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■ *Research Paper*

Enhancing Competitive Edge Through Knowledge Management in Implementing ERP Systems

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Using data from 170 manufacturing companies, we identified five facilitators for knowledge management in an ERP environment. Additionally, we examined the relationship between knowledge management and manufacturing companies' competitive advantages in the E-business environment. The result of the study suggests that adopting organizational preparation for KM, employee education and learning, information and data network, knowledge sharing process and knowledge scanning as knowledge management facilitators will have a synergistic positive effect on firms' competitive advantages. Copyright © 2006 John Wiley & Sons, Ltd.

Keywords knowledge management; ERP; enterprise information system; competitive advantage; organizational change; management information system; systems research

INTRODUCTION

The increased speed and power of computers and information systems coupled with development in advanced enterprise information systems are changing the ways companies manage their knowledge and intellectual assets in an E-commerce environment. In recent years, E-business has emerged as a new way of conducting business in a competitive market. As an important component of E-business, enterprise resource planning systems (ERP) integrate business functional areas such as marketing and sales, production, inventory, logistics, human resource and financial management of a company, and link suppliers and customers of the entire supply chain.

During the last decade, ERP systems became the replacement for legacy systems for many Fortune 500 companies. ERP system expenditures were amongst the largest IT investments of the 1990s and have been implemented in over 60% of multi-national firms. The license/maintenance revenue of the ERP market was $17.2 billion in 1998. Even major US software companies have adopted ERP products (Hitt *et al.*, 2002). For example, IBM and Microsoft now run most of their business on SAP R/3 ER software.

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Recently, ERP is becoming popular in the small and medium enterprise market segment due to the importance of Customer Relation Management (CRM), supply chain management (SCM), and business to customer commerce in the business environment. Unless an organization's entire operation is integrated under an enterprise information system, little information will be available to run such initiatives as CRM or SCM.

ERP implementation is closely related to knowledge management. Although technology by itself is not knowledge management, but knowledge management is often facilitated by human who uses technology (Li and Xu, 2002). An ERP system stores a company's data, processes its information, and embeds its knowledge. Such knowledge may reside in company's ERP software such as explicit transaction knowledge; some knowledge such as process knowledge is embedded in the way the activities are conducted and other knowledge may be recorded in process manuals on a regular basis. Yet, other knowledge may embed in the heads of individuals who work directly with the ERP systems themselves (Van Stijn and Wensley, 2001).

In the framework of systems research, the knowledge dimension encompasses specialized knowledge from the disciplines and professions (Warfield, 1989). In general, there is no universal definition of knowledge management. Schultze and Leidner (2002) suggest that knowledge management is to generate, represent, store, transfer, apply, embed, and protect organizational knowledge. We may also think of knowledge management in a broad sense and consider knowledge management (KM) as the process through which organizations generate value from their intellectual and knowledge-based assets (Santosus and Surmacz, 2005). Knowledge management is, therefore, to generate value from knowledge-based assets embedded in individual employees and company's enterprise information systems, to enhance a company's competitive edge and devise best practices.

To date, there is not much research investigates the effect of knowledge management and ERP systems on company's competitive advantages (Wang *et al.*, 2005). Hence, this study is to examine the role of knowledge management on manufacturing company's competitiveness after enterprise resource systems are implemented. The study presents findings about facilitators of knowledge management in 170 US manufacturing firms that have adopted and implemented ERP systems. Two research questions that we feel particularly important are (i) what are the factors that facilitate knowledge management in implementing ERP systems? And (ii) is there an association between knowledge management and company's competitive advantages in E-business environment? The study intends to contribute to the body of knowledge about tacit knowledge management in ERP implementation in several ways.

This paper is organized as follows. Section two provides literature and hypotheses. Section three discusses research methodology. Analysis and discussions are presented in Section Four. Finally, conclusions and limitations are included in Section Five.

BACKGROUND

Implementing ERP systems leads to close communication and tighter integration of business processes which enhance organizational effectiveness and competitiveness. Using ERP systems, manufacturing companies are able to integrate business processes, organization functional units and assimilate information flow. This integration creates new knowledge that enables companies to timely obtain new market insights, quickly adjust to market changes, and rapidly respond to customer requirements. Equipped with the right KM mechanism, ERP systems also enable companies to better extend their business processes beyond the organizational boundary to include customers, suppliers, and trading partners. That is the power of knowledge management in implementing ERP system (Black, 1999).

