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The relationship between ERP system and supply chain management performance in Malaysian manufacturing companies

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Abstract

Purpose – This research aims to improve supply chain management performance through the successful usage of ERP system. This can be through investigating the relationship between enterprise resource planning (ERP) system and supply chain management (SCM) performance in the context of Malaysian manufacturing companies that use ERP system.

Design/methodology/approach – The questionnaire survey was posted to the Malaysian manufacturing companies that are using ERP system in order to investigate the relationship between ERP system and SCM performance. The respondents of this study were the MIS or IT executives. A total of 80 usable responses were received and used in the analysis.

Findings – The findings of this research indicated that there is a positive and significant relationship between ERP system i.e. (integration, material management, production planning, and controlling), and SCM performance. The workflow management, however, does not have a significant relationship with SCM performance. The findings of this study imply that the successful implementation and the effective usage of ERP system can contribute toward enhancing supply chain management performance in many ways such as, integration of internal business processes, enhancement of information flow among different departments inside the company, improvement of the company's relationships and collaboration with outsourcing suppliers, customers, and supply chain partners.

Research limitations/implications – This research focuses only on post-implementation of ERP system life cycle, where ERP system passes through three implementation stages of system life cycle and that includes pre-implantation stage, implementation stage, and finally post-implementation stage. Two or three stages of ERP system life cycle could be investigated simultaneously.

Practical implications – There should be many success records in ERP system and this is to prove to companies that ERP systems can contribute toward improving their overall business performance. Therefore, this research encourages companies to adopt ERP systems and then contribute to technology diffusion. The finding of this study supports this justification and records a new success of ERP systems in Malaysian manufacturing companies.

Originality/value – The results of this study will enable companies to achieve optimum usage of ERP system after the implementation stage and help to avoid system failure and achieve better SCM performance. The study contributes toward technology diffusion between companies through reducing the likelihood of ERP systems failure, and therefore introduces ERP systems to other manufacturing companies in Malaysia.

Keywords Enterprise resource planning (ERP) system, Supply chain management, SCM, Malaysia, Manufacturing industries

Paper type Research paper

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Introduction

Business management has entered the era of networking competition which moves the competition from local to global business environment and from company against company to that of supply chain against another supply chain. Currently, competition is not measured only by individual company performance but also in terms of supply chain performance. This competition of supply chain performance will increase the pressure on companies to meet customer demands as well as to achieve customer satisfaction and loyalty (Hsu, 2005).

Today companies are constantly experiencing domestic and foreign competition, and they are seeking for robust technologies that can enable them to achieve better control over their business performance and attain cost reduction. There is also a need to improve quality standards as well as enhancing customer services to enable companies to compete in local and global marketplaces. Companies are also continuously struggling to reduce costs and response time, increase business profits, and improve their market share in order to gain a competitive advantage in the global economy. These great challenges also include managing stocks, distributions, services, customers, sales, workflow, operations, and materials (Spathis and Constantinides, 2003).

Companies are beginning to realize that in order to survive in the global business environment they must improve not only their organizational efficiency, but also their whole supply chain. This is because competition today is not limited between companies only, but it has extended to be among their supply chains as well. These reasons force many companies to keep up to date and make large investments in developing and implementing better technologies and systems such as enterprise resource planning (ERP) system (Davenport and Brooks, 2004).

ERP system could be a useful tool for companies to build a strong information systems infrastructure and to enable the management to undertake better decision making based on accurate and on-time information. Furthermore, these systems improve product quality and customer responsiveness and also enhance information sharing and information quality among different departments inside the company, as well as extend beyond the company's boundaries to suppliers, customers, and other partners in the supply chain. Ultimately, this will enhance overall business performance, particularly supply chain management (SCM) performance, help to achieve competitive advantage in the global economy, and improve long-term profitability (Klaus *et al.*, 2000; Akkermans *et al.*, 2000; Hsu and Chen, 2004).

