Linking Knowledge Management and Innovation: a Structural Equation Modeling Approach

Rosmaini Tasmin, Universiti Tun Hussein Onn Malaysia, Batu Pahat, Malaysia, rosmaini@uthm.edu.my

Peter C. Woods, Multimedia University, Cyberjaya, Malaysia, p.woods@mmu.edu.my

Abstract
Knowledge Management (KM) is gaining attention and acceptance by organizations in search for competitive advantage. KM facilitates opportunistic application of fragmented knowledge through system integration. Being a new discipline, KM has been associated with innovation, competitiveness, and business performance. General interest pertaining to KM and its link to innovation exists, however, there is little reported research that supports for such empirical links especially in Malaysian context. Furthermore, contemporary KM studies are based upon American and European models, frameworks, and instruments. There is a need for local research to address the KM practices and effects based on local settings. Using data from 149 large manufacturers, a KM enabling practices survey, which comprises of 5 key domains, is compared with four demographic firm elements. T-test, One-way ANOVA, LSD, and multiple regression analysis are applied to identify the level of KM practices and study the significant differences in terms of demographics among these large manufacturers. It is discovered that KM practices are at medium level among large firms being surveyed. It is found that there are significant differences in KM practices among firms with high annual sales. Measurement model analysis is engaged to confirm significant relationships between variables and their respective KM factors. Subsequently, structural model analysis is applied to test theory of structural relationship between KM enabling practices and innovation activities. Finally, a KM-Innovation model is proposed based on good fit indices of structural equation modeling.

Introduction
Knowledge management (KM) is increasingly recognized within manufacturing firms as a critical approach that can be leveraged to attain competitive advantage and superior performance. Managers realize that KM draws on principles, practices, and technologies from a wide spectrum of disciplines. These disciplines include management information system, computer science, behavioral science, organizational learning, research, and training. During the late 1980’s, managers in several industries believed that advances in technology prepared them to manage knowledge effectively. However, they soon discovered that managing knowledge is not a simple issue of managing technology, but it also requires managing social relations and interactions in the firm. Gooijer (2000) defined knowledge management as “those actions which support collaboration and integration”. Yahya and Goh (2002) described KM as “...a process of leveraging of knowledge as the means of achieving innovation in process and products/service, effective decision making, and organizational adaptation to the market” (pg. 458). Tasmin and Woods (2007) defined KM as “a socio-technological based system that supports collaboration and integration among interlocking organizational functions to create more innovative and value-added products and services for the market” (pg. 63). Knowledge management practitioners and researchers alike support the view that KM requires the integration between the IT systems and people who run the firm as means to attain innovation.

KM and innovation
Malaysia has embarked and moved forward to be a developed and industrialized country by the year 2020. This resulted in with the launch of Vision 2020 by Tun Dr. Mahathir, then Prime Minister of Malaysia, at the Inaugural Meeting of the Malaysian Business Council (MBC) in Kuala Lumpur in February 1991. Attempting to be a fully developed nation by 2020, Malaysia aggressively moves into knowledge-based economy via the Multimedia Super Corridor (MSC) initiatives (Sharma, 2003). Growth in internet-based application, information technology (IT), K-based economy, global e-learning and commerce leads to widespread knowledge management (KM) practices in many firms. Holsapple and Singh (2001) stated that in knowledge-based economy, KM practices are “nuts and bolts” for k-based organizations and determinants for organizational competitiveness. In addition, Carneiro (2000) proposed a conceptual model that links between KM, innovation, and competitiveness.

The perceived link between knowledge management and innovation has been widely discussed by scholars and practitioners in KM literature (Uden, L., Kekale, T. and Naaranoja, M., 2007; Darroch, 2005; Darroch and McNaughton, 2002; Brand, 1998; Ruggles and Little, 1997). However, many of these knowledge management-innovation studies are based on Western framework and setting. Furthermore, knowledge management studies in Malaysia are limited to investigating extent of KM awareness and practice, exploring perception of KM issue, and determining KM relationship with competitiveness and employees attitudes. An empirical research on KM approach among electrical and electronic firms in Malaysia reveals that most organizations are lacking of clear KM strategy (Sharma, 2003). This study, however, is limited to only a segment of
Malaysian manufacturing. Thus, the idea of researching the KM practices and innovation based on a whole Malaysian manufacturing industry context took its shape.