To our knowledge there is little empirical research that explicitly integrates knowledge management, ERP implementation, and their effects on manufacturing companies' competitive performance. The purpose of this study is

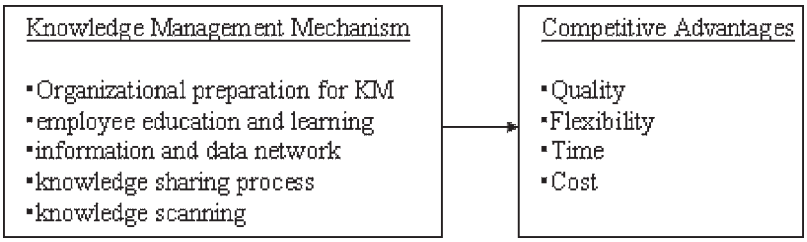

Figure 1. Knowledge management and competitive advantages

to address this gap in the literature by investigating ERP implementation issues related to knowledge management mechanisms, and their effects on competitive priorities.

The conceptual research model is shown in Figure 1. The model is based on an extensive review of the literature and direct discussions with numerous practicing managers. The model has two dimensions reflecting the two research questions introduced in Section One. The first dimension includes the knowledge management mechanisms; and the second dimension explores the effects of knowledge management and ERP systems on company's competitive advantages.

Organizational Preparation for KM

Today, knowledge becomes embedded not only in documents but also in organizational routines, processes, practices, norms, and employees' mind. Knowledge is the fact or condition of knowing something with familiarity gained through experience or association (Merriam Webster's Collegiate Dictionary, 1996). According to Devenport and Prusak, 'knowledge is a fluid mix of framed experience, values, contextual information and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers' (Devenport and Prusak, 1998). Flattened intra organizational networks improve knowledge transfer and organizational learning capabilities (Tu *et al*., 2005). Therefore, effective knowledge management involves organizational preparation such as moving from vertical organization to flattened network organization, adopting an organizational culture of shared vision and values, and changing from sharp line boundaries to blurred boundaries.

Employee Education and Learning

Knowledge management is in general supported by the design of a learning-oriented organizational system (Hall *et al*., 2003). This system must encourage interactivity between organizational members. On the practitioner's side, integrating the application of ERP systems and improving the staff member's knowledge and skill to use ERP has become a critical issue. In the 1990s, many major teaching hospitals embarked on integrated delivery networks (IDN) and adopted new integrated information systems. The idea of IDN is to provide a continuum service from primary health care to the most complicated cases. This project died due to lack of training and employee learning. Hospital managers and nursing staffs were unable to use the integrated database systems or were unwilling to adapt to the new processes required by IDN. This example suggests that without providing employee learning and training, organizations may not achieve the expected results when they adopt ERP systems (Hayes *et al*., 2005). Towards this end, the theoretical upshot is the notion of creating a learning environment that is critical to effectively managing new processes, routines and norms that are associated with ERP implementation and to amplify knowledge management.

Information and Data Network

Information and data network is important to an organization because a knowledge management system must be able to store and retrieve knowledge in a dynamic organizational memory environment while facilitating organizational learning (Hall *et al*., 2003). ERP implementation requires functional integration because ERP system nurtures an environment where all functional units work together to achieve organizational objectives (www.sap.com). An information and data network provides a communication scope and strengthens structural connection that brings flows of information and knowledge to different organizational units. This network facilitates effective communication that binds the organization units and is essential for increasing competitive advantages (Tu *et al*., 2005). For example, in developing an employee evaluation plan, an HR professional can access a broad range of workforce-related data to support accurate planning, facilitate simulated planning scenarios, and monitor actual performance relevant to the plan.

