The Impact of Information Infrastructure Capabilities on Knowledge Manipulation Skills: A Conceptual Framework

Lew Sook Ling, Multimedia University, Malacca, Malaysia, sllew@mmu.edu.my

Dr. Uchenna C. Eze, Multimedia University, Malacca, Malaysia, uchenna.eze@mmu.edu.my

Abstract

The globalisation of business, the growing use of information and communications technology (ICT) and, the shift from production-based to knowledge-based economy have given knowledge management (KM) a critical position across firms. However, there is limited empirical link between KM and information infrastructure capabilities [IICs] [1, 2]. A key objective of this paper, therefore, is to determine the impact of information infrastructure capabilities on knowledge manipulation skills. This study will also examine specific applications that enable KM activities in firms. We will collect data from a sample of about 600 firms in MSC using questionnaires. Multiple analytical tools will be used in this study to determine the significant levels of associations and interactions between the variables. This research would provide useful information that could help MSC companies determine types of information infrastructures for effective KM implementation. To academics, the empirical insights from this study would be useful for theory building in the subject area.

Keywords: Knowledge management implementation, knowledge manipulation skills, information infrastructure capabilities, Malaysia

Research Background

One of the objectives of the World Trade Organisation (WTO) is to help trade flow smoothly, freely, fairly and predictably [3]. The international trade can be significantly eased by communication between markets which leading to further progression of globalisation across borders. The progressive movement of globalisation demands employees who can work effectively across national and cultural boundaries. For example, progressive movement of globalisation in Asia resulting increased demand by business for a more skilled and educated workforce [1, 2, 4, 5].

Among the efforts undertaken by Malaysia in becoming an intelligent nation is the development of Multimedia Super Corridor (MSC) project which was conceptualized in 1996. The project was modelled after Silicon Valley, which will offer the best of first-world knowledge and infrastructure, at developing-nation costs [6]. This is also an initiative designed to help Malaysia leapfrog into an information and knowledge economy by the year 2020.

With this, the number of ICT companies has grown tremendously. In 1997, the country had less than 300 ICT companies. It now has reached 3,400 [7, 8]. As for the number of MSC companies, there were only 94 in 1997 and achieved 1,792 as of 17th April 2007 [6]. Having qualified for MSC-status, one of the conditions for the companies is that, at all times, at least 15% of the total numbers of employees (excluding support staff) are knowledge workers to maintain this preferential status. This requirement is in line with the k-economy initiatives complying [6].

One of the main challenges for Malaysia is the change in the emphasis of economic development from a production-based economy to a knowledge-based one [1, 4, 9, 10].

While the literature on knowledge management (KM) is still growing, an online research of databases indicates less than ten KM-related publications in Malaysian context to date. Furthermore, none of the publications discusses KM in context presented in this paper.

Statement of Problem

The KM literature has largely focused on general conceptual principles of KM and knowledge management systems (KMS) in leading firms. These do not provide concrete evidence on the relationship between knowledge manipulation skills and information infrastructure capabilities [IICs] 1, 2, 11-17]. It is thus difficult for knowledge managers to plan effective KM and information infrastructure despite all the understanding from the literature about what knowledge is and how it is created, organised, stored/maintained, shared and applied. The difficulties arise because an empirical link does not exist between knowledge manipulation skills and information infrastructure capabilities.

For instance, in 1997, a framework for organising corporate memories in KM was developed by Gertjan, Rob and Eelco. The framework only presents a conceptual outline of corporate memories and probably the major contribution is that it has identified a number of issues that needed attention [16].

While Hahn and Subramani's framework is valuable in focusing attention on the utility, limitations, and assumptions inherent in different KMS, it does not address the variations in the utility of similar systems in different contexts encountered in the study. For instance, why was a database of experts that was so successful in one division of an organisation viewed as being less useful when it was expanded to cover multiple divisions? Why did discussion forums that were vibrant and successful in one organisation fail to generate any user interest in another [12]?