Problem statement

Many studies in literature have shown the importance of ERP system in companies' effectiveness, and this is because ERP system have become one of the main prerequisites, a price of entry, and a strong and integrated IT infrastructure for many companies enabling them to compete in the local and global marketplace, and ensuring them to gain a competitive advantage in the global economy particularly with the current e-business era (Al-Mashari and Zairi, 2000; Huang *et al.*, 2001; Rashid *et al.*, 2002; Al-Mashari, 2003; Al-Mashari and Al-Mudimigh, 2003).

The implementation of ERP system leads to important changes in companies, affects the ways of conducting business, and reorganizes the supply chain of the companies. Therefore, SCM and all stakeholders involved in the supply chain in particular and in the entire company in general, need to realize and understand these important changes. Task performance will be in a new and different manner from that previously performed (Kremzar and Wallace, 2001; Thao, 2002).

Thus, if the management do not realize and understand the actual impacts of ERP system on the company and on its business performance includes SCM performance, and are not prepared and ready for the large changes, this might affect the performance of the whole company. It particularly affects SCM performance and may eventually lead to system failure. Hence, it is important to understand the actual effects of ERP system on a company as a whole and particularly on its SCM performance. It is also important to understand the relationship between ERP system and SCM performance in similar companies before undertaking any decision such as ERP system implementation. This probably will limit the likelihood of ERP system failure.

Low involvement of employees, lack of top management support, cultural misfit problem, and ineffective usage of ERP system will lead to ERP system failure and then lead the whole company to bankruptcy. These results will prevent Malaysian manufacturing companies to implement ERP system and therefore they will not be able to connect their supply chain with many of global as well as local companies in order to respond effectively to the market where ERP system has become a prerequisite in the marketplace and a backbone for e-business and this is eventually could cause a decline in their market share in the local as well as global markets (Loonam and McDonagh, 2005; Chen, 2001; Ravendran, 2002; Sangaran, 2000).

Research questions

- What is the relationship between integration and SCM performance?
- What is the relationship between materials management and SCM performance?
- What is the relationship between production planning and SCM performance?
- What is the relationship between controlling and SCM performance?
- What is the relationship between workflow management and SCM performance?

Significance of the study

This study contributes to the body of knowledge through the following:

(1) focussed on ERP system functionality that related to SCM performance;

(2) investigates the relationship between ERP systems functionality and SCM performance;

(3) provides organizational variables that can contribute to achieve successful usage of ERP system;

(4) contributes in reducing the likelihood of ERP system failure;

(5) elucidates the benefits of ERP system that can enhance SCM performance;

(6) encourages companies to implement ERP system through the success cases of ERP system;

(7) encourages Malaysian Government to provide financial assistance and grant for SMEs to implement and support the ERP systems implementations;

(8) contributes toward stimulating the ERP systems among Malaysian companies; and

(9) contributes in technology diffusion.

Literature review

ERP system

By the late of 1980s and early 1990s many companies were suffering from an enormous IT integration problems and were in need for an absolute software solution that can integrate different functional areas and at the same time allow these functional areas to share from a single and centralized database without any data inconsistency problems and without losing flexibility. Therefore, software vendors established ERP system in the mid of 1990s in order to solve integration problems, make effective business solution, and provide companies with all IT needs under a single software system (Loonam and McDonagh, 2005).

ERP system was emerged in the beginning of 1992, however, in the recent years ERP system has become one of the most well-known business software in the marketplace and an essential part of everyday IT investments for many companies that believe ERP system will provide solutions for their IT problems and therefore provide effective online transactions with the current e-business era. Moreover, one of the significant and global developments of IT is the broad acceptance of ERP system by many companies worldwide which reached today to consider ERP system as the most rapid growing system in operational area (Lopes, 1992; Zhang *et al.*, 2004; Molla and Bhalla, 2006).

In fact, ERP is software for business management system which integrates all business functions, processes, and information between different departments inside the company. This business software system will allow companies to automate and integrate the majority of their business processes, share common data and practices across the entire enterprise, and produce and access information in a real-time environment (Lopes, 1992; Deloitte, 1999).

This integrated enterprise-wide system will automate the main business functions such as manufacturing, human resource, finance, as well as SCM and eventually enable companies to streamline their operations and processes (Gibson *et al.*, 1999). As a conclusion from Lopes (1992) ERP system is better, faster, and more economical solution for business processes in the new information system paradigm. However, ERP system is an enterprise-wide integration of data, information, as well as business processes.

