KNOWLEDGE MANAGEMENT EMPLOYED BY FIRMS A STUDY OF THE INDONESIAN CONSTRUCTION CONTRACTORS

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ABSTRACT

Over the past twenty five years before the Asian financial crisis began, construction industry in Indonesia had played quite a big role in the Indonesian economic development. During the recent years there was a need of the construction industry particularly the multi-story buildings construction firms, to manage organizational knowledge in terms of how to gain access to new knowledge (renew) in construction technologies, to use, to store, to transmit and to share within the organization. A good knowledge management employed is a need toward the competition and increase profit. Indonesian construction firms namely multi-story buildings construction contractors had also established integrating learning through collaborative work arrangements which provide forums for knowledge acquisition.

This paper reports the result of a study in seeking answer to the question of how knowledge management employed affects competitive performance in Indonesian multi story buildings construction contractors. A knowledge strategy framework based on the literature was used in this study to evaluate knowledge strategy and management of construction firms operated in Indonesia. Some dimensions of the knowledge strategy, i.e., sourcing of knowledge, scope of knowledge, and depth of knowledge strategy. These measures includes acquisition of explicit and implicit knowledge, emphasis on organizational learning through external knowledge acquisition and internal training, monitoring evolving technologies in construction sector; breadth of technologies capabilities, emphasis on research and development and depth of technical capabilities of either head office technical management team and site technical management team. A total of twenty nine item knowledge strategy measures were investigated. The final measure of knowledge management utilizing a five point Likert response format. Competitive performance as defined in this paper consists of trends in the value of contract awards; including absolute contract award growth and proportional contract award growth (percentage); value of contract award per technical management employee; and a weighted average performance index. The evaluation of the specific competitive performance indicators for the firms over the period 1992 to 1997. During this period a lot of multi-story buildings were constructed in Indonesia.

In this report both qualitative and quantitative research were involved. Five Indonesian multi-story buildings construction contractors and five Indonesian Joint Venture multi-story buildings construction contractors with head offices located in Jakarta were included in the sample. The principal data collection in this study was via personal interviews which included completion of survey forms as part of the interview. Typically three people included top management officer and project manager from each firm were separately interviewed. To achieve the objective of the study the non parametric technique Spearman Rank Correlation was employed.

The results indicated that that knowledge management employed in terms of technological knowledge strategy applied had a direct relationship with competitive performance of either the local construction firms and the Indonesian joint venture construction firms. For both type of construction contractors, the better knowledge management employed, the higher the value of their competitive performance indicators. The report supports recent arguments of some organizational and knowledge strategy management scholars regarding the importance of the importance of knowledge management to a firm's performance. This paper also provides a basis for future investigation and understanding of knowledge strategy and management. Industry professionals can use these results to better define priorities and move forward into a culture of knowledge management to increase their ability to innovate and ensure continuous improvement demanded in today's dynamic business environment.

KEYWORDS

knowledge management, technological knowledge strategy, technology strategy, competitive performance, construction, joint venture, multi-story buildings.

BACKGROUND

Malhotra (1998) defined knowledge management in the following terms: Knowledge management caters to the critical issues of organizational adaption, survival and competence in face of discontinuous evironmental change. Knowledge management is necessary for companies because what worked yesterday may or may not work tomorrow. In construction the products are unique there is little room for change and experimentation in a given project. Processes change slowly and the choice of technology is not the exclusively decision of the user (Carillo,1993).But, the construction process should evolve to increase productivity and efficiency in coping with an evermore competitive era. This make the research of the implementation of technological knowledge management on construction companies is interesting. More focused investment and application in construction technology is expected to improve the value chain and competitive performance of firms (Hampson, K. and Tatum, C.B., 1997; Tatum, C.B., 1989). Construction firms managers need to recognize the competitive need to invest in and apply more appropriate technology that will benefit their operation. The technology strategy of such firms includes plans and actions to anticipate and acquire technology that can

