



# Aligning ERP implementation with competitive priorities of manufacturing firms: An exploratory study

HsiuJu Rebecca Yen<sup>a</sup>, Chwen Sheu<sup>b,\*</sup>

<sup>a</sup> College of Management, Yuan-Ze University, Chung-li, Taiwan

<sup>b</sup> Department of Management, Kansas State University, Manhattan, KS 66506, USA

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## Abstract

Companies worldwide have made substantial investments in installing enterprise resource planning (ERP) systems. In the meantime, implementing ERP systems has proven unexpectedly difficult, and the final benefits have been uncertain. Several researchers have concluded that the failures are usually the result of business problems instead of technical difficulties. ERP systems affect a firm's strategy, organization, and culture. Past research has recognized the need for planning an ERP implementation at the strategic level but offers no specific guidelines. Using the case study method that involves direct observation and systematic interviews at five US and Taiwanese manufacturing firms, this study investigates the relationship between ERP implementation practices and a firm's competitive strategy. The results confirm our research proposition, that ERP implementation should be aligned with competitive strategy. Specific guidelines are suggested for making the alignment. In addition, we identified two other variables, national culture and government/corporate policies, as being critical to ERP implementation in multi-national settings. Managerial implications of the findings and future research issues are discussed.

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## 1. Introduction

Enterprise resource planning (ERP) is an information system that manages, through integration, all aspects of a business including production planning, purchasing, manufacturing, sales, distribution, accounting, and customer

service (Scalle and Cotteleer, 1999). It streamlines data flows throughout the entire organization and allows managers direct access to real-time operations. Through data integration, ERP eliminates counter-productive processes and cross-functional coordination problems that hinder the integration of the organization. ERP arrived at a time when process improvement and accuracy of information became critical strategic issues. The emphasis on supply chain management and the advancement of information technology created a need for enterprise-wide integration. In the past few years,

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\*Corresponding author. Tel.: +1-785-5324363; fax: +1-785-5327024.

E-mail addresses: [hjyen@saturn.yzu.edu.tw](mailto:hjyen@saturn.yzu.edu.tw) (H.R. Yen), [csheu@ksu.edu](mailto:csheu@ksu.edu) (C. Sheu).

ERP has become a “must have” system for almost every firm to improve competitiveness. Mabert et al. (2000) surveyed 479 US manufacturing firms and found that over 60% of companies have installed or plan to install a packaged ERP system.

Previous studies have focused extensively on the implementation of ERP from an information technology point of view. While the technical aspect of installing ERP systems is undoubtedly critical, the strategic aspect of ERP systems could have an even greater impact on a firm’s competitiveness. Based on this premise, this paper investigates the relationship between ERP implementation and a firm’s competitive strategy. Understanding this relationship will enable managers to be more proactive in planning for ERP implementation. The next section reviews relevant literature followed by the presentation of research questions. The research method is then discussed. The methodology involves case studies and is used to explore the relationship between competitive strategy and ERP implementation. The findings from case studies are provided, and the research propositions are reviewed and revised. Finally, managerial implications and potential research issues are presented.

## 2. ERP and operations strategy

### 2.1. ERP implementation

Substantial research in ERP has been published over the last few years. These studies have covered a wide range of research issues pertaining to ERP systems. Some of these works identified technical issues pertaining to architecture, data standards, configuration, and hardware and software integration (e.g., Jordan and Krumwiede, 1999; Markus and Tanis, 2000; Olinger, 1998). Some researchers investigated critical factors (e.g., top management support, sufficient training, proper project management, communication, etc.) to the success of ERP implementation (Bingi et al., 1999; Kumar and Hillegersberg, 2000; Griffith et al., 1999; Holland and Light, 1999; Hong and Kim, 2002; Verville and Halington, 2002; Willcocks and Sykes,

2000). Others studied tactical issues such as process and organizational adaptation, measurement of the benefits, and resistance to change (Glass, 1998; Laughlin, 1999; Motwani et al., 2002; Swan et al., 1999).

A relatively small group of researchers were more concerned with strategic and cultural issues involving the alignment of ERP implementation to products and processes (Bowersox et al., 1998; Davenport, 1998; Hammer and Stanton, 1999; Jacobs and Whybark, 2000; Soh et al., 2000). Hammer and Stanton (1999) related ERP with reengineering, since ERP provides information that flows horizontally across the business. They argued that firms should use ERP as an integrative mechanism to create a new style of management. Davenport (1998), Bowersox et al. (1998), and Jacobs and Whybark (2000) asserted that ERP was not only a software package but also “a way of doing business”. Davenport attributed many failures of ERP implementation to the lack of the alignment with business needs. There is no single “best process” to do business as ERP systems assume and, therefore, the customization of ERP systems is necessary. He further cautioned that firms could lose their source of advantage by adopting processes that are indistinguishable from competitors. He even suggested that firms should restrain from ERP investment until further study of its business implications is fully understood. Bowersox et al. (1998) also supported the need for addressing issues of operational rigidity in order to maintain existing unique value-adding practices. They called for more effort toward integration of supply chain systems using ERP systems.