The origin of ERP system was in manufacturing providing only production planning, and afterward in the mid of 1990s, the system further expanded to contain functionality such as financial management, order management, assist management, and human resources management. In the recent years ERP system functionality increased to include marketing automation, e-commerce, sales, and supply chain systems. Currently, the major ERP systems applications contain financial applications, human resources applications, and manufacturing applications that provide multiple functionalities (McAdam and Galloway, 2005).

ERP system can cope with different functional area, such as, sales, accounts receivable, accounts payable, engineering, inventory management, production, purchase, quality management, human resources, production, and distribution planning. Basically, ERP system competent to integrate, optimize, and coordinate physical, cash, and information flow in the above-mentioned functional area as well as within the entire supply chain of the company (Shankarnarayanan, 1998; Zheng *et al.*, 2000).

Several modules in ERP system provide different functionality and support different business functions such as manufacturing, inventory management, personnel

management, storage management, financial administration system, marketing, and order processing. These modules are combined through a common data model and database system and are also integrated across functional support which indirectly supports the integrations among different business functions and ultimately provide integration functionality (Hsu and Chen, 2004; Klaus *et al.*, 2000).

For example, SAP R/3 package contains core modules where each module provides a particular functionality such as, materials management, asset management, production planning, plant maintenance, project system, controlling, quality management, industry solutions, financials, human resources, sales, and distribution. Each of these modules formed from sub-modules, for instance the financial module includes sub-modules like accounts payable, accounts receivable, and general ledger (Parr and Shanks, 2000).

Typically, when companies decide to implement ERP system, the first decision will be related to the selection of modules that the company needs, because usually most of companies select some modules that they need them in order to provide specific functionality that fit to the company requirements. Implementing all modules of ERP system is not affordable by many companies and this is because of the large sum of money that the company needs to pay in order to implement the whole package of ERP system and then obtain all functionality of the system (Parr and Shanks, 2000; Sheikh, 2003).

Therefore, companies usually implement some modules of ERP system and not all modules. The selection of the modules depends on the requirement of the company and on what functionality they need to be provided within the company as well as on the need of specific modules that can fit to particular requirements and therefore satisfy the business objectives (Parr and Shanks, 2000; Sheikh, 2003; Rolland and Prakash, 2001).

For instance, when companies need to improve their financial performance they implement modules related to finance and when they need to improve SCM performance they implement modules related to SCM (SAP, 2006). However, this study focusses on modules that can contribute in enhancing the SCM performance such as, integration, production planning, controlling, materials and workflow management, procurement and distribution.

This research aimed to improve SCM performance through the successful usage of ERP system. Therefore, the selection of the dimensions of this study was based on the functionality of ERP system that contributes in improving SCM performance. Five dimensions of ERP system were selected and that was based on extensive review of literature, suggestions from ERP vendors such as SAP and Oracle, and finally on the feedback obtained from some of Malaysian manufacturing companies that are using ERP system such as Proton, Intel, and Nippon, where eventually lead to the selection of five dimensions that contribute toward improving SCM performance. The functionality of ERP system that were selected as the dimensions or the independent variables of this study are integration, production planning, controlling, workflow management (Davis, 1998; Parr and Shanks, 2000; Sheikh, 2003; SAP, 2006).

ERP system and SCM performance

Davenport and Brooks (2004) noted the large impact of ERP system on SCM in helping companies to share information with other partners. Upon receiving an order from

their customer, their supplier will immediately replenish the raw materials based on the information they received. Therefore, in order to monitor and collect information within the supply chain, ERP system is needed with the additional external functionality and devices of SCM and manufacturing execution systems.

The main philosophy of SCM is to have the right product in the right place, at the right price, at the right time, and in the right condition. Therefore, companies need not only to flow information within the company but also they need to share this right information with the right supply chain partner in the right time. In order to achieve these goals, organizations need an information system, such as ERP system, to facilitate the synchronization of the entire supply chain and provide timely information to all supply chain partners in order to assist their decision making and eventually attain customer satisfaction. ERP system is generally conceived as an important precursor to SCM performance and a very useful tool for its improving (Zheng *et al.*, 2000).