improve performance (Hampson, K. and Tatum, C.B., 1997). In studies by Thee (1990), Narayanan (1994a, 1994b) and Ofori (1994b)**,** the type of relationship domestic firms have with the international corporation appears to be a basic factor which determines the degree of local technological application. Thee (1990) in his study of technology transfer through transnational corporations in selected manufacturing industries in Indonesia found that local technological effort, that is the use of technological knowledge to adapt technology which may lead to a higher level of technological mastery, is greater in national companies without transnational corporations equity involvement than in joint ventures. Conversely, Ofori's (1994b) case study in Singapore found that a joint venture is the most widely preferred vehicle for construction technological knowledge transfer. With a construction market worth billions of dollars, Indonesia has therefore, attracted the attention of construction companies from Japan, Great Britain, Europe, the United states and from Newly Industrial Economies. Such companies have established joint-ventures with local partner This shows the need to survey a technological knowledge management problem in the construction industry in a developing country namely, Indonesia.

Technological Knowledge Strategy

The technological knowledge management problem viewed in this paper as the application of the technological knowledge strategy by firms. The technological knowledge in construction namely construction technology would be measured. The difficulties arise largely from the fact that much of important technology is knowledge, not a tangible product, and cannot be directly put in place, observed and enumerated. Hampson (1993) sought answer to one of his research questions: "Can technology strategy be measured?". His research extended Burgelman and Rosenbloom's study (1989), which proposed an evolutionary process framework for the formation of technology strategy. The researchers' idea is that technology strategy emerges from organizational capabilities, shaped by the generative forces of the firm's strategic behavior and the evolution of the technological environment, and by the integrative mechanism of the firm's organizational context and the environment of the industry in which it operates. The results of the study of Hampson (1993) provide a series of quantitatively-based dimensional measures for analyzing a firm's technology strategy. In this paper the framework of Hampson and Tatum (1997) was used to serve as the basis for analyzing technological knowledge strategy (technology strategy) in construction. They described five dimensions of technology strategy portion of their research in studying the relationship with competitive performance as follows: competitive positioning, sourcing of technology, scope of technology strategy, depth of technology strategy and organizational fit. Competitive positioning includes: relative emphasis of technology in business strategy and relative command of key technologies in the market; the dimension of sourcing of technology consists the degree of the firm structures its approach to the acquisition of explicit (hardware) and implicit (knowledge) value-creating technologies; the scope of technology strategy consists of the core and peripheral technologies in the firm and sources of information concerning these technologies; while the dimension of depth of technology strategy includes: relative emphasis on research and development, depth of technical capabilities, and emphasis on breaking construction operations down into task performed by specialists. The last dimension, organizational fit includes the matching of the reward systems in the firm with

the technological objectives and the structuring of information flows throughout the organization.

Competitive performance

Competitive performance is a difficult concept to define and measure. Thompson (1967) stated that regardless of the basis for organizational assessment (efficiency, instrumental or social tests), the important issue for organizations is preparedness for future action. Very often the determinants of industry, firm and business performance is described in models which link to various indicators such as some combination of elements of environment, firm strategy and organizational characteristics. Examples of this type of research are found in several disciplines including economics, management, business policy, finance, accounting, management science, international business, sociology and marketing (e.g., Snow & Hambrick, 1980; Rajagopalan 1996; Richard, O.C., 2000; Gupta & Govindarajan, 1984; Eisenhardt & Schoonhoven, 1990; Keeley & Roure, 1990; Miller, D., 1988; Pettigrew and Whipp 1992). In their framework for diagnosing competitive superiority, Day and Wensley (1988) input elements of competitive advantage is superior skills and superior resources which could also be achieved by technology development. The output elements influenced as performance outcomes are market share and profitability, satisfaction and loyalty. Hampson and Tatum (1997) incorporates organizational policies, size and contract volume to moderate the influence in the relationship of technology strategy and competitive performance.