Knowledge Sharing Process

An effective information and data network lays a foundation for organization knowledge sharing. Knowledge sharing process is the atmosphere within the organization that defines accepted communication behaviour, which may facilitate or hinder the communication processes (Tu *et al*., 2005). A growing body of literature suggests that a supportive knowledge sharing process can greatly improve employees' ability to learn and manage knowledge (Hall *et al*., 2003).

Knowledge sharing process provides analysis tools for operational and analytical reports that are shared by various functional areas of a company. An effective knowledge sharing process can help employees to analyse cause-and-effect chains and optimize enterprisewide processes to help increase customer's and shareholder's value. For example, a purchasing manager can apply his knowledge and experience to analyze the distribution statistics needed for supply chain inventory measurements and capture the day-to-day information/data stored in an ERP system.

Knowledge Scanning

ERP systems are able to store, discover, and retrieve large volume of useful data and information. However, sometime there is too much data and information that managers feel it is difficult to figure out meaningful patterns. Knowledge scanning can help to discover useful information and transcend it to knowledge. Knowledge scanning is a KM mechanism that enables firms to identify and capture relevant external and internal knowledge (Tu *et al*., 2005). Many business activities such as market tracking, benchmarking, and technology assessments may be involved in this process. Data warehouse and data mining tools are useful methods to assist knowledge scanning (Li and Xu, 2001; Li *et al*., 2003). Data mining is a process of knowledge discovery in a warehouse of databases. It extracts previously unknown knowledge or patterns on demand, leadtime, production, sales etc. Data mining is an especially useful tool to profile customers. Some people refer to this as 'one-to-one' marketing. Very soon, data mining will be a requirement of supply chain management rather than a competitive advantage.

Not all information is valuable. Therefore, it is up to individual companies to determine what information qualifies as intellectual and knowledge-based assets. In general, intellectual and knowledge-based assets are either explicit or tacit. Explicit knowledge consists of assets that can be documented, such as brand names, patents, and customer lists. The concept of tacit knowledge, or the know-how contained in people's heads, is much hard to define. The challenge inherent with tacit knowledge is figuring out how to recognize, generate, share and manage it (Santosus and Surmacz, 2005). Knowledge scanning could improve a firm's ability to understand and exploit elicit and tacit knowledge and resources.

Knowledge management is to scan a large volume of data and information a company

collects with the assistance of IT network and communication process. ERP systems transact, store, and retrieve data and information. These activities enhance knowledge management. Based on the discussion on knowledge management mechanism in an ERP environment, the following hypothesis is proposed.

> *Hypothesis 1*. Organizational preparation for KM, employee training and learning, effective information and data network, knowledge sharing process, and knowledge scanning have an effect on enhancing knowledge management in an enterprise resource planning environment.

Competitive Advantages

The major theme of manufacturing competitive edge is the manufacturers' choice of emphasis among key tasks (Hill, 1994; Krajewski *et al*., 1996; Hayes *et al*., 2005). These competitive edges include cost efficiency, high quality, time, and product/process flexibility.

Cost
Competing in the market place on the basis of cost efficiency requires striving for low cost production. In order to keep manufacturing costs competitive, managers must address materials, labour, overhead and other costs. Material cost has long been the focus of cost reduction in manufacturing companies. Therefore, material and purchasing related activities are considered as the indicators of the cost capability. Controlling labour, material and production cost variations are all important factors of the cost efficiency construct (Li, 2000).

Quality
Quality has been identified as a manufacturer's capability to compete in the world market (Hill, 1994; Krajewski *et al*., 1996) since quality is an effective mechanism to attract and retain customers. Quality means superior features and tight tolerance of the product. Quality determinants usually include product design quality, manufacturing production quality, employee's technical skill through learning and training, and reliable and dependable product performance. Quality can be used to increase productivity, to catch up with the market competition, and to maintain dependable product performance. Quality is often considered a part of other competitive edges such as low cost or time-based operations because these competitive dimensions benefit from higher quality.