Jacobs and Whybark (2000) expressed their concerns with ERP implementation. Using the furniture industry as a reference, they illustrated how ERP implementation could lead to disaster unless there were consideration for production processes and customer demand. They suggested that two factors, centralization of information and flexibility of production systems, should be simultaneously considered as firms configure their ERP systems at multiple facilities. For example, firms that have the need for highly centralized control and low flexibility could develop one single set of “best practices” to fit all facilities. In contrast,

firms with no need for centralized control but a desire for highly flexible systems to meet frequent customer changes may opt for multiple ERP systems with multiple “best of breed” processes in individual facilities. Akkermans et al. (2003) also supported the strategic impact of ERP implementation on a firm’s competitive advantage. Finally Soh et al. (2000) studied the ERP implementation practices in a hospital in Singapore and cautioned about potential cultural incongruence in implementing ERP in Asia. Potential misfits could arise from areas including data format, operational procedures (e.g., billing and collection), and output format. Resolving such incompatibilities has resulted in extra implementation time and expense.

Overall, research in this area emphasized the business implications of ERP implementation, which should be far more important than the technical challenge presented. However, there is no framework or procedure available as a guide for linking ERP implementation to a firm’s competitive strategy. Research has not made sufficient effort in addressing ERP implementation from the strategic perspective, although such a need is well recognized. This study intends to extend research in this direction and provides a more in-depth and comprehensive investigation of the strategic aspect of ERP implementation. The remaining portion of this section reviews the relationship between competitive strategy and ERP implementation.

## 2.2. *Competitive strategy, competitive priorities and ERP implementation*

Corporations often consist of several strategic business units (SBU’s). Each SBU is usually a subsidiary, division or plant within the corporation. It has its own business strategy that specifies the scope and the competitive strategy of that business unit. The competitive strategy refers to the basis on which the SBU can achieve and maintain a competitive advantage through differentiation, cost leadership, and response (Miller and Roth, 1994). It is the competitive strategy that guides the choice and development of competitive priorities and specifies how the operations function provides a firm with a competitive advantage in the marketplace. Skinner (1974) first suggested that the choice of competitive priorities includes cost, quality, delivery, and flexibility. Other studies (see, e.g., Hill, 2000; Wheelwright and Bowen, 1996) have since added various dimensions of competitive priorities such as service and innovation. Table 1 defines various competitive priorities that have been commonly adopted in industry (Hayes and Wheelwright, 1984; Krajewski and Ritzman, 2001).

Safeskin Corporation, the number one manufacturer in latex exam gloves, provides a good example of how competitive strategy connects with competitive priorities (Heizer and Render, 2003). Safeskin’s competitive strategy is to achieve its competitive advantage by differentiating its

Table 1  
Competitive priorities

Criteria	Definition
Price	Production and distribution of the product or service at lowest cost
Quality	(a) High performance design: superior features, close tolerance, and great durability (b) Quality consistency: the frequency of meeting the design specifications
Delivery	(a) Dependability: the ability to meet delivery schedules or promises (b) Speed: the ability to react quickly to customer orders
Flexibility	(a) Customization: the ability to satisfy unique need of customers by changing product or service designs (b) Volume: the ability to operate profitably at varying production levels

Source: Krajewski and Ritzman, (2001).

products from competitors. The competitive priority chosen to support such differentiation is “quality product design”, which means that the company must constantly produce reliable state-of-the-art gloves in order to stay ahead of its competitors.

Once competitive priorities are chosen, they become the basis for making structural and infrastructural decisions. Structural decisions refer to facility location, capacity, processes, and integration. The decisions are usually long-term and strategic in nature. On the other hand, infrastructural decisions are related to workforce skills, reward systems, planning and control systems, quality issues, and organizational structure. They tend to be more tactically oriented compared to structural decisions. The literature has verified that the alignment of competitive priorities with both structural and infrastructural decisions is necessary to ensure a firm’s competitiveness (Hayes and Wheelwright, 1984; Hill, 2000; Krajewski and Ritzman, 2001). For example, Southwest, with the competitive priority of low price, performs its operations differently from its rivals. It does not offer meals, assigned seats, interline baggage checking or premium class of services, which altogether reduces its costs but still manages to satisfy the needs of price-sensitive travelers.