With ERP system companies are able to integrate all functional units, standardize and manage information sharing within their entire departments and then extended it to suppliers and customers in order for suppliers to expedite the delivery of necessary raw materials and also in order for customers to place an order faster and smoother. For example, Northern Digital Inc implemented ERP system from intuitive manufacturing systems which provided a level of ERP system that could immediately improve inventory management, expandability of entire system, and flexibility in the whole supply chain in order to support the company in current competitive business environment. After a successful implementation of ERP system the revenue of the company has increased from $10 million to over $20 million (Turban *et al.*, 2008). Usually the implementation of ERP system will be linked to business process reengineering in order to focus on business process activities in entire company (Subramoniam *et al.*, 2009).

There is a wide consensus among many authors on the importance of ERP system in the improvement of supply chain performance. For instance, Wieder *et al.* (2006) found that, there are positive impacts of ERP system on supply chain performance. Zeng and Pathak (2003) stated that, there are several records of success indicating that the integration of supply chain can enhance and improve the performance of the supply chain to be effective and competitive in the global business environment.

Moreover, Hitt *et al.* (2002) pointed out that, investment in ERP system improves productivity and business performance. Cotteleer (2002) found that, ERP system is able to improve operational performance within the supply chain. Themistocleous *et al.* (2002) come up with a conclusion that ERP system supported SCM since long time.

On the other hand, there is a large argument among several authors in ERP literature about the section or the area that ERP system improves inside the company as well as within the whole supply chain. Rom and Rohde (2006) argue that, ERP system can support data collection and management accounting better than other systems such as strategic enterprise management system. Spathis and Constantinides (2004) noted that, ERP system improves flexibility in information generation, as perceived by many companies, and it is able to decrease operational costs and cycle time and thus increase customer satisfaction and loyalty. Tarn *et al.* (2002) pointed out that, ERP system able to expedite information sharing within SCM in order to enable closer cooperation among supply chain partners and to reduce the cost of transaction.

Moreover Akkermans *et al.* (2000) found that, ERP system contributes toward enhancing SCM in technical areas such as standardization, transparency, and

globalization. They also found that, there is a close interrelation between ERP and SCM. Madu and Kuei (2005) stated that, in order to support SCM effectively, companies need to implement ERP system. A conclusion can be drawn from the above discussion as ERP system able to support and improve all departments inside the company as well as the entire supply chain of the company.

In order to improve supply chain performance ERP system is needed where companies can integrate all their business processes through breaking the barriers among different functional departments inside the company in order to be more responsive and flexible and at the same time avoid repeating the same task. This could be possible because ERP system contains single and integrated database that prevents any data inconsistency problems and smooth the flow of information among supply chain partners (Chuang and Shaw, 2005).

The overall supply chain performance could be improved through the channel coordination, information sharing, operational efficiency, and integrated communication within the supply chain. ERP system provides integration for better communication and coordination within the company and its supply chain. The success of ERP system and the supply chain highly depends on the process of integration achieved in the company and this could be achieved smoothly with the core functionality of ERP system which provides web linkage, facilitates electronic data interchange, and integrates the entire supply chain in order to support effectively the company's supply chain activities (Goodhue *et al.*, 1992; Lee *et al.*, 1997; Olson *et al.*, 2005; Park and Kusiak, 2005).

According to a study conducted in Thailand on Thai-owned and multinational companies, ERP system able to improve scheduling, tracking, and managing inventories and raw materials. It also able to save costs, improves business processes and internal integration, reduce human error and staff costs, enhance visibility and accessibility to data, and increase responsiveness (Arunthari, 2005).

SCM performance

SCM performance defined as the procedures to measure the effectiveness and efficiency of the supply chain, and that includes the measures of cost, quality, time and customer responsiveness, and flexibility (Neely *et al.*, 1995; Beamon, 1999).

Davenport and Brooks (2004) noted that SCM contributes toward the reduction of inventory and working capital. It also makes a close relationship between suppliers and customers. In fact, SCM is a coordination and cooperation between suppliers and customers to share information and exchange goods and services.