Time
Using time as a competitive advantage is to focus on the reduction of time needed to complete various business activities to satisfy customer needs. In recent years, manufacturing companies have achieved time reduction in various areas. For example, delivery capability is a time issue. Delivery is usually defined in a number of aspects of an organization's operations. One is how quickly a product or service is delivered to a customer. Another is how reliably the products or services are developed and brought to the market. The third is the rate at which improvements in products and process are made (Krajewski *et al*., 1996; Li, 2000). Many companies seek to maintain or increase their customer base by focusing on the competitive priorities of new product development speed, inventory turnover cycle time and rapid and dependable deliveries. Time management can contribute to cost reduction and productivity increase. With time-based competition managers need to carefully identify the steps and time needed to deliver a product or service, and analyze the trade-off between time and cost, and between time and quality (Li, 2000).

Flexibility
Flexibility is the ability to respond to changes. Flexibility is the ability to accommodate the unique needs of each customer which typically implies that the production operating system must be flexible to handle specific customer needs and changes in design. Flexible manufacturing is a strategic approach to manufacturing for competitive advantages that focuses on the use of flexibility to respond to customer requirements and market changes. Process flexibility includes quick equipment changeover, production planning and scheduling. Product flexibility

reflects in the ability to increase and/or decrease product mix, volume and product design. Usually, product mix flexibility is measured by the frequency of occurrence of product mix changes. Volume flexibility is, on the other hand, to accelerate or decelerate the rate of production quickly to handle large fluctuations in demand (Li, 2000).

Given the relationship above, the second hypothesis is proposed.

Hypothesis 2. Knowledge management in ERP environment contributes to companies' competitive advantages.

Hypothesis 2a. Knowledge management contributes to companies' low cost capability.

Hypothesis 2b. Knowledge management contributes to companies' high quality capability.

Hypothesis 2c. Knowledge management contributes to companies' flexibility capability.

Hypothesis 2d. Knowledge management contributes to companies' time capability.

RESERCH METHODOLOGY

Data

The survey reported here was mailed to a group of 2000 APICS members employed within manufacturing firms in the US. We chose to sample APICS members because they have the required knowledge and expertise of firm level ERP implementation. Two hundred and ten responses were received. The effective response rate is 10.5%. In the follow-up process, the most often cited reasons for not responding to the survey were that companies had not implemented ERP systems yet, do not participate in surveys, and the address has changed.

One hundred and seventy responses were used for this study. Forty cases were dropped due to some incomplete responses. The sample included large corporations and large divisions within corporations.

Research Instrument

The primary research instrument for this study is a questionnaire designed to collect data from US manufacturing firms on knowledge management in ERP environment. The survey items used in measuring the model are listed in Table 1. Seven-point Likert scales are used to collect data. The questions on knowledge management have response categories ranging from no evidence (1) to fully implemented (7). The content of these questions is consistent with some empirical studies on knowledge management and ERP implementation (Devenport, 1998; Van Stijn *et al*., 2001; Hall *et al*., 2003; Tu *et al*., 2005).

The performance constructs have theoretical and empirical support. The most commonly cited competitive priorities in the production management literature are low cost, high quality, flexibility, and time (Krajewsky *et al*., 2004; Hayes *et al*., 2005). Indicators for competitive advantages are based on published production and operation management literature focusing on quality performance, product flexibility, process flexibility, cost control, and time-based competition, etc. The performance items are measured on a 7-point Likert scale, ranging from significantly lower (1) to significantly higher (7) as compared to their pre-implementation performance.

Analysis

The analysis phase includes two parts. First, the results from descriptive statistics were analysed to illustrate the factors that constitute knowledge management mechanisms. Then, the relationships between KM and competitive advantages were tested using correlation and regression analysis. In general, regression analysis relates a factor or factors to a specific outcome. For each competitive advantage factor, the technique of least-squares was used to estimate the simple regression coefficient (b_i). The least square technique was also applied to estimate the multiple regression coefficients (b_i). The regression coefficient (b_i) represents the expected change in the competitive advantage indicator associated with one-unit change in