PURPOSE OF THE PRESENT STUDY

The purpose of this study is to examine how knowledge management in terms of the technological knowledge strategy applied by firms affects competitive performance in the Indonesian construction contractors in particular the multi-story buildings contractors. From the theories and previous research findings presented earlier it was anticipated that technological knowledge strategy would have a correlation with competitive performance. Specifically, it was expected that :

$H1_A$: There is a direct relationship between technological knowledge strategy applied by "internationally linked domestic firms" (Group L) within the construction industry and their competitive performance.

$H1_B$: There is a direct relationship between technological knowledge strategy applied by "domestic firms" (Group D) within the construction industry and their competitive performance.

METHODS

The nature of the data collected for each group in this study is ordinal and the sample size is small (n=5). The data will be analyzed both quantitatively and qualitatively. To achieve the objectives of the study, the nonparametric technique Spearman Rank Correlation was employed. A study of the construction industry by Hampson and Tatum (1997) and

Kululanga et al.(1999) assessed the degree of association between the independent variable and dependent variable using Spearman Rank Correlation.

Sample

The sample of this study were five Indonesian joint venture multi-story buildings construction firms as the "internationally linked domestic firms" include joint ventures (Group L) and five "domestic firms"(Group D) Both group are members of the Indonesian Contractors Association for the year 2000. Throughout the interviews, the managers of these privately held-firms studied were reluctant to disclose the name of each individual construction firm for this research. Therefore in the current study the first five firms (Group L) were described as firm L1 to L5 and the other five firms (Group D) were described as firm D1 to D5.

Measurement

The questionnaires consisted of standardized, multi-item measures that had been validated and shown to be reliable by other researchers. Measures of technological knowledge strategy/ technology strategy (TS) of Hampson and Tatum (1997) were used in this study. They consisted of 29 items scale, grouped in 5 dimensions i.e.: *competitive positioning*: relative emphasis of technology in business strategy, and relative command of key technologies in the market; *sourcing of technology*: how the firm structures its approach to the acquisition of explicit (hardware) and implicit (knowledge) value-creating technologies; *scope of technology strategy*: core and peripheral technologies in the firm and sources of information concerning these technologies; *depth of technology strategy*: relative emphasis on research and development, depth of technical capabilities, and emphasis on breaking construction operations down into task performed by specialists and o*rganizational fit*: match of the reward systems in the firm with the technological objectives and the structuring of information flows throughout the organization. The technology strategy measures utilizing a five point Likert response format.

As developed by Hampson (1993):a series of competitive performance indicators (i.e.: trends in value of contract awards both in value of contract awards and proportional growth in contract awards) have been used and these indicators applied consistently to all firms. Also included a productivity measure i.e.: contract award value per technical management employee as an objective indicator of competitive performance.

FINDINGS

The objective of this study is to examine how technology strategy affects the competitive performance of multi-story buildings contractors owned by the internationally linked domestic firms (Group L) and the domestic firms (Group D). A summary of technology strategy dimensional values assigned for each firm of Group L (L1-L5) was presented in Table 1. The possible values for these items measures range from 1 to 5. The evaluation of each firm's technology strategy dimensional values posited each firm's rank among other

firms in their group. Table 2 displays the summary of technology strategy group dimensional values and rank of firms belongs to Group L. These data provided the independent variables values and rank order to examine the relationship of technology strategy and competitive performance. The summary of technology strategy dimensional for each firm of Group D (D1-D5) would be presented the same way as for Group L

For the current study, firm's performance in the period of 1992 through 1997 was selected since this period can be considered as a well operating phase as far as the foreign investment considered and a lot of multi story buildings and many huge and complex construction have been executed in Indonesia specifically Jakarta and surrounding area. The specific competitive performance indicators for firms over the 1992 –1997 period i.e.: Trends in Value of Contract Awards consists of (1) Absolute Contract Award Growth ($million per year) and (2) Proportional Contract Award Growth (percentages), Value of Contract Award per Technical Management Employee ($million per employee). Indonesian rupiah values were converted to US dollars using an index (PDBI, 2000) that accommodates the Indonesian rupiah and US dollar exchange rates and also inflation rates through the period 1992 –1997. Both annual and three-year average contract award data will be used as the performance indicators. The rank of Group L firms' competitive performance was then presented in Table 3. This evaluation of a series of competitive performance indicators provided the dependent variable: competitive performance for this study. The following section reports the research hypotheses which were tested. The rank of Group D firms' competitive performance was presented in the same way as for Group L.