SCM contains activities that can facilitate the movement of goods and the flow of information from the raw materials to end customers. It helps companies to improve the relationship between suppliers and customers in order to produce a high-quality product at a lower cost. This is to gain a competitive advantage in the global market (Chuang and Shaw, 2005).

In the present economy SCM considered as one of the most important and powerful management strategies that has significant impact on business performance. However, when companies place SCM in their business model they can provide products with premium quality at low price in order to attract customers. In fact, SCM is an important component to extend and link with suppliers, distributors, and retailers in one distribution network whereby companies can obtain the best products at the lowest cost and thus increase profitability and gain a competitive advantage in the business world (Chou *et al.*, 2004; Zheng *et al.*, 2000).

In fact, SCM facilitates the movement of products through the supply chain, managing the associated information flow, organizing the business relationship with customers and suppliers and other partner in the supply chain, and creating customer value to achieve customer satisfaction and loyalty (Burca *et al.*, 2005).

On the other hand, SCM can be perceived through managing upstream and downstream operations, which resulted in reducing the operational costs in order to improve the profit margin, and in delivering the products to the market in order to reach the customer on time (Sundaram and Mehta, 2002). The goals of SCM are to reduce uncertainty and risks related to the supply chain, and this can contribute in decreasing inventory levels and cycle time, improving business processes, and enhancing customer service, and finally increase profitability and enhance competitiveness of the company (Turban *et al.*, 2008).

In 2000, a survey has been conducted on large manufacturing companies in USA indicated that, companies with a solid SCM are able to reduce their operating costs, inventories, product life cycle, and cycle time tremendously, and that will certainly increase cash flow, working capital, efficiency of transactions in supply chain, customer services, and on-time delivery (Zheng *et al.*, 2000).

However, SCM is considered as one of the most important success factors in the future of business environment, meanwhile managing the entire supply chain is very challenging and not an easy task, therefore companies began to consider and redirect their efforts toward information systems, such as ERP system, in order to improve their SCM performance and give them the opportunity to gain a competitive advantage in the global economy (Lambert and Cooper, 2000).

Zheng *et al.* (2000) pointed out that, the main five parts of any supply chain is plan, buy, make, move, and sell. SCM contains applications such as, manufacturing planning, demand planning, distribution planning, transportation management, warehousing management, performance management, production scheduling, freight payment, capacity planning, customer clearance, sourcing and procurement, and finally supply chain optimization.

Therefore, the success of supply chain depends on how efficient and effective each part and application of the supply chain, and also on how well these parts and applications integrated with each other in order to assist the entire supply chain to move smoothly and efficiently (Zheng *et al.*, 2000). ERP system is able to integrate all parts and applications of the supply chain, and also able to facilitate the efficiency of each part and application in the supply chain.

In order to create an effective and successful SCM, it requires cross-functional integration, as well as many companies need to integrate the whole supply chain, which includes suppliers, warehouses, factories, distributors, and retail outlets, and provide cooperation between all supply chain partners through planning, coordination, and information sharing which is critical to achieve successful and effective operation of supply chain (Stevenson, 2002).

In fact, the key to achieve effective SCM is accomplishing customer demand on time. However, there are several steps must be taken in order to attain an effective supply chain that includes developing a strategic objectives and tactics, creating strategic partnerships, coordinate activities with suppliers and customers, and finally organize planning and execution within the supply chain (Lambert and Cooper, 2000).

These require implementation of an information system that facilitates and expedites the exchange of data and information between supply chain partners, integrate functional units, and allow everyone in a company to access to a single

database and use the same data and information without any data inconsistency problems. The suitable information system that can provide all the above-mentioned characteristics is the ERP system (Amoako-Gyampah, 2007; Kemp and Low, 2008). During the implementation of ERP system, companies should seek assistance from the external consultants in order to provide the above-mentioned facilities and avoid system failure (Maditinos *et al.*, 2012).

ERP could be an effective system that assists companies in creating effective and successful SCM. In fact, ERP system introduced to integrate all functional units of a company and its supply chain in order to make it in one system. Therefore, all data and information related to SCM will be accessible and retrieved from one system. The ease of access to one system from various functional units and the advancement of IT and computing research have resulted in enhancement of SCM performance (Tjoa and Raman, 1999; Rashid *et al.*, 2002).