**Research hypotheses**

The followings are the research hypotheses that this study seeks to proof or disproof.

**Hypothesis 1**
There is evidence of KM practices among large manufacturers in Malaysia.

**Hypothesis 2**
There is significant difference in KM practices (leadership, culture, technology, process, and measurement) in terms of firm’s demographics (operation years, annual sales, total employees, and ISO certification).

**Hypothesis 3**
KM practices are positively associated with innovation activities.

**Research framework**

Though practitioners and scholars differ in some of their KM approaches, they do project common knowledge practices in culture, technology, and process. However, they have different perspectives on KM practices to strategy, content, structure, and measurement. Since practitioners and scholars more often than not have their own perspectives, this research proposes the combination of both perspectives. This KM research proposition for knowledge management practices pivots around leadership, culture, technology, process, and measurement (Table 1). The argument here is that this proposition encapsulates the overall “best practices” of knowledge management in both worlds of practitioners and scholars alike. The next sections elaborate on this research methodology and data analysis, prior ending it with discussion and conclusion.

**Research methodology**

This research utilizes stratified random sampling in which firms are chosen based on 871 large manufacturers in West Malaysia, listed by database directory of the Federation of Malaysian Manufacturers (FMM), 37th edition. The survey consists of 31 questionnaires with 5-point Likert scales. This research applies SPSS statistical tests and AMOS5 structural equation modeling (SEM) software to determine the relations between KM enabling practices and innovation activities. Maximum likelihood estimation (MLE) is the most widely used estimation procedure under SEM approach. Hair et al. (2006) suggested that minimum sample sizes between 100 and 150 are required to achieve stable MLE results. The research conceptual diagram shows the linkage between firms’ demographics, KM practices, and innovation (Figure 1). Innovation activity assessment is based on the framework proposed by Johannessen et al. (2001).

![Figure 1. Conceptual Diagram of the study](image)

**Table 1: Comparative matrix of KM practices and Research proposition**

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Data analysis and finding
A total of 149 usable data received out of 871 large firms being surveyed. The rate of response is 17.1%. It was ascertained that the outlook of KM practices among Malaysian large manufacturing firms is at overall mean value of 3.06, which is considered at a moderate extent. This is in support to the first hypothetical statement. Alternatively, the outlook of KM practices can be better viewed in a radar chart (Figure 2). It shows both current and perceived importance perspectives on KM.

Figure 2. KM radar chart
Subsequent analysis involves the regression between firm’s demographics and elements of KM practices to determine significant differences among them (Table 2). There is significant difference in knowledge technology between firms with ISO certification and those without (p=0.04). This signifies that ISO certified firms have higher level of knowledge technology. In sum, there is a significant difference in the overall KM practices (F=2.275, sig. f =0.05) particularly among firms with high annual sales of above RM151 million/year. This finding supports the second hypothesis. The finding conforms to other research reports that claimed KM is widely practiced among large corporations (Takeuchi and Nonaka, 2004; Bhatt, 2001; Brand, 1998) and influencing performance (Carneiro, 2000).

The last analysis is to determine the relationship between KM practices and innovation activities. It was executed using the Structural Equation Modeling (SEM), via software Amos5. The SEM technique consists of two components which is also known as two-step approach (1) the measurement model and (2) the structural model (Hair et al., 2006). Prior to the SEM analysis, an exploratory factor analysis (EFA) is done to ensure only the significant variables with high loadings are used in the measurement model. It was found that all significant variables have loading values of 0.50 and above (ranging from 0.605 to 0.902).

