

4.2 Analysis of Measures

4.2.1 Analysis of Table 4.1 (a)

Table 4.1 (a) (Appendix A) presents the general characteristics of construction firms that are interviewed.

All of the construction firms interviewed are public companies listed on Bursa Kuala Lumpur. All the interviewees are grouped companies with construction as core business and have diversified into various construction related field such as property, highway concession, etc.

All of the companies have ventured to construction overseas except Pintaras Jaya Berhad and Gadang Holdings Berhad. Pintaras Jaya Berhad and Gadang Holdings Berhad recorded a lower annual turnover in 2004 of RM87.4 million and RM133.4 million respectively. Company X doubled its annual turnover from RM153.75 million in 2003 to RM381.91 million in 2004.

On the other hand, WCT Engineering Berhad, Gamuda Berhad, Road Builder Berhad and IJM Corporation Berhad are larger construction group with an annual turnover in the range of RM900 million to RM1.4 billion. These construction companies have extensive capabilities to implement mega construction projects not only in Malaysia, but have also spread their wings to foreign markets in India, China, Taiwan, Arab Saudi, Vietnam, Argentina etc. and have gained international recognition for their professionalisms.

4.2.2 Analysis of Table 4.1(b)

From the summary, it is found that all the construction firms valued knowledge and are practicing knowledge transfer within their organisation and between external sources.

From the interview session with all the companies, it is learnt that knowledge transfer from individuals to external structure are very minimum. This is because construction firms stressed on operation efficiency and less attention is focus on academic research. Gamuda Berhad, Road Builder Berhad and IJM Corporation Berhad reviewed that even though their organisations encourage such knowledge transfer, it is very much depending on the individual capabilities to instantiate such knowledge transfer. Mr. Andrew P.K.Yew, Design and Technical Manager of Gamuda Berhad justified that there are several experts in Gamuda Berhad that often give talks on technical seminars organised by Institute of Engineers, Malaysia (IEM) and Construction Industry Development Board (CIDB) and contribute technical papers to their publications. Gadang Holdings Berhad, WCT Engineering Berhad, Pintaras Jaya Berhad and Company X do not practice knowledge transfer from individuals to external structure.

On the other hand, all the companies unanimously supported the statement that knowledge transfers from external sources are essential for continuous

education. Evidences of knowledge transfer from external structure to individual individuals are obvious from attending training courses, seminars, forums and workshops organised by various professional bodies such as Board of Engineers, Malaysia (BEM), Institute of Engineers, Malaysia (IEM) and Construction Industry Development Board (CIDB).

All the interviewees ranked knowledge transfer from external structure to internal structure medium to high. Knowledge transfer from external structure includes from joint venture partners and alliances. Mr. Liang Kai Chong, Executive Director of WCT Engineering Berhad reviewed that WCT benefited from joint venture as new knowledge and technologies are transferred from their foreign partners. For example, during the construction of Sepang Formula One Circuit in Malaysia, WCT Engineering Berhad has joint ventured with expertise from South Africa. Technology of construction for the Formula One circuit was transferred to WCT Engineering Berhad and this has enabled them to construct the Bahrain International Racing Circuit in Arab Saudi. Similar alliance was formed between WCT Engineering Berhad and Dam specialist from China for the construction of Bakun Hydroelectric Dam Project (Package CW2). Dato' Goh Chye Koon, Deputy Managing Director of IJM Corporation Berhad shared the same view and stated that knowledge transfer from external structure were made known when IJM Corporation Berhad joint venture with Japanese companies such as Shimizu Corporation, Takenaka (M) Sdn Bhd etc. However, all the interviewees responded that knowledge

transfer from internal structure to external is not significant in their organisation.