ERP implementation impacts many aspects of business operations and performance. It is essentially an infrastructural decision that affects various aspects of planning, scheduling, and control systems. Fig. 1 displays the integrated

view of competitive strategy/priorities and operations decisions. In theory, the types of competitive strategies and competitive priorities define the nature of operations, such as product variety, production volume, and production processes (i.e., make-to-order vs. make-to-stock). For example, a firm that competes on the dimension of customization flexibility would offer more product options specified by individual customer orders. Production volume is likely to be low, and production schedules change more frequently to meet customer needs. In order to respond quickly to customer specified changes, organizational control should be decentralized and supported with an entrepreneurial style. A firm with these characteristics definitely should not install an enterprise system that could force it to follow a more bureaucratic but less flexible process for filling orders and scheduling production. Otherwise, its core source competitive advantage would be at risk. The nature of operations that determines the ERP implementation practices a firm should follow (Jacobs and Whybark, 2000). Implementation practices are referred to as actions taken at various implementation stages including software purchasing, team selection, adaptation, pilot test, and so on. Some of these actions are technology related (e.g., selection of software), while some of them are management related (e.g., training).

The literature has suggested various practices that are critical during the ERP implementation. For example, almost every firm would discover inconsistency between the ERP packages and its current process and organizational structure. Managers must determine whether they want to revise the ERP package or to adapt the current process and structure to the package (Griffith et al., 1998). The decision affects the implementation process and effectiveness of the ERP system. Other possible decisions of implementation practices include process standardization (Bingi et al., 1999), package customization (Glass 1998; Hong and Kim, 2002), degree of information sharing and centralization (Markus et al., 2000), accessibility to ERP information (Markus et al., 2000), and the degree of centralization (Markus et al., 2000). Those are practices believed to be critical the

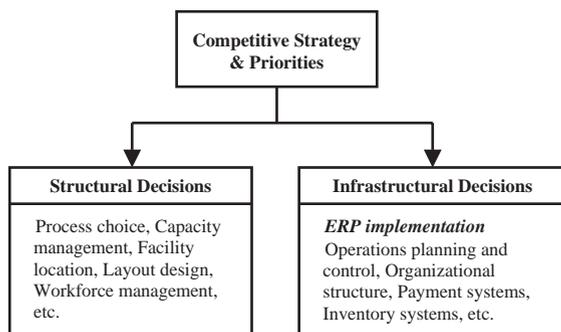


Fig. 1. Research proposition: competitive strategy, competitive priorities and ERP implementation.

success of implementation (Jacobs and Bendoly, 2003).

In summary, our research proposition is that a firm's competitive strategies affect its ERP implementation practices. These competitive strategies will be operationalized by competitive priorities. Specifically, we are interested in research questions such as

- (1) *Which ERP implementation practices are affected by competitive priorities? How and why is it affected?*
- (2) *How should firms align an ERP system with their competitive priorities?*
- (3) *Are there factors other than competitive priorities that affect ERP implementation?*

### 3. Research design

#### 3.1. Case study method

This study is exploratory in nature, since past research has not addressed the issue of aligning ERP implementation with competitive strategy and priorities. We believe that through direct observation and systematic interviewing, the case study methodology would be most valuable to explore and understand the relationship between ERP implementation and competitive strategy. While case study research has been frequently criticized for its lack of rigor, we have closely followed suggestions from previous studies (e.g., Eisenhardt, 1989; Yin, 1994; Miles and Huberman, 1994; Stuart et al., 2002; Voss et al., 2002) to ensure the validity of this study.

This case research identified five manufacturing companies in the United States and Taiwan for the purpose of on-site interviews, observation, and data collection. Table 2 summarizes the company profiles consisting of industry, products, production method, time after ERP implementation, ERP software, facilities locations, etc. In general, all companies have the following characteristics:

- (1) they are all multinational corporations with facilities located in more than one country;
- (2) they all have a clear and long-term vision and specific competitive strategies; and

- (3) they have implemented ERP for two years or longer.

Methodologically each company is treated as an individual "case." For each case the patterns between competitive priorities and ERP implementation practices are studied. Therefore, this research is a multiple-case study that searches for some sort of "pattern matching" in ERP practices. Four of five plants interviewed are located in Taiwan, and the other one is in the United States. All plants have implemented ERP systems in multiple facilities/sites. In this study we interviewed local facilities rather than an overseas facility of each company. We collected information regarding the "cross-national" ERP implementation based on archival documents and interviews with managers who were involved in overseas ERP implementations. Three companies are from the high-tech industry, and the remaining two are from the chemicals and personal care industries. The average annual sales volume ranges from \$2 to \$10 billion. With various production methods and potentially different competitive priorities and industries, the selected companies offer a good mixture of scenarios for the purpose of this study.

