coupled with poor implementation or efficient execution ends up with bad investments. Hence, the new property developers must rely upon a pool of knowledgeable consultants through hiring, and outsource expertise as well as having a competent management team with good track record, know-how in the sector to manage this new business.

To conclude, property development as it is may be an interesting business to venture into however property developers are finding this as a challenge, as the road to success has never been easy. Right from the planning and securing the necessary development approvals could take more than five years for a medium-size development. The emerging of these new property developers that claim to have the right strategy to be successful in the property development however it remains to be seen as to how many of them will be able to survive and succeed in this ever challenging times.

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