All the interviewees responded that they appreciate and valued special competence in their organisations. Knowledge transfer from competence to internal structure is considered medium for most of the companies except Gadang Holdings Berhad that they considered the transfer is low. Mr. Khoo Keow Pin, Director of Pintaras Jaya Berhad expressed that knowledge and technology are two determinant factors for the success of a specialist contractor like Pintaras Jaya Berhad. Special competence that an individual held is therefore essential to transfer new technology to the organisation. He further explained that the knowledge transfer from competence to internal structure often occurred during the process of construction projects when they engage experts in particular fields. On the other hand, introducing new technologies that can enhance the efficiency of the individuals are equally important and are not neglected by all the interviewed companies. For example, Pintaras Jaya Berhad owned advanced Germany hydraulic bore-piling machines and Diaphragm Wall grab that will increase the efficiency and speed of construction. All the interviewed companies responded that knowledge transfer from internal structure to competence is medium.

From the interview session, it is found that levels of knowledge transfer within the organisation are mixed. One important point is that most knowledge

transfer within the organisation occurred within the Ad-hoc project teams within the construction companies. Mr. Teo Sock Cheng, Road Builder Berhad General Manager of Construction Division explained that there are more interactions and exchanging of ideas within a particular project team to resolve challenges in construction projects. Thus, transfer of tacit knowledge occurred unintentionally during the process of resolving technical difficulties in construction.

4.2.3 Analysis of Table 4.1(c)

Table 4.1 (c) presents the findings on the types of knowledge transfer in construction firms. All the interviewees except IJM Corporation Berhad responded that transfer of tacit knowledge occurred more often than explicit knowledge. This finding contradicts with the research result by Kogut and Zander (1992) in which their findings shown explicit knowledge is easier to transfer while tacit knowledge is more costly, uncertain and difficult to transfer.

Mr. Ong Ka Thiam, Technical Manager of WCT Engineering Berhad expressed that most of the technical knowledge transfer are via tacit knowledge during the process of construction. These transfer of knowledge occurred unintentionally from joint venture counterparts to internal structure; from senior managers to junior engineers; and so on. Mr. Koay Teng Keong, Gadang Holdings Berhad Executive Director supported this statement and added that this form of knowledge transfer occurred naturally in the construction process and often was not codified or recorded.

Contrary to this, Dato' Goh Chye Koon, Deputy Managing Director of IJM Corporation Berhad stated that transfer of explicit knowledge is preferred and has been practised more commonly compared to transfer of tacit knowledge within IJM Corporation Berhad. The management preferred a systematic way of transferring explicit knowledge as it can be codified and shared between

individuals and departments from time to time. This can overcome the problems of lost of knowledge due to changing of personnel within the organisation.

4.2.4 Analysis Of Table 4.1(d) and Table 4.1(e)

Table 4.1(d) summarised the types of innovation in construction firms whereas table 4.1(e) summarised evidence of innovations in construction firms. From the interview sessions with the management of construction firms, it is found that there is not much innovation in the business management of construction firms. All the interviewee responded that they do not have any innovation in managing company's assets. Only three companies, which are Gamuda Berhad, Road Builder Berhad and Pintaras Jaya Berhad, responded that they have innovated the management of their machineries. For example, Pintaras Jaya Berhad owned over hundreds of crawler cranes and bored-piling machines, apart from utilising all of the machineries themselves, these machineries are rented to other construction firms. On the other hand, apart from renting unused machineries to other construction firms, Gamuda Berhad and Road Builder Berhad joint venture with other counterparts to share the initial cost of the expensive machineries such as tunnel coring machines.

It is also found that innovation in management of human resources and expertise is not common in construction firms. Only Gamuda Berhad and IJM

Corporation Berhad responded that they adopt some innovation in their management of human resources. For example, IJM Corporation has offered Employee Share Options Scheme (ESOS) and bonuses for outstanding staffs. Apart from that, certain percentage of a project's net revenue will be allocated as special incentives for the project team. This is an innovative way to motivate the project team to be dedicated to their projects and maximise the revenue for the company.

All of the interviewees responded that their organisation adopt innovative ways for business development and marketing. However, all of the interviewees refuse to reveal their innovation in business development and marketing as it is considered classified and confidential.