#### 3.2. Data collection

Data collection for this study utilized structured interviews in a field setting to ensure that the same data were collected at all sites. A case study protocol was designed and used to guide the structured interview and data collection (Yin, 1994). The protocol was reviewed and pre-tested by a group of researchers and senior managers. A pilot study, conducted to review the research propositions, improved the conceptual understanding of the research issues. Based on the results of the pilot study, the protocol was revised to include multi-site ERP implementation questions. The interviewees also made several suggestions to enhance the interview method.

On-site interviews and observations were conducted after the pilot case study was concluded. Prior to each interview, the protocol questions were shared with the interviewees for the purpose

Table 2  
Company profile

	NCQ	ChemD	CareM	NoteF	MoniP
Industry	Computer	Chemical	Consumer personal care products	Computer	Computer
Products	Notebook, motherboard	Titanium dioxide, adhesion promoters	Cosmetics, personal care, home cleaning	Notebook/PC	Monitor
Annual sales	~US\$ 4.0 billions	~US\$ 2.0 billions	~US\$ 0.6 billions	~US\$ 1.5 billions	~US\$ 2.2 billions
No. of employees	10,000	2000	4300	5400	5000
Production method	Make-to-order (MTO)	Make-to-stock (MTS)	Make-to-stock (MTS)	Make-to-order (MTO)	MTO & MTS
Facilities locations	Taiwan, <sup>a</sup> China	USA, <sup>a</sup> Taiwan	USA <sup>a</sup> (production), Taiwan (telemarketing)	Taiwan, <sup>a</sup> USA, China, Czech Rep.	Netherlands, <sup>a</sup> Taiwan
Facilities visited	Taiwan	Taiwan	USA	Taiwan	Taiwan
Time after implementation	3 years	6 years	2 years	4 years	3 years
ERP software	SAP	SAP	J. D. Edwards	Magic (Taiwan, China); varies in other areas	SAP
Why ERP?	Requested by customers	Requested by headquarters	Self initiated	Requested by customers	Requested by headquarters
Position in supply chain systems	Manufacturer	Supplier	Manufacturer & retailer	Manufacturer	Manufacturer

<sup>a</sup>Corporate headquarters.

of preparing and gathering necessary information. The respondents were also informed of the purpose of the study. In all cases, we met with at least two interviewees from a group of IT managers, ERP project team leaders, plant managers, and functional managers. At least two researchers participated in the interviews in order to reduce confirmation bias. The first researcher wrote up notes from the visit, and the second researcher verified these notes. Disagreements were handled by follow up telephone calls. Sources of data collection included interviews, direct observation, documentation, and archival records. While most of the data were qualitative in nature, quantitative data were also collected to verify the findings. The use of multiple sources of evidence enhanced both the reliability and validity of this study (Voss et al., 2002).

#### 4. Data analysis and results

Data analysis was performed based on the original research propositions regarding the alignment of ERP implementation to competitive priorities. Following the “pattern-matching” strategy (Yin, 1994), patterns between competitive priorities and ERP implementation practices were identified for each individual case. To ensure quality of research design and our findings, we carefully conducted several validity tests indicated as necessary by previous studies (Kidder and Judd, 1986; Yin, 1994). To ensure the quality of the case study method, we conducted the tests of construct validity, external validity, and reliability following Yin’s suggestions (1994). Table 3 presents the patterns identified across cases with regard to the alignment. For the sake of discussion, we grouped

the five companies into three clusters based on the type of competitive priorities they pursued.

- (1) Flexibility: Company NCQ;
- (2) Quality consistency: Companies ChemD and CareM; and
- (3) Fast & on-time delivery: Companies NoteF and MoniP.

The rest of this section examines the alignment of competitive priorities with structural and infrastructural decisions, followed by the relationship between competitive priorities and ERP implementation practices.

4.1. Structural and infrastructural decisions

Company NCQ is a supplier of notebook computer for several large US companies such as Dell, Hewlett Packard, IBM, and Gateway. As an

original equipment manufacturer, it faces frequent order changes including changes in volume, delivery and product specifications. The company maintains an excellent R&D department, able to quickly respond to various customization orders. With a well-established supplier network, it effectively uses outsourcing and overtime to adapt to changes in production volume and delivery. It had an on-time delivery rate of 90% (increased to 95% after implementing an ERP system) even with constant order changes. The competitive priorities of customization and volume flexibilities are associated with the make-to-order production method, small production volume, wide range of product varieties, high labor skills, unstable production schedule, and a large number of suppliers.