An extended KM assessment framework was proposed by Kim. Based on the service type and knowledge type used, each with two dimensions, this extended framework classifies the organisational KM frameworks into four distinct groups, which may provide more realistic approaches to the industry practices. However, there is no perfect framework developed so far [14]. It offers a starting point for more sophisticated organisational KM framework assessment and development [14]. An inevitable limitation of Kim's framework is that it is based on one assumption: a firm takes one dominant KM approach. However, some companies are engaged in multiple businesses that are heterogeneous in terms of service type and knowledge type used. As such, when a company takes multiple KM approaches, the proposed framework may not be applied [14]. Furthermore, Kim's framework is limited to the management consulting industry in the U.S.A and Canada only. Other industries in different countries may indicate different results.

Later, in 2005, Rajiv and Sanjiv reiterated the potential impacts of ICT-based KM efforts and highlighted the need for managers to carefully consider the specific circumstances surrounding their firms in deciding whether, and what kind of ICT-based KM efforts are most appropriate, at least in terms of how well they would be received in the short term. However, the study may be limited due to their focus on a specific KM effort. They made simplifying assumption that each announced KM effort concentrated on one of the activities such as knowledge creation, sharing or applying. In fact, a firm may have a number of mechanisms and processes.

In addition, there have been numerous studies about KM and ICT. However, there have been only limited physical numbers of studies about KM and its underlying ICT components [14] specifically in Malaysian context [2]. Studies conducted in Western countries may not be generalised to the Malaysian context due to differences in culture and business customs [1, 2]. Although there were studies done in Asian countries such as Japan [18], Singapore [1], Taiwan [17], and Hong Kong [15], they still may not be generalised to Malaysian context.

In 2004, a study on success factors of KM implementation was carried out. The study has addressed the need for theory-based research on the influence of 14 KM factors on the performance of organisations in Singapore. The research has confirmed previous works on the efficacy along with mechanisms to ensure that the KM success factors proposed would increase the organisational performance [1]. However, the study has selected companies in Singapore only. The data could not be extracted to the worldwide markets as well as the Malaysian market.

Furthermore, although there have been numerous studies about KM, there are only a few studies to suggest or prove the factors and perceptions of KM implementation in organisations. There have been only a limited number of surveys done by KM experts and consulting companies [1]. Additionally, these surveys only provide a general guideline to identify the success factors of KM implementation in organisations. In order to truly understand the information infrastructure capabilities, it is indispensable to investigate the underlying components of ICT because no individual ICT application can exist without its infrastructure support [14].

The Holsapple and Joshi's threefold framework can be employed to organise an exploration of available technologies. The framework recognised that technology can play an important role in KM, but does not emphasise its role relative to non-technological aspects. That is, the framework is applicable regardless of whether one wants to use it from a technological, human, or hybrid vantage point. However, there are uncertainties found especially in KM technology context:

1. What types of technologies can support and/or perform each of knowledge manipulation activities?
2. What types of technologies facilitate KM initiatives (e.g., measuring, controlling, and coordinating knowledge manipulation activities and resources)?
3. What types of technologies can be used for storing, representing, and embedding knowledge?
4. How can technology affect projection and learning [13]?

Hence, this study addresses the impact of information infrastructure capabilities on knowledge manipulation skills in MSC Malaysia companies. This could provide some clarity to the uncertainties in terms of the role of information infrastructure capabilities in KM.

Recognizing that MSC companies pioneer the ICT efforts in Malaysia, a study on these companies would provide a guide on the necessary information infrastructures that would aid KM implementation. Consequently, serve as a reference point for companies and industries intending to apply KM framework to identify KM technologies and infrastructures, which would be useful for KM activities and business performance.