On the other hand, evidences of innovation are more throughout in the operation of construction firms. All the interviewees responded that they adopt innovativeness in engineering and design construction methods. For example, Mr. Foo Sheh Eem, Road Builder Berhad Engineering Manager reviewed that expert and innovative use of technology has enable award winning Putrajaya Seri Saujana Bridge to become the state of the art landmark that provides exceptional functional aesthetics without any compromise to the underlying structural efficiency. On the other hand, over the decades, IJM Corporation Berhad has been investing in research and development to promote the usage precast concrete panels as an alternative construction method via its

subsidiary Industrial Concrete Products Berhad. IJM is also the pioneer in introducing system formwork for the shear wall system for the construction of high rise buildings. On the other hand, Gamuda Berhad has used climbing formwork for the erection of box-girder of the elevated bridge to avoid obstruction to the hectic traffic flow below the bridge. Besides that, Gamuda Berhad has also adopted pre-grout method for the boring works of tunnel. Evidences of innovation in operations were also obvious in Company X and IJM Corporation Berhad as innovative ways of construction such as top-down construction were adopted. Pintaras Jaya Berhad has introduced new type of ground anchor that will ease the removal of the anchor. WCT Engineering Berhad has shown its innovative way by implementing rock-fill method for the Bakun Dam construction.

On the other hand, all the interviewed companies responded that they have adopted innovativeness in engineering design. All of them often proposed alternative design that is cost effective and will reduce the construction period significantly. For example, Pintaras Jaya Berhad often provide alternative design of substituting several small size bored pile with a large diameter bored pile to cut down on the construction period.

From the interview sessions, four of the construction firms responded that they adopt innovation in construction material, which are Gamuda Berhad, Road Builder Berhad, IJM Corporation Berhad and WCT Engineering Berhad.

IJM Corporation Berhad has involved in the research and development of using rice hush as an alternative to aggregate in concrete. Similarly, Gamuda Berhad has also introduced steel fibre concrete with higher strength and durability to substitute conventional concrete. Road Builder Berhad has introduced Jumbo Beam which has higher strength and smaller size as an alternative for conventional U-Beam construction. WCT Engineering Berhad has utilised black pipe as an alternative for G.I. pipe for inclinometer installation.

From the summary of Table 4.1(d), all of the construction firms responded that they do not have any innovation in construction contracts. On the other hand, all of the interviewees except Gadang Holdings Berhad reviewed that they have innovative ways to improve the construction logistic. According to Company X, management of a construction project is the management of change. Construction logistic is often determined by site constraints and innovation is extremely important to ensure the flow of the project is not affected by the bad access at site.

4.2.5 Analysis of Table 4.1(f)

Summary of Table 4.1(f) as in Appendix A consists of factors affecting innovation of construction firms. These factors are crucial to sustain the innovativeness of construction firms.

From the interview sessions with eight construction firms selected, it is found that effective exchange of knowledge within organization and effective transfer of knowledge from external sources are important to innovativeness of construction firms. Apart from that, all the interviewees agreed that absorptive capacity of the organization is also crucial to innovativeness of their organisations. This is because knowledge is the basis of innovation and absorptive capacity determines the permeability of an organisation towards new knowledge. The higher the rate of knowledge transfers from external sources and the higher the absorptive capacity of an organization, the higher the innovativeness of the organization. From the interview sessions with eight construction firms, it is learnt that all the companies stressed on the continuous learning and training programme for their staffs and knowledge transfer from external sources to individual and internal structure are ranked from medium to high.

Apart from that, all the interviewed companies unanimously agreed that short-term planning and long-term strategy of the organization are another two

important factors affecting the innovation level of construction firms. According to Mr. Liang Kai Chong, Executive Director of WCT Engineering Berhad, a complementary short-term planning and long-term strategy will enhance the innovativeness of an organization. For example, a long-term strategy that encourages research and development will definitely increase the innovativeness of the organization.