Table 1. Rank order of knowledge management items

Item	Description	Mean	*SD*
OC3	Have become a customer-focused organization	4.83	1.36
ID2	Have implemented completely reliable information networks and communication systems (software, hardware, etc.)	4.45	1.52
EL2	Business leaders committed to the principle of lifelong learning	4.37	1.66
OC5	Have adopted an organizational culture with shared vision, values, and goals	4.28	1.52
OC1	Have flattened the organizational hierarchy	4.13	1.54
ID3	Have developed and implemented procedures that ensure standardization of information in all business operations	4.1	1.45
ID4	Have developed business policies and procedures to ensure complete data integrity ?	4.06	1.41
OC2	Have successfully moved to a team-based organization	4.05	1.56
OC4	Have become a truly global organization	4.03	1.75
KN4	Have institutionalized the process of continuous and rapid operational improvement	3.97	2.56
EL4	Have driven out fear of adopting a new system	3.92	1.5
KN2	Have developed a truly flexible work force and process capability	3.9	1.42
EL1	Have fully educated personnel in enterprise-wide thinking	3.84	1.42
ID1	Have adopted the principles of integrated supply chain management	3.81	1.43
KN3	Have a formal process for identifying and resolving process constraints	3.71	1.65
EL3	Prepared our people to operate in a paperless environment	3.51	1.43
EL5	Have educated all our business leaders in integrated resource management	3.45	1.47
KS1	Supports data warehousing	3.45	2
KS3	Provides decision support tools for analysis of reports	3.31	1.83
KS2	Supports data mining	3.18	1.97
KN1	Can demonstrate total companywide process capability performance of six sigma or better	2.79	1.47

the *i*th independent variable, i.e. knowledge management facilitators.

Reliability for five knowledge management and four competitive advantage scales are range from 0.776 to 0.901 (Table 2). All meet the general reliability acceptable level of 0.6.

RESULTS AND DISCUSSION

Knowledge Management Facilitations

The facilitators for knowledge management are described in five areas. The means and rank orders for the importance ratings of the 21 knowledge management items are given in Table 1. There was a considerable degree of consensus in the sample concerning the importance of the top five items in the five knowledge management items. This suggests that manufacturing companies tend to implement better on items viewed as most important.

Top three out of the twenty-one most important items for knowledge management are in the areas of organization preparation for knowledge management, information network and communication systems, and employee education and learning (Table 1). The mean for becoming a customer-focused company is 4.83 out of the maximum value of seven and the mean for reliable information network and communication systems that include hardware and software is 4.45 and the mean for commitment to life long learning is 4.37. These results indicate that the purpose of knowledge management is to be a better customer-focused organization. The

Table 2. Knowledge management and competitive advantage constructs

Item	Question	Mean	*SD*	Alpha
Organizational preparation for KM (X_1)				0.776
OC1	Have flattened the organizational hierarchy	4.13	1.54	
OC2	Have successfully moved to a team-based organization	4.05	1.56	
OC3	Have become a customer-focused organization	4.83	1.36	
OC4	Have become a truly global organization	4.03	1.75	
OC5	Have adopted an organizational culture with shared vision, values, and goals	4.28	1.52	
Employee education and learning (X_2)				0.830
EL1	Have fully educated personnel in enterprise-wide thinking	3.84	1.42	
EL2	Business leaders committed to the principle of lifelong learning	4.37	1.66	
EL3	Prepared our people to operate in a paperless environment	3.51	1.43	
EL4	Have driven out fear of adopting a new system	3.92	1.50	
EL5	Have educated all our business leaders in integrated resource management	3.45	1.47	
Informatin and data network (X_3)				0.852
ID1	Have adopted the principles of integrated supply chain management	3.81	1.43	
ID2	Have implemented completely reliable information networks and communication systems (software, hardware, etc.)	4.45	1.52	
ID3	Have developed and implemented procedures that ensure standardization of information in all business operations	4.10	1.45	
ID4	Have developed business policies & procedures to ensure complete data integrity ?	4.06	1.41	
Knowledge sharing process (X_4)				0.840
KN1	Can demonstrate total companywide process capability performance of six sigma or better	2.79	1.47	
KN2	Have developed a truly flexible work force and process capability	3.90	1.42	
KN3	Have a formal process for identifying and resolving process constraints	3.71	1.65	
KN4	Have institutionalized the process of continuous & rapid operational improvement	3.97	2.56	
Knowledge scanning (X_5)				0.865
KS1	Supports data warehousing	3.45	2.00	
KS2	Supports data mining	3.18	1.97	
KS3	Provides decision support tools for analysis of reports	3.31	1.83	
Quality (Y_1)			0.890	
QU1	Quality performance	4.32	1.09	
QU2	Product quality control	4.44	1.14	
QU3	Experienced/trained personnel	4.44	1.22	
QU4	Dependability performance	4.56	1.18	
Flex (Y_2)			0.901	
FX1	Flexibility in product packaging sizes	3.85	1.23	
FX2	Flexibility in product variety	3.98	1.18	
FX3	Innovation in manufacturing processes	4.13	1.26	
FX4	Innovation in products or services	4.03	1.17	
Time (Y_3)			0.895	
TM1	New product introduction pace	4.01	1.26	
TM2	Timeliness of shop floor performance information	4.42	1.31	
TM3	Rapid delivery speed	4.60	1.24	
TM4	Dependable delivery	4.61	1.24	
TM5	Inventory turnover cycle time	4.72	1.22	