ERP system includes SCM module which contains sub-modules for materials procurement, material transformation, and distribution of products to deliver the right product to the right place at low price in order to gain customer satisfaction and loyalty as well as achieve effective and successful SCM performance (Tjoa and Raman, 1999; Rashid *et al.*, 2002).

ERP market

ERP market found a great acceptance in developed countries such as USA, UK, Canada, and Australia, while in developing countries, ERP systems is a new idea and still in infancy stage because there are many untapped countries such as China, Korea, and Malaysia. In 2001, ERP market share was 66 percent in North America, 22 percent in Europe, and only 9 percent in whole Asia. Therefore, ERP vendors have a great target to increase market share in the developing countries in Asia, such as Malaysia and China, as well as in Latin America (Huang and Palvia, 2001).

North America and western Europe are the two largest market segments for the ERP system in 2004 with approximately 51.6 and 29.9 percent, respectively. However, in the same year, the Asia/Pacific region was the third largest market segment for ERP system, with approximately 13.6 percent of the total spending on ERP system. The results of a market research conducted by the Korea IT Industry Promotion Agency indicated that the total ERP market in Korea was $252 million in 2001 and increased to $262 and $277 million in 2002 and 2003, respectively (Katerattanakul *et al.*, 2006).

The total ERP market in Korea was $290 million in 2004 which is approximately 8 percent of the total spending on ERP system in the Asia/Pacific region. It was also estimated that the ERP market in Korea would continue to grow with an estimated growth rate of 4.8 percent during 2005-2010 (Katerattanakul *et al.*, 2006). Moreover, it was reported a rapid growth of ERP systems in Taiwan market, the market grew from $2.113 billion in 1997 to $4.68 billion in 1998 and from $6.13 billion in 1999 to $8.01 billion in 2000, and from $9.88 billion in 2001 to $12.65 billion in 2002. These results indicate a rapid growth of ERP market in Asia. However, ERP market was expected to increase up to $36.1 billion in 2008 (Sonnen *et al.*, 2005).

International Data Corporation shows a growth in ERP market in China, for instance, from 1997 to 2002 the ERP market increased from $78.4 million to $243 million, and expected to increase by 25 percent annually. On the other hand, a study has been conducted on five companies in China indicates unsuccessful results of ERP systems because of seven main problems such as language, price, report format and content, cost control module, customer support, consulting partner, and business

process. The study recommended that, foreign ERP vendors need to overcome all these problems in order to penetrate the Chinese marketplace, for example, regarding the language problem, they need to translate all ERP modules to Chinese language (Liang *et al.*, 2004).

The investments of ERP systems in China record billions of dollars. For example, in 2001 more than 1,000 Chinese companies implemented ERP systems, 300 of them used SAP's R/3 software package. However, globally, China market considered as the third largest IT market after USA and Japan. Therefore, China market is a good target place for foreign ERP vendors to penetrate this market, for example, the CEO of SAP company (Henning Kagermann) noted that, the company revenue growth increased 50 percent annually in China (Martinsons, 2004).

Research model and hypotheses

This research attempts to investigate the relationship between ERP system and SCM performance. Based on the extensive literature review of ERP system and SCM as well as the socio-technical theory an integrated theoretical framework has been developed in order to investigate the relationship between ERP system (integration, material management, production planning, controlling, and workflow management) and SCM performance.

Derived from the theoretical framework, the hypotheses for this research dimensions were formulated and developed in order to test the relationships between ERP system and SCM performance and finally achieve the research objectives. Therefore, the following hypotheses were developed (Figure 1):

H1. There is a relationship between integration and SCM performance in Malaysian manufacturing companies.

H2. There is a relationship between materials management and SCM performance in Malaysian manufacturing companies.

H3. There is a relationship between production planning and SCM performance in Malaysian manufacturing companies.

H4. There is a relationship between controlling and SCM performance in Malaysian manufacturing companies.

H5. There is a relationship between workflow management and SCM performance in Malaysian manufacturing companies.