All the interviewed companies agreed that coordination with external network by developing mutual trust and respect with the permanent network of the organization would affect the innovation level of an organisation. All of the companies stressed that developing a long-term partnership with external network will help the organization gain competitive advantage. This is because some mega projects need to be completed within a very short period of time and shortage of labour and other resources is a common problem these large construction firms often encounter. Therefore, at critical time like this, all these large construction firms need the support of its sub-contractors and suppliers to expedite the work in order to complete the project in time. Of course, with the strong ties that are developed, the interactions and exchanging of knowledge between construction firms and its network will spur the innovativeness. However, most of the interviewees responded that they only allow limited openness with its permanent network, especially when it comes to interest of the organization.

In terms of detailed contractual in temporary network, 71.43% of the interviewed companies felt that it will affect the innovativeness of the organization whereas WCT Engineering Berhad and Pintaras Jaya Berhad noted that this is not a factor affecting innovativeness and competitiveness of an organization.

Adjust to environment and research and development are two factors that affect moderately the innovation level of an organisation. Response from the interviewed companies varies. According to Mr. Khoo Keow Pin, Executive Director of Pintaras Jaya Berhad, even though Pintaras Jaya Berhad does not have research and development but there is still innovations in its operation. He further expressed that adjust to environment is important for construction firms but it rarely affect the innovativeness of the firm.

Majority of the companies interviewed said that development of social ties and understanding of social values has no direct impact to innovation of an organization. Contrary to the majority view, Mr. Andrew Yeow, Design and Technical Manager of Gamuda Berhad said that local construction firms have the advantages of understanding local norms in Malaysia. However, in foreign markets, understanding of social values and development of social ties are important and will affect innovation of construction firms. For example, due to the high labour cost, construction in Taiwan requires massive machineries and high technologies. Innovation in construction therefore needs to be

focused on technology. Mr. Teo Sock Cheng, General Manager of Road Builder Berhad construction division supported this view and added that construction of highways in India normally stretching through poor rural area where labour cost is relatively cheap. Heavy usage of high technology machineries will burden the projects due to the logistic difficulties. Moreover, heavy usage of machineries will cause dissatisfaction amongst local Indians as no job opportunities are created. This will then create more social problem that may hinder and delay the project. Based on the reasons above, only Gamuda Berhad and Road Builder Berhad agreed that a matching culture would affect innovation of construction firms.

All of the interviewed companies unanimously agreed that joint venture and alliances would affect the innovation of construction firms because joint venture and alliances will encourage more interaction and exchanging of ideas between two or more competent organization in different fields, therefore yield better results through innovation.

4.3 Testing of Propositions

4.3.1 Proposition 1

According to proposition 1, more efficient and effective exchange of knowledge between external and internal parties of construction firms leads to higher innovation performance. From the findings, it is found that companies that have high frequency of knowledge transfer from external structure to internal structure have higher coverage of innovation within its organization.

This proposition is accepted. Construction firms that have international joint venture experiences will gain more exposure to new knowledge and interaction of different ideas. This often leads to higher innovation performance during the process of construction projects. Therefore, this proposition is accepted.

4.3.2 Proposition 2

A long-term view in construction firms enhances the firm to adjust to changes in the environment and increase innovation performance. This proposition is accepted because all the interviewed companies unanimously agreed that long-term strategies are important to increase innovation performance within the organization. They believe that well-planned business strategies such as forming alliances and investment in research and development will encourage innovation. From the findings, all of the interviewed companies felt that

management of construction firm is the management of change. Long-term view in construction firms will enhances the capabilities of the construction firms to adjust to the changing environment.

4.3.3 Proposition 3 :

A firm that has higher absorptive capacity are more open to changes and influx of new ideas from various external sources. This will encourage and enhance the innovation performance of the firm. Firms that have low absorptive capacity and close-door policy have little room for improvement as well as innovation. All the interviewed companies supported this proposition. Therefore, proposition 3 is valid and in line with Sijtsema & Postma (Sijtsema & Postma, 2004) claim that the better developed the absorptive capacity of the construction firm, the higher the innovation performance.