Technological Knowledge Strategy and Competitive Performance

The hypothesis of $H1_A$ that there is a direct relationship between technological knowledge strategy applied by "internationally linked domestic firms" (Group L) within the construction industry and their competitive performance. Spearman coefficient for the correlation in the Table 4 indicated that there was a perfect direct relationship ($r_{s=}$ 1.000) between technology strategy (all five group dimension) applied by Firm L1- Firm L5) and their average objective competitive performance. Sourcing of technology was negatively correlated with three competitive performance indicators: contract award growth from 1992 through 1997, growth rates in annual contract award from 1992 through 1997, and growth rates in annual contract award from 1992 through 1995. Competitive positioning was negatively correlated with two competitive performance indicators: contract award growth from 1992 through 1997 and growth rates in annual contract award from 1992 through 1997. Competitive positioning was inversely correlated with two competitive performance indicators: contract award growth from 1992 through 1997 and growth rates in annual contract award from 1992 through 1997. The rest of other dimensions of technology strategy and all competitive performance indicators were directly correlated varying from 0.132 to 0.900. Hence the hypothesis $H1_A$ was supported.
The hypothesis of $H1_B$ stated that there is a direct relationship between technological knowledge strategy applied by "domestic firms" (Group D) within the construction industry and their competitive performance. Spearman coefficient for the correlation in the Table 5 indicated that there was a significant direct relationship ($r_{s=}$ 0.667) between

technology strategy (all five group dimension) applied by Firm D1- Firm D5) and their average objective competitive performance. Also Spearman coefficient for the correlation in the Table 5 indicated that there was a perfect direct relationship ($r_{s=}$ 1.000) between scope of technology strategy applied by Firm D1- Firm D5) with contract award growth annual data from 1992-1997. Depth of technology and organizational fit were significantly correlated with three competitive performance indicators: contract award growth from 1992 through 1997, contract award growth from 1992 through 1995, and average annual contract award per technical management employee from 1992 through 1995. Competitive positioning was negatively correlated with two competitive performance indicators: growth rates in annual contract award from 1992 through 1997 and also with growth rates in annual contract award from 1992 through 1995. The rest of other dimensions of technology strategy and all competitive performance indicators were directly correlated varying from 0.051 to 0.900. Hence the hypothesis $H1_A$ was supported

DISCUSSION

The findings of this study have potentially significant implications for technological knowledge strategy as well as for managerial practice. The results strongly support the importance of technology strategy for firm performance. Furthermore, this research also suggest a complex resource technology strategy-contingency fit. Thus, it provides more empirical support for theoretical understanding of the value of technology strategy. One possible weakness of the results of the study was the small sample size. While substantial efforts were made to achieve a higher response rate, the relatively small study population limited the number of actual responses. Only a small number (9) joint venture multi-story buildings constructions firms held the ICA 2000 membership. Future studies may also well consider other industries with a larger population and therefore having potential for more robust findings.

Though there is evidence in the body of knowledge that technological knowledge strategy is linked to firm performance, previous studies do not appear to reflect the strength of the relationship identified in this study. Clearly this is an area which deserves substantial additional inquiry. Further study might include investigating technological knowledge strategy (technology strategy) and its relation to other variables such as business strategy, organizational structure, organizational competencies and managerial characteristics.