Methodology

The questionnaire survey of this study was posted to the Malaysian manufacturing companies that are using ERP system. The questionnaire focussed on the dimensions

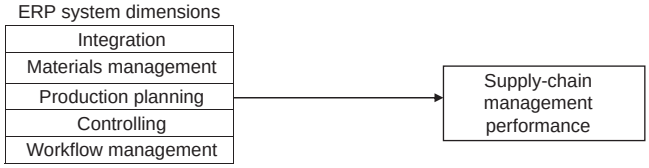

Figure 1.
The research model

of ERP system, namely, integration, material management, production planning, controlling, and workflow management, with respect to SCM performance. The respondents were asked to rate the degree of agreement for each dimension of ERP system as well as for the SCM performance using five-point Likert-type scale rating from 1 = strongly disagree to 5 = strongly agree. The target respondent in each manufacturing company was the MIS or IT executive or the person in charge for ERP system. The population of this research is the Malaysian manufacturing companies that are using ERP system listed in the Federation of Malaysian Manufacturers which consists of 200 companies out of 200 companies, 132 were selected randomly in order to be the sample of this research.

The instrument for ERP system was adapted from different sources such as Spathis and Constantinides (2004), Tadinen (2005), and Vanderfeesten and Reijers (2006). On the other hand, the instrument for SCM variable was adapted from Zhang *et al.* (2006), Beamon (1999), Neely *et al.* (1995), Shepherd and Gunter (2006), and Li *et al.* (2005).

Data analysis

Response rate

A total of 132 Malaysian manufacturing companies that are using ERP system were selected randomly to be the sample of this study and were also contacted in order to respond to the questionnaire. Out of 132 companies, only 83 companies were responded the questionnaire. From the responded questionnaires, 80 questionnaires were extracted as usable questionnaires and were used for data analysis in this research.

Test of differences

In order to detect the response bias and compare between early and late responses a typical χ^2-test was carried out. In this research the early responses were 32 respondents and that were received in the first wave of questionnaire. Whereas in the second and third waves 48 questionnaires were received and considered as late responses from the target respondents.

According to Table I, the significance value for all cases is larger than the α value of 0.05, and therefore this indicates that there are no significant differences, as well as no response bias has taken place between early and late responses. The details of χ^2-test for early and late responses on the basis of company ownership, company size, geographic scope, customers' number, suppliers' number, ERP provider, start using ERP, and the reasons to adopt ERP system, are all presented in Table I.

Demographic profile of respondents

Majority of the companies' ownership was local ownership rating 58.8 percent; on the other hand the foreign companies' ownership was rating 41.2 percent. All companies' type was manufacturing companies because this study focussed only on manufacturing companies. The size of the companies in term of employees' number shows that, the majority of respondents were having more than 150 employees constituting 72.5 percent. The geographic scope of most companies was worldwide rating 46.3 percent.

In term of customers' and suppliers' number, more than half of the respondents were having more than 150 customers rating 53.8 percent and more than 150 suppliers rating 51.3 percent. On the other hand, 31.3 percent of the target companies selected SAP as the provider of their ERP system, where SAP is the leader of ERP systems in the global market. Typically, companies need eight months after the implementation of

Variables	Category	Responses Early (32)	Responses Late (48)	Significance
Company ownership	Local	17	30	0.55
	Foreign	15	18	
Company size in term of employees	5-50 employees	0	2	0.41
	51-150 employees	7	13	
	More than 150 employees	25	33	
Geographic scope	Local	12	20	0.89
	Regional	5	6	
	Worldwide	15	22	
Customers number	Less than 50 customers	6	13	0.37
	51-100 customers	3	7	
	101-150 customers	2	6	
	More than 150 customers	21	22	
Suppliers number	Less than 50 suppliers	4	5	0.90
	51-100 suppliers	6	9	
	101-150 suppliers	7	8	
	More than 150 suppliers	15	26	
ERP provider	SAP	10	15	0.47
	Oracle	2	3	
	PeopleSoft	0	1	
	J.D. Edwards	4	1	
	Baan	2	2	
	Others	14	26	
Start using ERP system (years)	<1	5	3	0.27
	1-2	4	4	
	2-3	2	6	
	3-4	1	8	
	4-5	3	6	
	>5	17	21	
Reasons to adopt ERP system	Improve overall business performance	11	24	0.47
	Improve SCM performance	18	20	
	Enhance decision making	0	1	
	Integration of application	1	2	
	Integration of information systems	2	1	