4.3.4 Proposition 4 :

Government regulations and laws do have an impact on construction industry in terms of cost and time. However, government regulations such as safety and health, environment impact assessment (EIA) are gazetted to protect the interests of the public. The government regulations and restrictions will not cause any hindrance to the development of new knowledge and do not have any impact on the innovation within construction firms. Research findings

show that 85.71 percent of the interviewed companies said that government regulations do not have any impact on innovation within construction firms. Gamuda Berhad is the only company responded that government policy that encourages innovation by giving tax relief and incentives will enhance development of new knowledge within construction firms. The research findings contradict with Sillars and Knagari (Sillars and Knagari, 1997) claim that less strict regulations and restrictions has a positive impact on the development and diffusion of new knowledge for innovation within construction firms. Therefore, proposition 4 is rejected.

4.3.5 Proposition 5 :

Knowledge is power. Therefore, knowledge can help gain competitive advantage for a firm. The research findings show that all the interviewed companies supported this proposition and are in line with Sijtsema & Postma (Sijtsema & Postma, 2004) claim that coordination between construction firm and its external knowledge resources will enhance knowledge transfer and thus gaining competitiveness in the industry. Therefore, proposition 5 is valid and accepted.

4.3.6 Proposition 6 :

Five out of seven of the interviewed companies supported the proposition suggested by Hamel (Hamel, 1991) that coordination of temporary network, in the form of detailed contracts, has a negative impact on exchange of knowledge for competitive advantage between internal and external knowledge resources in construction industry. This is because temporary network with extensive focus on contractual details will cause parties in the project team to be hostile and too afraid to disclose information and knowledge. They will optimise work only within their scope to avoid any delay that will cause Liquidated and Ascertained Damages (LAD). As a result, interaction and sharing of ideas and knowledge is minimum and little effort is seen to create win-win situation for the temporary network. However, there are two interviewed companies responded that they opposed to this proposition as they claimed that temporary network in the form of detailed contracts do not have any impact on exchange of knowledge for competitive advantage between internal and external knowledge resources in construction industry. This show that the proposition is weak and is reject for this purpose.

4.3.7 Proposition 7 :

Trust has been the key factor to sustain long-term relationship between construction firms and its network. The trust-based network has instilled

confidence in all parties within the network and has caused interactions within the permanent network become more active. As a result, more exchanging and sharing of knowledge take place. All of the interviewed companies supported this proposition. Therefore, proposition 7 is accepted and is in line with Dubois and Gadde (Dubois and Gadde, 2000) claim that coordination of permanent network, in the form of trust, has a positive impact on exchange of knowledge for competitive advantage between internal and external knowledge resources in construction industry.

4.4 Summary of Research Results

Generally, the research can be divided into two parts of propositions. The first part includes propositions one, two, three and four that propose the factors affecting the knowledge transfer for innovation in construction firms. The second part includes proposition five, six and seven that states the factors affecting exchange of knowledge for competitive advantage in construction industry. The summary of the result is shown in table 4.2 (Appendix A).

From the research results, percentage of propositions accepted for the knowledge transfer for innovation in construction firms is 75% whereas percentage of propositions accepted for the knowledge transfer for competitive advantage in construction industry is 66.67%.

The research results shown that effective transfer of knowledge; well-planned long-term view; and better developed of absorptive capacity will leads to higher performance of innovation in construction firms. Proposition four that support less strict regulations and restrictions has a positive impact on development of new knowledge for innovation in construction firms is rejected.

On the other hand, proposition five that supports coordination between construction firm and its external knowledge can help to gain competitive advantage; and proposition seven that supports coordination of permanent

network, in the form of trust, can help to gain competitive advantage are accepted. Proposition six that supports coordination of temporary network, in the form of detailed contracts, has negative impact on gaining competitive advantage is rejected. The research results are in line with the Knowledge-based View model indicates that firms with valuable, rare and inimitable knowledge, skills and expertise have the potential of gaining competitive advantage.

The popularity of Knowledge-based View (KBV) model has shown gradual increase amongst construction firms. However, much more effort is needed to further enhance the application and penetration amongst construction firms in Malaysia.