CONCLUSION

Importantly the results indicated a significant direct relationship between technological knowledge strategy applied by either the internationally linked Indonesian construction firms and the domestic firms and their competitive performance. These findings mirrored the results obtained by Hampson (1993) and Hampson and Tatum (1997), which concluded that the technology strategy did appear to matter on competitive performance. The results of this research are significant for several reasons. First they support recent arguments of some organizational and technological knowledge strategy management scholars regarding

the importance of technology strategy to a firm's performance. Equally, the results provide strong support for the importance of technology strategy for the firm as presented by several strategy scholars in recent years (Maidique, 1980; Burgelman, A & Rosenbloom,1989; Hampson, KH & Tatum C.B.1997). This should increase the motivation of managers of construction firms in Indonesia to pursue a more advanced approach to technology strategy for competitive performance.

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TABLE 2
TECHNOLOGY STRATEGY DIMENSIONAL VALUE
AND RANKS OF FIRMS (GROUP L)

Technology Strategy (TS) Dimensional Values	Firms				
	L1	**L2**	**L3**	**L4**	**L5**
a Competitive Positioning	17	16	17.5	15	16
Rank a	**4**	**2.5**	**5**	**1**	**2.5**
b Sourcing of Technology	15	13	16.8	14	16.5
Rank b	**3**	**1**	**5**	**2**	**4**
c Scope of Technology Strategy	11	10	12.5	10	10.5
Rank c	**4**	**1.5**	**5**	**1.5**	**3**
d Depth of Technology Strategy	15	12	15	14	13
Rank d	**4.5**	**1**	**4.5**	**3**	**2**
e Organizational Fit	13	9	12	11	10
Rank e	**5**	**1**	**4**	**3**	**2**
Total TS Values	20.5	7	23.5	10.5	13.5
Rank of Total TS Values	**4**	**1**	**5**	**2**	**3**

TABLE 1

SUMMARY OF TECHNOLOGY STRATEGY VALUES OF FIRMS (GROUP L)

MEASURE	Firms				
	L1	**L2**	**L3**	**L4**	**L5**
a **COMPETITIVE POSITIONING**	**17**	**16**	**17.5**	**15**	**16**
(i) Emphasis of tech in overall business strategy	3.5	4	3	3	3
(ii) Command of key technologies is sector	3	3.5	4	3	3
(iii) Command of unique technological position	3.5	3.5	3.5	3	3
(iv) Ability to be key technology leader	4	2	3	2.5	4
(v) Monitoring of competitor technologies	3	2	4	2.5	3
b SOURCING OF TECHNOLOGY	**15**	**13**	**16.8**	**14**	**16.5**
(i) Acquisition of explicit technology	3	2	3.3	3	3.5
(ii) Acquisition of implicit technology - head office management	3	2.5	3	3	2.5
(iii) Acquisition of implicit technology - site management	2.5	3	3.5	2.5	3.5
(iv) Emphasis on organizational learning	3.5	2.5	4	2.5	3
(v) Monitoring evolving technologies in sector	3	2	3	3	4
c SCOPE OF TECHNOLOGY STRATEGY	**11**	**10**	**12.5**	**10**	**10.5**
(i) Breadth of technological capabilities	3.5	3.5	4	3	3.5
(ii) Content focus of tech monitoring and development	3.5	3.5	4	3.5	3
(iii) Geographic focus of tech monitoring and development	4	3	4.5	3.5	4
d DEPTH OF TECHNOLOGY STRATEGY	**15**	**12**	**15**	**14**	**13**
(i) Emphasis on research and development	3.5	3.5	4	3.5	3
(ii) Depth of tech capabilities - head office management	4	3	4	3.5	3.5
(iii) Depth of tech capabilities - site management	3.5	2.5	3.5	3.5	3
(iv) Degree of specialist tasking	4	3	3.5	3.5	3.5
e ORGANIZATIONAL FIT	**13**	**9**	**12**	**11**	**10**
(i) Reward systems - head office management	3.5	2.8	3	3	2.5
(ii) Reward systems - site management	3	2.2	3	2.5	2.2
(iii) Structuring of info flows - site to site	3	2	3	2.5	2.5
(iv) Structuring of info flows - site and head office	3.5	2	3	3	2.8

TABLE 3

RANKS OF FIRM'S COMPETITIVE PERFORMANCE (GROUP L)