Both ChemD and CareM compete on the dimension of quality consistency. ChemD is a

Table 3  
Case study results

	NCQ	ChemD	CareM	NoteF	MoniP
Competitive Priorities	Flexibility, Fast delivery	Quality consistency	Quality consistency	On-time & fast delivery	On-time & fast delivery
<i>Structural &amp; infrastructural decisions</i>					
Production Method	Make-to-order (MTO)	Make-to-stock (MTS)	Make-to-stock (MTS)	Make-to-order (MTO)	MTO & MTS
Production volume	Small	Large	Large	Med/Large	Med
Product variety	Wide	Narrow	Narrow/Med	Med	Med
Labor skills	High	Low	Low	Med	Med
Production schedule	Instable	Stable	Stable	Instable	Instable
No. of suppliers	Large	Small	Small	Large	Med
<i>ERP implementation practices</i>					
Organizational structure	Functional→PWP	Functional (No change)	Functional (No change)	Functional (No change)	Functional (No change)
Process standardization	Low	High	High	Med	Med
Type of adaptation	Packaged software	Operating processes	Operating processes	Combination	Combination
Level of package customization	Extremely high	Low	Low	High	High
Centralization of ERP implementation	Med	High	High	Low	Low
Organizational control: Local autonomy	High	Low	Low	High	High
Information sharing	High	Low	Low	Low	Low
Accessibility	High	Low	Low	Med	Med

large multi-national chemical corporation that offers a wide variety of chemical products including adhesives, abrasives, building and construction materials, and carpet and flooring products. The company has 135 manufacturing facilities located in 70 countries worldwide. The company is known for its quality consistency. It uses a continuous production process, which is associated with make-to-stock, high production volume, long set ups, stable production schedules, relatively small number of suppliers, lower labor skills, and a functional organization. CareM is famous for its high quality personal care and cosmetics products. It has three manufacturing facilities located in the US and more than 10 overseas telemarketing offices. All three manufacturing facilities have implemented an ERP system. We visited one of CareM's manufacturing facilities and the headquarters. As expected, its make-to-stock production method is also associated with similar structural and infrastructural decisions as Company ChemD.

NoteF and MoniP compete on the dimensions of speedy and on-time delivery. NoteF manufactures notebook computers. Its product design and sales functions are located in Taiwan, and key components such as the CPU and motherboard are manufactured in China. Depending on customer location, final assembly is performed in either the US or Czech plant to speed up delivery. The headquarters of MoniP is in the Netherlands, with the manufacturing in Taiwan responsible for orders from nearby Asian countries to achieve speedy delivery. As expected, most structural and infrastructural decisions in both companies are different from that of the two former groups of companies due to the differences in competitive priorities.

The upper part of Table 3 verifies the theoretical relationship between competitive priorities and structural and infrastructural decisions (Krajewski and Ritzman, 2001). This relationship further provides the construct validity of this case study (Yin, 1994; Voss et al., 2002).

#### 4.2. ERP implementation practices

The information presented in the lower part of Table 3 focuses on the alignment between compe-

titive priorities and several ERP implementation practices, including type of adaptation, process standardization, amount of software modification/customization, level of local autonomy, the centralization of implementation decisions, information sharing between facilities, and data accessibility. Other implementation practices suggested by the literature (e.g., implementation duration, employee resistance, use of consultants, top management support, and project execution) were found to be irrelevant with competitive priorities in these five firms. More extensive work is necessary to confirm this particular finding. In this section, we present separately the findings of various relevant implementation practices in each company. For each specific practice, we reviewed all collected information (including protocol and archival data) and assigned a subjective rating of low, medium or high. Note that all ratings were chosen based on comparisons between these five companies.

(1) *Company NCQ (flexibility)*: With customization and volume flexibilities as its competitive priorities, NCQ converted the organization structure from centralized to several self-contained units using decentralized ERP systems. Each SBU had a high level of local autonomy and was organized around a specific customer (e.g., Dell Computer) to better satisfy demand with quick delivery. Depending on the needs and involvement of individual customers, each unit developed its own unique ordering process, forecasting methods, and warehousing practices. There was no single generic process for all units to adopt, as most packaged ERP software assumes. Imposing one standard process could decrease the company's competitive advantage. Consequently the company spent significant time and effort to customize the ERP software packages to its own use. The company went so far as to rewrite the software source code to ensure a fit with its business, an effort unfortunately never anticipated nor planned for prior to the implementation. This hidden cost eventually caused the implementation to exceed its original budget and time line.