Continues

Table 2. Continued

Item	Question	Mean	*SD*	Alpha
Cost (Y_4)			0.845	
CT1	Financial performance	4.37	1.18	
CT2	Purchase cost variance	4.02	1.23	
CT3	Job order cost variance	3.76	1.26	
CT4	Cost of activities	3.99	1.12	

mechanisms that manufacturing companies have employed to facilitate knowledge management include a complete reliable information network and communication system which is operated by well-educated and knowledgeable employees.

Another two of the five top items are in the organization preparation for knowledge management area: adopting an organization culture of shared vision, value and goals (with a mean of 4.28) and changing moving from hierarchical organization to flattened organization (with a mean of 4.13). Organizational preparation for knowledge management has gained more attention from manufacturers now. ERP systems that can be viewed as a part of the organizational memory store a diverse range of organizational memory contents located at other memory media, such as organizational processes, structure and culture (Van Stijn *et al.*, 2001). Therefore, manufacturing companies that focus on organizational adaptation in terms of process, structure, and culture are able to adjust to ERP environment and managing the knowledge of how their business functions. The results of our study indicate that organization preparation for knowledge management helps to shape and reinforce behaviour prescriptions in the organization.

The three least emphasized competence items were in knowledge scanning and process areas: provide decision support tools (with a mean of 3.31); data mining (with a mean of 3.18) and six sigma process capability (with a mean of 2.79). A possible reason for a low rating of these three items is that these elements are new business applications and manufacturing companies do not have enough time and experience to implement these practices.

We hypothesized that organizational preparation for KM, employee training and learning, effective information and data network, knowledge sharing process, and knowledge scanning have an effect on enhancing knowledge management in an enterprise resource planning environment (H1). The result of the study indicates that manufacturing companies have put a lot of emphasis on these factors which facilitate knowledge management in ERP environment.

Correlation of Knowledge Management and Competitive Edges

The association between knowledge management and competitive advantages are tested using regression analysis. The multiple regression analysis used five independent variables. They are organizational preparation for KM, employee education and learning, information and data network, knowledge sharing process and knowledge scanning. The four competitive advantage variables (quality, flexibility, time and cost) are dependent variables. The model was run four times with each competitive advantage variable as the dependent variable at a time. The results of regression analysis are given in Table 3, which lists the model R^2, the intercept, the model p-value, the parameters (betas) for the independent variables. The multiple regression models with dependent variables, quality, flexibility, time and cost, are all significant at $p < 0.01$.

We hypothesized that knowledge management in ERP environment contributes to companies' competitive advantages (H2). The result

Table 3. Regression analysis

Dependent variable	Model R^2	Intercept	β for X_i X_1	X_2	X_3	X_4	X_5
Quality (Y_1)	0.198***	13.59***	0.06	0.08	0.22**	0.06	0.14*
Flexibility (Y_2)	0.133***	12.51***	0.13	0.03	0.24**	0.12	0.13
Time (Y_3)	0.165***	16.72***	0.19	0.12	0.22	0.01	0.21*
Cost (Y_4)	0.103***	12.37***	0.12	0.02	0.22**	0.10	0.01