Competitive Performance Indicator	Firms				
	L1	**L2**	**L3**	**L4**	**L5**
Contract Award Growth ($M/Year) Annual Data - 1992-1997	14.00	4.00	16.80	19.00	4.00
Rank	**3.0**	**1.5**	**4.0**	**5.0**	**1.5**
Contract Award Growth ($M/Year) Annual Data - 1992-1995	12.00	6.00	81.30	11.33	14.00
Rank	**3.0**	**1.0**	**5.0**	**2.0**	**4.0**
Av. Annual Contract Award Per Tech. Mngt.Emplyee ($M/Year) - 1992-1995	2.17	1.67	6.65	1.37	3.03
Rank	**3.0**	**2.0**	**5.0**	**1.0**	**4.0**
% Growth in Annual Contract Awards 1992 – 1997	13.10	12.60	14.70	23.00	12.60
Rank	**3.0**	**1.5**	**4.0**	**5.0**	**1.5**
% Growth in Annual Contract Awards 1992-1995	50.00	24.23	35.60	16.55	30.14
Rank	**5.0**	**2.0**	**4.0**	**1.0**	**3.0**
Average Objective Performance Indicator	3.40	1.60	4.40	2.80	2.90
Rank of Average Objective Performance	**4.0**	**1.0**	**5.0**	**2.0**	**3.0**

TABLE 4

SPEARMAN COEFFICIENTS FOR TECHNOLOGY STRATEGY VALUES
AND COMPETITIVE PERFORMANCE INDICATORS OF FIRMS (GROUP L)

Competitive Performance Indicators	Technology Strategy Values					
	Compe-titive Positi oning	Sourcing of Techno-logy	Scope of Techno-logy Strategy	Depth of Techno-logy Strategy	Organi-zational Fit	Total Techno-logy Strategy Values
Contract Award Growth ($M/Year) Annual Data 1992-1997	-0.053	-0.41	0.132	0.632	0.564	0.308
Contract Award Growth ($M/Year) Annual Data 1992-1995	0.667	0.5	0.872*	0.616	0.5	0.900*
Av Annual Contract Award Per Tech Mgt Employee ($M/Year) - 1992-1995	0.821*	0.6	0.872*	0.526	0.3	0.8
% Growth in Annual Contract Awards 1992-1997	-0.053	-0.41	0.132	0.632	0.564	0.308
% Growth in Annual Contract Awards 1992-1995	0.872*	-0.1	0.872*	0.667	0.7	0.8
Average Competitive Performance Indicators	0.821*	0.900*	0.975**	0.872*	0.8	1.00**

* correlation is significant at 0.05 level (1-tailed)
** correlation is significant at 0.01 level (1-tailed)

TABLE 5

SPEARMAN COEFFICIENTS FOR TECHNOLOGY STRATEGY VALUES
AND COMPETITIVE PERFORMANCE INDICATORS OF FIRMS (GROUP D)

Competitive Performance Indicators	Technology Strategy Values					
	Competitive Positioning	Sourcing of Technology	Scope of Technology Strategy	Depth of Technology Strategy	Organizational Fit	Total Technology Strategy Values
Contract Award Growth ($M/Year) Annual Data 1992-1997	0.700*	0.900*	1.00**	0.975**	0.975**	0.975**
Contract Award Growth ($M/Year) Annual Data 1992-1995	0.308	0.564	0.667*	0.684*	0.684*	0.684*
Av Annual Contract Award Per Tech Mgt Employee ($M/Year) - 1992-1995	0.700*	0.900*	1.00**	0.975**	0.975**	0.975**
% Growth in Annual Contract Awards 1992-1997	-0.500	0.100	0.200	0.051	0.051	0.051
% Growth in Annual Contract Awards 1992-1995	-0.600	-0.300	-0.100	-0.205	-0.205	-0.205
Average Competitive Performance Indicators	0.200	0.600*	0.700*	0.667*	0.667*	0.667*

* correlation is significant at 0.05 level (1-tailed)
** correlation is significant at 0.01 level (1-tailed)