To ensure data integration, the headquarters played a major role in overseeing and managing the implementation project in all individual facilities.

The headquarters also selected common ERP software and sent a project team to all facilities to assist with their ERP implementation. After the installation of the ERP systems, each facility assumed the responsibility of maintaining the system. Overall, the level of centralization of ERP implementation in this company is rated as medium, while its organizational control in terms of local autonomy is rated high due to its flexibility needs. This finding is consistent with suggestions from other studies (Markus et al., 2000). The headquarters was in complete control of chartering and managing the ERP implementation project in order to establish a global supply chain system.

Another aspect of ERP implementation related to organizational control is the level of data accessibility. The need for greater flexibility in NCQ required more employees in each SBU to have access to their ERP database for making quick decisions. For instance, most sales representatives have the authority to access purchasing, inventory, and production scheduling information for the entire enterprise, including not only Taiwan but also other overseas facilities located in China. There is substantial information sharing between facilities using the newly developed ERP database. Correspondingly, there is also a high degree of local autonomy in operations. Each manufacturing facility makes its own inventory, production planning, and scheduling decisions, while the headquarters retains purchasing decisions.

(2) *Companies ChemD and CareM (consistent quality)*: ChemD and CareM have a different pattern of ERP implementation practices than NCQ due to their focus on quality consistency. When they began the implementation, both companies were concerned with the fact that some of their products were manufactured using different methods at different facilities. They felt that implementing an ERP system would coerce them into best practices internally. Specifically, they attempted to use ERP systems to standardize manufacturing and operations processes across facilities to ensure consistent quality in their products. The issue of standardization was particularly critical to ChemD. As a chemical company, it must impose strict procedures to ensure environ-

mental compliance and maintain industrial safety at all facilities. Overall, both companies imposed low local autonomy, with all decisions made centrally and communicated to local operations. This practice is consistent with Markus et al.'s (2000) suggestion that “total centralization” is necessary when companies need to present a single global “face” to customers worldwide.

Both companies had a low degree of information sharing between facilities. Information was strictly centralized and rarely accessible to employees. The level of information accessibility is significantly lower than that of NCQ. While the companies also took a substantial amount of time preparing for ERP configuration, they did not rewrite source code or develop their own in-house modules. A common ERP package was adopted in all manufacturing facilities and centrally configured, which enabled the companies to identify and disseminate their best operating processes across facilities. A substantial amount of effort was made to standardize organizational processes, and to alter process flows and documentation in order to align with the selected ERP packages. The type of adaptation was clearly different from that of NCQ.

(3) *Companies NoteF and MoniP (fast and on-time delivery)*: Companies NoteF and MoniP have the competitive priorities of fast and on-time delivery. They developed ERP implementation practices that are similar with each other. Like the other three companies, they also spent a significant amount of time configuring their ERP systems. They found it difficult to develop standardized operational processes at facilities located across different countries. On the other hand, neither of them had to customize the ERP software modules like NCQ, which had to respond to the needs of individual SBU's. In general, both companies experienced large incompatibilities between their organizational requirements and the ERP packages. As a result, they used a “mutual adaptation” process (Hong and Kim, 2002) that involved a combination of package customization and organizational change. For instance, companies had to add several ERP data items to fit organizational process needs, while they also had to revise their document and data elements to align with the ERP packages.

We observed a high degree of local autonomy in both companies. Overseas facilities kept control of inventory management, forecasting, and purchasing functions. The level of data accessibility is rated medium, since only middle managers or above has access to the ERP database. The level of centralization of ERP implementation decisions in NoteF and MoniP was found lower than that of NCQ. All individual facilities had authority to purchase, configure, and maintain their own ERP packages. Unlike NCQ that sent out a project team to enable implementation at each facility, NoteF and MoniP gave their local facilities complete authority to perform ERP implementation with very little coordination. Theoretically, NoteF and MoniP were expected to centralize their implementation decisions more than NCQ, which has a flexibility emphasis (Krajewski and Ritzman, 2001). The finding of lower centralization of implementation decisions in these two companies is somewhat surprising.