Objectives of Research

The overall goal of this study is to determine the impact of information infrastructure capabilities on knowledge manipulation skills. Specifically the following are the objectives of this study:

1. To identify the information infrastructure capabilities [IICs] that are needed for the knowledge manipulation skills;
2. To determine the impact of information infrastructure capabilities on knowledge manipulation skills; and
3. To examine the effect of demographic characteristics as moderating variables

Significance of Research

This research is one of the first that attempts to investigate the impact of information infrastructure capabilities on knowledge manipulation skills in Malaysia. Since the MSC companies are recognised as knowledge-based firms, the findings will offer useful information to the MSC companies with respect to the types of information IICs to effectively implement KM and eventually lead them to future business success. This study would also offer a guideline to other industries on key information infrastructure necessary for KM implementation.

To academics, the empirical insights from this study would add to the theoretical development of the relationships between knowledge manipulation skills and information infrastructure capabilities. This would lead to a better understanding of the relationship between knowledge manipulation skills and IICs.

Conceptual Framework

The Organisational Information Processing Theory (OIPT), developed by Jay Galbraith, identifies three important concepts: information processing needs, information processing capability, and the fit between the two to obtain optimal performance. Organisations need quality information to cope with environmental uncertainty and improve their decision making. Environmental uncertainty stems from the complexity of the environment and dynamism, or the frequency of changes to various environmental variables [19, 20]. The concern of OIPT includes organisational needs, organisational capability and effectiveness.

Typically, organisations have two strategies to cope with uncertainty and increased information needs: (1) develop buffers to reduce the effect of uncertainty, and (2) implement structural mechanisms and information processing capability to enhance the information flow and thereby reduce uncertainty. A classic example of the first strategy is building inventory buffers to reduce the effect of uncertainty in demand or supply; another example is adding extra safety buffers in product design due to uncertainty in product working conditions. An example of the second strategy is the redesign of business processes in organisations and implementation of integrated IS that improves information flow and reduces uncertainty within organisational subunits. A similar strategy is creating better information flow between organisations to address the uncertainties in the supply chain [19-21].

With respect to this research, IIC is conceived as organisational needs and capability, which will lead to better knowledge manipulation skills. In line with the foregoing, we consider the OIPT theory appropriate for this study.

Independent Variables

In this research, the independent variable is a group of information infrastructure capabilities (Fig 1).

Each capability of the IICs is distinct. But they are highly interrelated, constrain, facilitate, and reinforce each other.

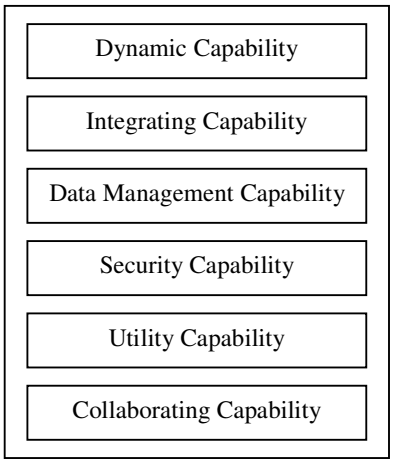

Fig 1. Information Infrastructure Capabilities

Dynamic Capability

KM involves distinct but interrelated processes of KM activities. At any point in time, an organisation and its members can be involved in multiple KM

activity chains. As such, KM is a dynamic organisational phenomenon. Organisations need to be highly responsive in an environment of rapid change. Dynamic capability refers to the ability of organisational flexibility with respect to environmental changes [12, 16-18, 22, 23].

Organisations need to be flexible and innovative when they consider the time to market their product and technological change demands highly responsive decisions when future competition and market structures are difficult to forecast [17]. For instance, in collecting organisational knowledge, easy to use and easy to remember retrieval mechanisms (e.g., search and retrieval commands) are important aspects of an organisational KM strategy while a variety of search and retrieval approaches and tools exist. The challenge in design of organisational knowledge retrieval strategies is providing timely and easy access to knowledge while avoiding a condition of information overload [22].