The measurement model is the first stage in the SEM approach. Such measurement model analysis is in fact a multiple indicator approach which has tendency to reduce overall effect of measurement error of variables toward resulting output accuracy (Hair et al., 2006). There are 6 measurement models, namely leadership, technology, measurement, culture, process, and innovation in this study, as shown in Figure 3, 4, 5, 6, 7, and 8 respectively.
Figure 3. Measurement model for leadership

Figure 4. Measurement model for technology

Figure 5. Measurement model for measurement
Figure 6. Measurement model for culture

Figure 7. Measurement model for process
Figure 8. Measurement model for innovation

Figure 9. Structural model of KM and Innovation

KM – Knowledge Management Practices; INNV1 – Innovation Activities
The measurement model analysis of leadership (Figure 3) consists of 11 variables, namely LDR2, LDR3, LDR4, LDR5, LDR6, LEADERSHIP, e1, e2, e3, e4 and e5. The measurement model for knowledge leadership was evaluated using a covariance matrix of the five indicators. Modification indices (MI) were evaluated. Based on the MI values, the following two covariances of measurement errors were allowed to be correlated: (1) e5 and e2; and (2) e5 and e4. According to Hair et al. (2006), five determiners of goodness-of-fit indices are ratio of cmin-df, goodness-of-fit index (GFI), normed fit index (NFI), comparative fit index (CFI), and root mean square error of approximation (RMSEA) as shown in Table 3. The model fit indices of leadership measurement model are all within specifications. Cmin/df is 1.015. GFI equals 0.992. NFI equals 0.993. CFI equals 1.000 (the perfect level). RMSEA equals 0.010. Hence, all fit indices comply to the required ranges and acceptable limits. Similar analytical processes were applied to the other 5 measurement models. Results showed that they complied with the required specifications as shown in Figures 4, 5, 6, 7, and 8.

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<th>Table 3: Goodness-of-Fit Indices</th>
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<td>Root Mean Square Error of Approximation</td>
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Source: Hair et al. (2006), Arbuckle (2003), Byrne (2001), and Kline (1998)

Subsequently, the structural model is the second stage and last step in the SEM approach. This model integrates and correlates all factors to the KM construct. It also provides a structural link from the KM construct to the innovation factor (Figure 9). The full structural model result shows that there are 11 correlations and covariances to achieve stable model fit estimates. Figure 9 displays its indicators of fit: Cmin/df = 1.226 (Cmin = 4.903, df = 4); GFI = 0.991; NFI = 0.996; CFI = 0.999; RMSEA = 0.039. In sum, figure 9 empirically shows that KM has a highly significant influence (β=0.74, p=0.001) on firm Innovation activity (R²=0.52). Thus, relationship between KM and Innovation is well supported. Hence, the third hypothetical statement is supported by this finding.

In other words, KM practices are positively associated with innovation activities.

**Discussion**

Abraham (2008) stressed that the major intention of KM is innovation. As such, this research finding of KM significance and influential effect on innovation is consistent with prior study by Gloet and Terziovski (2004). The authors reported that an integrated human resource management (HRM) and humanist KM approach was correlated positively to innovation performance by applying Pearson correlation method. Both authors also recommended that managers focus more attention on the HRM practices when designing organisational strategies for innovation. In another study based on 443 New Zealand firms, Darroch (2005) reported that knowledge acquisition, knowledge dissemination, and knowledge response were positively influencing innovation.

**Conclusion**

Knowledge Management has been regarded as one vital management approach in new era of k-based economy. Harnessing knowledge strength that a firm has leads to higher performance through innovation. It is generally acknowledged that innovation serve as firm’s life line for continuous survival and profitability. It is essential for managers and researchers to ponder what factors contribute to being innovative organisations. This study shed the light that KM leads to innovation. A number of experts stated that the bottom-line of KM is innovation. It should be noted here that this phenomenon is not a causal and effect relationship. There are other strategic practices that also lead to innovation especially among large firms.

It has been shown empirically that large manufacturers in Peninsular Malaysia attain moderate extent of KM practices. Reports stated that large and multinational firms are a typical group of firms that practices KM. This is due to its available pool of knowledge workers and resources. This is in accordance to this study finding which showed some extent of KM practices. In addition, this study also reported that there is a significance difference in KM practices especially among firms with high annual sales. It is generally acknowledged that high volume of sales is a standard feature of large firms. Hence, this study showed that large manufacturers have significance difference in technology among ISO certified firms. Large manufacturers with high sales also depicted significance difference in leadership and technology. It can be deduced that top management of high performing firms is willing to acquire better technological infrastructure with strong sales as an assurance and a means to be more productive and innovative. As a whole, it is fair to state that high sales among large manufacturers do affect KM practices which are highly significant in influencing innovation.
References


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