After further discussion and investigation, we found that national culture may have been the primary factor determining the level of centralizing implementation decisions. The facilities that NCQ has are located in either Taiwan or China, while NoteF and MoniP have facilities spread throughout the Netherlands, USA, and the Czech Republic. In the case of NCQ its headquarters is located in Taiwan, and there is little difficulty communicating with facilities in China because of language and cultural similarities. Consequently, it is easy for NCQ to centralize its ERP implementation decisions without getting undue resistance from overseas facilities. Similar findings were discovered in ChemD and CareM, where all the facilities interviewed were located in the same countries. In contrast, the headquarters of NoteF (located in Taiwan) and MoniP (located in the Netherlands) do not speak the same languages as their overseas facilities, and the cultural differences are so significant that communication becomes very challenging.

For example, the US facilities of NoteF resisted adopting the same ERP software packages and configurations the headquarters requested, claiming that this software was inconsistent with its current operating processes. Several US employees

threatened to resign if they were forced to adjust their culture to the business practices of NoteF. The difficulties of centralizing ERP implementation were due to not only language and communication barriers but also culture and employee resistance. Many studies have suggested that the business models underlying most ERP packages reflect a bias toward western practices (see, e.g. Jacobs and Whybark, 2000; Soh et al., 2000). Operating processes in Taiwanese organizations are likely to be different, having evolved in a different cultural, economic, and regulatory environment. As a result, many implementation decisions, including the selection of ERP software and other implementation practices, were largely decentralized to local facilities. Each site purchased, installed and maintained its own ERP software without consulting the other. The information sharing between facilities and headquarters is currently limited to financial and accounting information.

## 5. Discussion

Overall, the information presented in Table 3 addresses the first two research questions regarding which ERP implementation practices are affected by competitive priorities and how the alignment of the two factors is made. For instance, the competitive priorities of flexibility and quality consistency correspond to two distinct cases of ERP implementation practices. Competitive priorities clearly affect the practices of ERP implementation in many aspects. When companies compete with customization or volume flexibility, the ERP system is implemented to support these competitive priorities with more information sharing, higher local autonomy, more software packages adaptation, and easier accessibility to the ERP database. There are also more efforts in writing in-house modules to fit the customized requirement of a process for the sake of maintaining flexibility. On the other hand, the requirement of quality consistency and make-to-stock production methods cause a demand for standardized manufacturing and operating processes, highly centralized implementation decisions and organizational

control, more processes adaptation, minimum information sharing between facilities, and thus low information accessibility. The consistent patterns found from NCQ, ChemD, and CareM seem to support our research proposition in Fig. 1.

The alignment pattern is, however, less distinct with the competitive priorities of on-time and fast delivery in multi-national ERP implementation. When ERP was implemented over several countries, national culture became a dominant factor in making implementation decisions. For Companies NoteF and MoniP several aspects of the implementation practices that we investigated, such as centralization, information sharing, and accessibility were not associated with competitive priorities. For example, national culture dominated competitive priority in determining the degree of centralizing implementation practices. In this study, the facilities that NCQ has are located in either Taiwan or China, while NoteF and MoniP have facilities throughout the Netherlands, US, and Czech Republic. The headquarters of NCQ is located in Taiwan; thus, there is little difficulty communicating with facilities in China because of language and cultural similarities. Consequently, the headquarters played a major role in overseeing and managing the implementation project in all individual facilities. In contrast, since the headquarters of NoteF (located in Taiwan) and MoniP (located in the Netherlands) do not speak the same languages as their overseas facilities, communication becomes very challenging. As a result, many implementation decisions, including the selection of ERP software and other implementation practices, were largely decentralized to local facilities. Organizations that plan to implement ERP across countries must be aware of the influence of the national culture factor.

In addition to national culture, we discovered another unexpected variable, corporate or government policies, which could affect ERP implementation practices. Specifically, corporate policies seem to contribute to low information sharing between facilities in all companies. All companies expressed concerns of too much information sharing, fearing that individual facilities could compete and argue for better or equal treatment (in terms of materials, customer orders or any kind

of resource support) than other facilities. The corporate office would have more difficulties allocating resources based on the global benefits to the whole organization. As a result, companies have purposely limited information sharing between facilities, even though this approach diminishes the benefits of ERP systems.

An example of how government policies affect ERP implementation is that of the current diplomatic relationship between Taiwan and China. These two governments have imposed strict restrictions on transporting goods, exchanging information, and transferring money between the two countries. Before they can agree on a formal relationship, many business operations between these two countries have to be conducted in a way that current packaged ERP software does not permit. As an example, for a Taiwanese company to establish another firm in China, it would need to first set up a third company in a third country, which would then transfer all funds from the Taiwanese headquarters to the branch company in China. A political issue like this forces companies to make extra efforts to modify ERP software according to their use.