Dynamic capability has been shown to improve KM for the delivery of business excellence and competitive advantage by facilitating the related knowledge resources across the businesses [12, 17, 18, 22, 23].

Integrating Capability
Integrating capability refers to the ability of "linking individual components and services for the purpose of sharing software, communication, and data resources" [14]. Information from different organisational repositories should be integrated in a unified view instead of having information spread across many sources within organisation. The data sources include file servers, databases, business systems, groupware systems, document repositories, and the web [24]. Integrating capability of information infrastructure can ensure enterprise wide compatibility among ICT components so that ICT applications can be assessed and used by employees across the organisation [14].

Effective performance and growth in knowledge intensive organisations requires integrating and sharing highly distributed knowledge [25, 26].

From the foregoing discussion, ICT components support ICT applications in different levels. ICT applications will have varying degrees of appropriateness for the KM activities. There is a variety of ICT components in an organisation in order to support different levels of KM activities. Hence, it is indispensable to integrate all physical ICT components (such as hardware, software, data and telecommunications) working together as an integrated resource.

Data Management Capability
Knowledge is comes from data and information [15, 27]. Data are raw facts that must be stored, grouped, analysed and summarised to have meaning. When data are organised and processed in a meaningful context, they become information. Knowledge consists of data and information that has been organised and processed to give understanding, experience, and expertise in a specific context [24, 26]. The organised and processed knowledge is the KM activities. Hence, data management includes creating, organising, storing/maintaining, sharing and applying data.

Data management capability includes the capability to manage data. This capability includes database management systems [14], data storing (databases or online repository) [28], data tracking [28], data transaction [22, 28], data analysing [28] and data translating [28].

Security Capability
Security is the capability to minimise ICT vulnerability and abuse [14]. Security in an organisation focuses on maintaining knowledge in its original and constructive state (i.e. not losing it or allowing it to become altered or obsolete) and keeping knowledge from unauthorised transfer to other organisations using policies, procedures, technical and legal measures [14, 29]. The policies, procedures, technical and legal measures include backup, disaster management and recovery planning [14].

Utility Capability
KM is the basis for the effective utilisation of many important resources [15]. Utility capability is the basic and common services that every type of information infrastructure has. Even though all capabilities are important, in order to support different needs, different KM frameworks will need different capabilities at different degrees [14, 17]. Utility capability includes ICT planning, training, education, customer service and support.

Collaborating Capability
Collaborating capability refers to the ability of linking people so that they can work together. Collaborating capability of information infrastructure can ensure mutual efforts by two or more individuals in order to perform task [14, 24, 25].

The rise of suits of collaboration tools over the last couple of years has been substantial [25]. Most of the largest ICT vendors, for example, IBM have introduced the concept of activity-centric collaboration through Activity Explorer, and MS Office Communicator delivers enhanced collaboration between many of its synchronous

communications. Those developments are a welcome improvement to the collaboration technologies and it is expected to see more in the near future [25].

Collaboration tools are central to KM effectiveness. Common collaboration tools include instant messaging, SMS, e-mail, discussion groups, blogs, wikis, bulletin boards, project workspaces, task lists, calendars, document sharing and corporate portals [14, 24, 25]. For instance, corporate portals can also give organisational participants the ability to create a shared community because they present a natural forum for online collaboration by assembling a set of content and services to which members of a group have special accesses [14, 24, 25].

Dependent Variable

The dependent variable in this research would be knowledge manipulation skills. This refers to the capability of performing KM activities using information infrastructure capabilities. For instance, an individual's knowledge manipulation skills can be applied to create a unit of knowledge for the organisation or the skills of multiple participants may jointly create knowledge [12-15, 17, 23, 24, 30].

Moderating Variables

Demographic characteristics of respondents and companies do moderate the relationships between the independent and dependent variables. There were five key characteristics viewed as demographic characteristics: job title, number of years in the position, educational background, number of employees and annual avenues [14].