*The model is significant at 0.10.
** The model is significant at 0.05.
*** The model is significant at 0.01.
(X_1) Organizational preparation for knowledge management.
(X_2) Employee education and learning (X_2).
(X_3) Information and data network (X_3).
(X_4) Knowledge sharing process (X_4).
(X_5) Knowledge scanning (X_5).

shows that quality is positively and significantly affected by both information and data network ($p < 0.05$) and knowledge scanning ($p < 0.1$) (H2a). Flexibility is significantly associated with information and data network ($p < 0.05$) (H2b). Time is significantly related to knowledge scanning ($p < 0.1$) (H2c) and cost is significantly associated with information and data network ($p < 0.05$) (H2d). It seems to us that information and data network is the mechanism that contributes most to quality, flexibility, and cost. Data scanning, on the other hand, contributes to the time-based competitive advantage.

In summary, the two hypotheses have been supported by the results of the statistical analysis. Examining the four regression models of KM and competitive advantages as a set, a couple of conclusions can tentatively be drawn. First, all five knowledge management scales—organizational preparation for KM, employee education and learning, information and data network, knowledge sharing process and knowledge scanning—have played significant roles in enhancing competitive advantages in terms of quality, flexibility, time, and cost. Second, information and data network has appeared to be the most critical mechanism that facilitates knowledge management which contributes to better quality, flexibility, time and cost performance in today's E-business environment.

DISCUSSION

In the E-business age, manufacturing organizations are seeking to furnish their end users, partners, and customers with corporate data knowledge. This endeavour has been supported by applying knowledge management in an ERP environment. Equally important has been a central information and data network that allows management to control, secure, and guarantee the quality of the information it allows users to see. The results of our study show that an effective knowledge management system must be equipped with an information and data network that is able to collect data from many sources, distribute data via the Internet as well as client/server systems. At the same time, a knowledge sharing process should be established to collate the data, offer end users a simplified view of complicated information, and provide various standard reports and analyses on product and production-related information. While the knowledge management system distributes data, reports, and accurate results, it also must capitalize on the ability of people who use ERP systems. Our study shows that being a learning organization and committing to lifelong learning are a new mind-set for knowledge management.

Our results show that some benefits of knowledge management correlate directly to a com-

pany's competitive edge, such as better financial performance, less variance in purchasing and production costs, while others contribute to better product quantify and manufacturing quality. Using knowledge management mechanisms, users can enhance their time-based competition ability through effectively using data and information collected and stored in ERP systems. Effective knowledge management mechanisms can help a company to improve customer service by streamlining response time, boost revenues by getting products and services to market faster, and streamline operations and reduce costs by eliminating redundant or unnecessary processes. An innovative method to knowledge management could result in improved cost performance, better quality and increased flexibility in practically any business organization.

In today's information-driven economy, companies that are aware of the most leading edge opportunities will ultimately derive the most value from their intellectual assets. Nevertheless, to get the most value from a company's intellectual assets, knowledge must be shared among knowledge management practitioners, end users, partners and customers. In other words, knowledge should serve as the foundation for collaboration.

CONCLUSION AND LIMITATIONS

Using data from 170 manufacturing companies, we identified five facilitators for knowledge management in ERP environment in this research. Additionally, we examined the relationship between knowledge management and manufacturing companies' competitive advantages in the E-business environment. The result suggests that adopting organizational preparation for KM, employee education and learning, information and data network, knowledge sharing process, and knowledge scanning as KM facilitators will have a synergistic positive effect on firms' competitive advantages.

We have provided two major findings in this study: (i) establish a mechanism to conduct KM in ERP environment. Specifically, organizational preparation for KM, employee education and learning, information and data network, knowledge sharing process and knowledge scanning are identified as KM facilitators; (ii) knowledge management has significant positive effects on enhancing the competitive edges of manufacturing companies. Consequently, manufacturing firms would be well advised to emphasize facilitating knowledge management in ERP environment in order to enhance their competitiveness in the market place.

It should also be noted that this research is based on the responses of managers from 170 manufacturing companies. Different organizations may facilitate their knowledge management differently. Therefore, caution should be taken when readers try to generalize the results of this study. Additionally, any generalizations to service organizations require caution.

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