There are numerous other examples in our findings about the effects of national culture and policies on ERP implementation. Some of our findings confirm that the “misfits” between ERP packages and organizational requirements may be worse in Asia (Soh et al., 2000). Consequently we suggest revising our original research proposition in Fig. 1 by including two additional variables, national culture and government/corporate policies. That is, competitive priorities, culture and policies should all be considered in determining the ERP implementation strategy, especially in the situation of multi-national implementation. The next section discusses managerial implications and limitations of the findings and proposes opportunities for future research.

## 6. Conclusions

Many companies are following the trend toward making large investments in implementing ERP systems. At the same time, many of them did not

even conduct a formal analysis or strategic plan prior to implementation (Mabert et al., 2000). Even when a formal analysis was performed, it was generally limited to traditional ROI and payback methods. Considering the potential impact ERP systems could have on business competitiveness, it is no wonder that many firms failed to recognize the benefits of ERP because of the lack of planning at the strategic level. The research proposition of this study is that an ERP implementation should be aligned with a firm's competitive strategy. The results of this study reveal the following:

- (1) When firms choose to compete in flexibility and quality consistency, competitive priorities affect ERP implementation practices on the aspects of centralization, software customization, information sharing, type and effort of adaptation, and data accessibility.
- (2) Realizing the potential effects of competitive strategy on ERP implementation practices is necessary to enable managers to be more proactive in planning and implementation.
- (3) National culture and government/corporate policies can have a significant impact on the multi-national ERP implementation practices considering information sharing and local implementation practices such as the selection, configurations and maintenance of software packages.
- (4) Industry type does not appear to be a variable in choosing ERP implementation practices. For example, Companies NCQ and NoteF are both from the computer industry, but they have very different implementation practices, while Companies ChemD and CareM share similar practices even though they are from different industries.

The above findings are important to both managers and researchers. From a management point of view, there is a need to recognize the unique strategic, cultural, and political context when adopting an ERP system. Early identification of pattern matching between ERP and these three contextual variables provides a more accurate basis to budget for contingency implementation funds and allows adequate planning for related management issues. Company NCQ clearly

learned an expensive lesson from failing to foresee the effect of competitive priorities. The implementation exceeded the original budget by more than 40%. By realizing the potential effects of competitive strategy, national culture, and government/corporate policies, resolution strategies can be carefully thought through and are likely to be less reactive.

For future ERP research, we suggest the study of multi-national implementations by including two additional factors, national cultural and government/corporate policies. In this study the five interviewed companies focused their ERP implementation primarily on integrating functional areas without much consideration for the integration across multiple sites or nations. To our knowledge, current literature has seldom addressed the issue of multi-national ERP implementation even though there is a strong need in industry. For instance, CareM is currently in the process of implementing ERP systems at its overseas telemarketing companies in Japan and Taiwan. During our visit, its CEO specifically suggested national culture as the biggest concern to the successful implementation. As more and more international supply chain systems are developed, international culture and political environment become more critical to the success of supply chain management. Since ERP is the information backbone of supply chain management (Al-Mashari and Zairi, 2000), more studies should investigate the impact of international culture and government/corporate policies on multi-national ERP implementation and thus supply chain management practices. Future research should conduct more comprehensive analysis of cultural misfits and design resolution strategies accordingly.

To ensure the quality of this case study, we carefully followed previous prescriptions in case study research (e.g., Eisenhardt, 1989; Yin, 1994; Voss et al., 2002). For example, we selected theoretically useful cases, used multiple investigators and respondents, conducted reliability and validity tests, collected multiple sources of evidence, and systematically searched for cross-case patterns. There are still some potential shortcomings regarding the generalization of the findings. First, this

study only examines five competitive priorities. Although the relationship between competitive priorities and ERP implementation is clearly confirmed, other competitive priorities such as product innovation and high performance designs need to be examined in the future. Another limitation of the study is that we did not consider the scenario of multiple competitive priorities. Many multinational companies may compete on many different priorities for different segments of their businesses (Bartlett and Ghoshal, 1991), which could further complicate ERP implementations in different countries. Furthermore, due to logistical issues in the companies we studied, we interviewed only their local facilities and not their overseas locations. Even though we collected necessary information and interviewed those managers who participated in their overseas ERP implementation projects, there may still be some bias regarding our judgment of information sharing between facilities and the degree of centralization of implementation. Finally, this study does not address the benefit of aligning ERP implementation with competitive priorities, culture, and other factors. Whether such alignment benefits these companies in the long term remains to be studied. Regardless of these potential shortcomings, this exploratory study raises several issues that should be considered in future ERP and supply chain management research.

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