Further, types of ICT application would be tested as moderating variable [14, 15, 17, 23, 24, 25, 31]. The most frequently utilised types of ICT application include Intranets, content management systems, document management systems, relational and object databases, groupware and workflow systems, data warehousing systems and data mining systems [15, 22].

Hypotheses

The hypotheses for this study include:

H1: *High information infrastructure capabilities will positively influence knowledge manipulation skills.*

H2: *Types of ICT application would moderate the effects information infrastructure capabilities on knowledge manipulation skills.*

H3: *Demographic characteristics would moderate the effects of information infrastructure capabilities on knowledge manipulation skills.*

Research Model

The research model includes three groups of variables. These variables are based on theoretical and empirical considerations described above. Table 1 summarises the variables and sources.

The research model is summarised and presented in Fig 2. The information infrastructure capability [IIC] is the independent variable. Knowledge manipulation skill is the dependent variable. Demographic characteristics and types of ICT applications are the moderating variables.

We conceive IICs as organisational needs and capabilities, which influence knowledge manipulation skills. Consequently, firms that have high IIC capability that are used effectively to enhance knowledge manipulation skills would have a greater chance of achieving higher performance.

Table 1: Summary of Variables

Item	Variables	Sources
Independent		
V1	**Information Infrastructure Capabilities**	
	V5: Dynamic	[12, 17, 18, 22, 23]
	V6: Integrating	[14]
	V7:Data Management	[14, 18, 22, 24, 28]
	V8: Security	[14, 29]
	V9: Utility	[11, 12, 14, 24, 28]
	V10: Collaborating	[14]
Dependent		
V2	**Knowledge Manipulation Skills**	[13]
Moderating		
V3	**Demographic Characteristics**	[14]
V4	**Types of ICT Application**	[16-18, 22, 28]

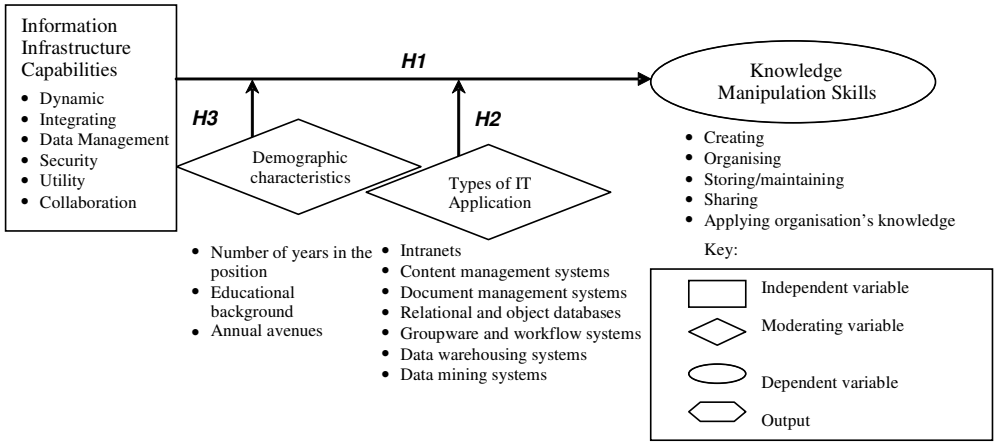

Fig 2. Research Model

Research Methodology

Research Questions

The main research question of this study is: What is the impact of information infrastructure capabilities on knowledge manipulation skills? Specifically, it tries to answer the following research questions:

- What are the information infrastructure capabilities needed to enhance knowledge manipulation skills in organizations?
- Are there any interaction between knowledge manipulation skills, types of ICT applications and demographic characteristics?

Source of Data

Primary data will be derived from a set of survey questionnaire. The questionnaire was developed based on the literature review, the objectives of the study and the three hypotheses. The survey questionnaire will be distributed to about 600 middle IT managers working in the MSC companies to collect relevant information.

Questionnaire Design

The research questionnaire will have three main sections. Section A will have two parts. We will design Part A for data on organisational and individual respondents' demographic characteristics. We will use nominal scale to measure the respondents' answers in this part [32, 33].

Section B will include questions on the respondents' agreement or disagreement on the current business environment of information infrastructure capabilities as adopted from both Choi and Chongs' studies [5, 34]. Most questions in this section will be positively worded. Rensis Likert has formalised this procedure through the creation of the Likert Scale [32, 33], a format in which respondents are asked in the example as follows:

1	=	Strongly Disagree	4	=	Agree
2	=	Disagree	5	=	Strongly Agree
3	=	Neither Agree nor Disagree (neutral)			

Responses will be coded in such a way that higher values indicate higher levels of agreement. Each respondent would then be assigned an overall score representing the summation of the scores received for his or her responses to the individual items. Since the questions require the respondent to indicate the level of agreement on each item and the distance between points has meaning, interval scale will be used [32, 33].

Section C will be designed to collect information on information infrastructure capabilities that are needed for knowledge manipulation skills. Nominal scale again will be used to measure the respondents' answers as in Section A [32, 33].

Sampling Method

The population frame for this research contains about 1,711 companies as at 17th April 2007 [35]. We will use simple random sampling to select the samples for this study. This sampling design allows all company in the database equal chances of being selected [33].

Unit of Analysis

The unit of analysis in this study will be organisation. The questionnaire will be

addressed to the middle managers of each of the chosen company will be invited to participate in this study because of their importance as stressed by many knowledge management researchers (see the next section). Nonaka (1994) asserted that the most important knowledge creating individuals are neither top managers nor lower managers. It is the middle manager that takes a strategic position at which he or she combines strategic, macro, universal information and hands-on, micro, specific information. They serve as a bridge between the visionary ideals of the top and often chaotic reality on the frontline of business.

Literature suggests that ultimate KM initiatives are to make tacit knowledge explicit [12, 14, 18, 22, 26, 28, 36, 37]. Middle managers synthesize the tacit knowledge of both frontline employees and top management, make it explicit, and incorporate it into new technologies and products. In other words, they are the true knowledge engineers of the knowledge-creating company [1, 2, 18].

Middle managers perform an even more critical role than binding top to bottom or inner to outer core. They tie the company together horizontally by looking for opportunities to leverage skills, methodologies and capabilities – in other words – organisational knowledge. They are closer to the marketplace than the senior executive and possessing a more strategic perspective than the front-line worker. A key role of middle managers has been to make meaning or knowledge from the information gathered at the front line, a task which the senior executives of the organisation generally have neither the time for nor the appropriate perspective of.

Posing questions to the right person is critical in any survey approach; a middle manager from each MSC-status company will be selected to participate in this study due to their importance as stressed by many KM researchers. In other words, middle manages are appropriate persons and knowledgeable about the topic to answer the survey questions. This is especially true when the unit of analysis is organisation [32].

Pilot Survey

A pilot survey aims at providing an opportunity to measure face validity and reliability of the instrument [32, 33]. Based on the above recommendations, a pilot study for this research is necessary in developing the survey questionnaire. Pilot study will be conducted using a group of 20 middle managers. The suggestions and comments from the pilot study will be evaluated and incorporated into the survey or test design prior to the actual study. The revised questionnaire will then be sent to KM and information system experts for further reviews. These experts will be professors in academic institutions.

Data Analysis Techniques

We will apply multiple data analytical techniques in this research including factor analysis, multiple linear regression, t-test, analysis of variance (ANOVA), and Bonferoni post hoc test. Structural equation modelling (SEM) will be used to test the model [38].

The descriptive analysis will enable understanding of respondent's feedback using frequency, mean and standard deviation [32, 33]. In order to develop reliability and validity measurement for the variables, factor analysis will be carried out before subjecting the data to inferential analysis. Multiple linear regression will then be used to examine the relationship between independent and dependent variables. T-test and ANOVA will be used to understand the level of significant difference between variables especially the demographics, types of ICT application and the key constructs (Fig 3).

Acknowledgement

We would like to thank Dr. Eddy Chong Siong Choy for his advice and contructive comments at the initial stages in this research.

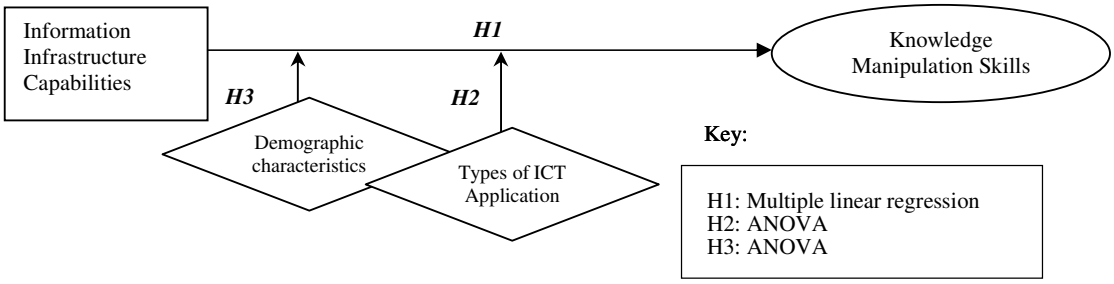

Fig 3. Data Analysis Techniques

References

[1] S. Bawany, "Key Success Factors of Knowledge Management (KM) Implementations in Singapore," Bawany Associates Pte Ltd, Singapore 20 February 2004 2004.

[2] S. C. Chong, "Implementation of knowledge management among Malaysian ICT companies: An empirical study of success factors and organisational performance," in Faculty of Business and Law, PhD: Multimedia University, Malaysia, 2005.

[3] World Trade Organisation. Retrieved October 23, 2007, from://www.wto.org/

[4] S. C. Chong, "KM Implementation and Its Influence on Performance: An Empirical Evidence from Malaysian Multimedia Supercorridor (MSC) Companies," Journal of Information and Knowledge Management, vol. 5, pp. 21-37, 2006.

[5] S. C. Chong and Y. S. Choi, "Critical factors in the successful implementation of knowledge management," Journal of Knowledge Management Practice, 2005.

[6] Multimedia Development Corporation. Retrieved January 15, 2008, from://www.mdc.com.my/

[7] Department of Statistics, Malaysia. Retrieved June 15, 2007, from://www.statistics.gov.my/

[8] M. Zulfakar, "Don't lose your staying power, PM advises MSC Malaysia," in The Star. Cyberjaya, 2006.

[9] M. A. Taap, "Challenges and potentials in human resource development in a knowledge-based economy: A Malaysian perspective.," 2001.

[10] J. S. Sidhu, "Information and communications technology among key focus of 9MP," in The Star Online. Kuala Lumpur, 2006, pp. B2.

[11] V. H. Gertjan, V. d. S. Rob, and K. Eelco, "Corporate memories as a tool for knowledge management," Expert Systems with Applications, vol. 13, pp. 41-54, 1997.

[12] J. Hahn and M. R. Subramani, "A framework of knowledge management systems: issues and challenging for theory and practice " presented at International Conference on Information Systems, Brisbane, Queensland, Australia, 2000.

[13] C. W. Holsapple and K. D. Joshi, "Knowledge Management: A Threefold Framework," Information Society, vol. 18, pp. p47-64, 18p, 2002.

[14] S.-K. Kim, "An empirical study of the relationship between knowledge management and information technology infrastructure capability in the management consulting industry." United States – PhD: Nebraska: The University of Nebraska - Lincoln, 2001.

[15] E. W. T. Ngai and E. W. C. Chan, "Evaluation of knowledge management tools using AHP," Expert Systems with Applications, vol. 29, pp. 889-899, 2005.

[16] S. Rajiv and S. Sanjiv, "Knowledge Management Using Information Technology: Determinants of Short-Term Impact on Firm Value*," Decision Sciences, vol. 36, pp. 531, 2005.

[17] P. J. Sher and V. C. Lee, "Information technology as a facilitator for enhancing dynamic capabilities through knowledge management," Information & Management, vol. 41, pp. 933-945, 2004.

[18] I. Nonaka, "A Dynamic Theory of Organizational Knowledge Creation," Organization Science, vol. 5, pp. p14, 24p, 1994.

[19] J. R. Galbraith, "Designing Complex Organizations," Reading. MA: Addison-Wesley, 1973.

[20] J. R. Galbraith, "Organization design: An information processing view," Interfaces, vol. 4, pp. 28-36, 1974.

[21] G. Premkumar, K. Ramamurthy, and C. S. Saunders, "Information processing view of organizations: An exploratory examination of fit in the context of interorganizational relationships.," Journal of Management Information Systems, vol. 22, pp. 257-294, 2005.

[22] M. Alavi and D. E. Leidner, "Review: Knowledge management and knowledge management systems: conceptual foundations and research issues.," MIS Quarterly, vol. 25, pp. 30, 2001.

[23] H. Tanriverdi, "Performance effects of corporate diversification: Roles of knowledge resources, knowledge management capability and information technology.," vol. Ph.D.: Boston University, United States--Massachusetts., 2001.

[24] H. Benbya, G. Passiante, and N. Aissa Belbaly, "Corporate portal: a tool for knowledge management synchronization," International Journal of Information Management, vol. 24, pp. 201-220, 2004.

[25] H.-J. Christopher, "Knowledge management past and future," KM World, vol. 15, pp. 20, 2006.

[26] M. H. Zack, "Managing codified knowledge," Sloan Management Review, pp. 44-58, 1999b.

[27] A. Tiwana, *The knowledge management toolkit: practical techniques for building a knowledge management system*, Prentice-Hall, Inc., 2000, p. 608.

[28] M. H. Zack, "Developing a Knowledge Strategy," California Management Review, Spring99, vol. 41, pp. 21 (125-145), 1999a.

[29] J. M. Bloodgood and W. D. Salisbury, "Understanding the influence of organizational change strategies on information technology and knowledge management strategies," Decision Support Systems, vol. 31, pp. 55-69, 2001.

[30] V. Nath, "Heralding ICT enabled knowledge societies: Way for forwarding for the developing countries ", 2000.

[31] T. Meek, "The Evolution of Information Technology at Buckman: How an IT infrastructure can support knowledge management.," Knowledge Management Review, vol. November/December 1999, 1999.

[32] E. Babbie, Survey Research Methods, Second ed: Wadsworth Publishing Company, 1990, p. 395.

[33] U. Sekaran, *Research Methods for Business: A Skill Building Approach., 4th Edition:* John Wiley & Sons, Inc., 2003, p. 450.

[34] Y. S. Choi, "An empirical study of factors affecting successful implementation of knowledge management," University of Nebraska, 2000.

[35] Multimedia Development Corporation. Retrieved June 15, 2007, from://www.mdc.com.my/

[36] T. Dingsoyr, H. K. Djarraya, and E. Royrvik, "Practical knowledge management tool use in a software consulting company," Communications of the ACM, vol. 48, pp. 96-100, 2005.

[37] M. T. Hansen, N. Nohria, and T. Tierrney, "What's your strategy for managing knowledge?," Harvard Business Review, pp. 106-116, 1999.

[38] C. Dewberry, *Statistical methods for organizational research: theory and practice,* New York, NY: Routledge, 2004, p. 340.