Table I.
χ^2-test for early and late responses

ERP system in order to start reap the benefits of the system and observe its impact on the companies. In this study the majority of companies implemented and currently uses ERP system since more than five years rating 47.5 percent. The main two reasons behind adopting ERP system in most of the companies was to improve SCM performance and overall business performance rating 47.5 and 43.8 percent, respectively.

The results of the descriptive analysis for the demographic profile of respondents are shown in Table II.

Status of SCM performance

According to Table III, the majority of respondents rating 77.5 percent agree that the management will be able to renew their capability in any time in order to meet

Variables	Category	Frequency	%
Company ownership	Local	47	58.8
	Foreign	33	41.2
Company type	Manufacturing	80	100
Company size in term of employees	5-50 employees	2	2.5
	51-150 employees	20	25
	More than 150 employees	58	72.5
Geographic scope	Local	32	40
	Regional	11	13.8
	Worldwide	37	46.2
Customers number	Less than 50 customers	19	23.8
	51-100 customers	10	12.5
	101-150 customers	8	10
	More than 150 customers	43	53.7
Suppliers number	Less than 50 suppliers	9	11.2
	51-100 suppliers	15	18.8
	101-150 suppliers	15	18.8
	More than 150 suppliers	41	51.2
ERP provider	SAP	25	31.2
	Oracle	5	6.3
	PeopleSoft	1	1.2
	J.D. Edwards	5	6.3
	Baan	4	5
	Others	40	50
Start using ERP system (years)	<1	8	10
	1-2	8	10
	2-3	8	10
	3-4	9	11.3
	4-5	9	11.3
	>5	38	47.4
Reasons to adopt ERP system	Improve overall business performance	35	43.8
	Improve SCM performance	38	47.5
	Enhance decision making	1	1.3
	Integration of application	3	3.7
	Integration of information system	3	3.7

Table II.
Summary of demographic profile of respondents

Supply chain management (SCM) performance	Frequency (80)	% (100%)
Inventory costs have been reduced	46	57.5
Operational costs have been reduced	45	56.3
Products quality has been improved	42	52.5
Response to the changes has been improved	62	77.5
Quick action can be made based on accurate and on-time information	58	72.5
On-time delivery has been improved	47	58.8
Customers responsiveness has been improved	52	65.0
Customers are satisfied	47	58.8
Quick information flow	54	67.5
Accurate information is usually available	55	68.8
Link of information systems	42	52.5
Joint with production planning and scheduling	36	45.0

Table III.
Summary of distribution for SCM performance

the changing customer needs. This result indicated that ERP system provides flexibility to the company in order to respond to the changes in customer needs as well as in marketplace.

Moreover, 72.5 percent of the respondents agree that, the management can take quick actions based on the available information within the supply chain. In other words, ERP system provides on-time and accurate information that enable the management to take rapid and precise actions. This is followed by 68.8 percent of the respondents believe that accurate information is usually available for decision making, whereas 67.5 percent of the respondents agree with the quick flow of the information within the supply chain.

The overall results obtained from Table III indicated that ERP system improve SCM performance through reducing inventory and operational costs, improving product quality and on-time delivery, and enhancing flexibility and customer satisfaction. Briefly, the majority of Malaysian manufacturing companies believe that SCM performance has been improved after the implementation of ERP system. The details for each element of SCM performance are presented in Table III.

Factor analysis on ERP system

Table IV presents the factors loadings of ERP system items after deleting the items that show either low factor loading (<0.40) or high cross-loading (>0.35), the results indicate that the loadings of the remaining items were from 0.40 to 0.85. These loadings are acceptable because they were greater than the minimum requirement level which is 0.30 (Pallant, 2001; Hair *et al.*, 2006).

The factor analysis for the 25 items of ERP system provided five factors with 23 items (two items deleted). The five factors were renamed based on the questions in each factor as integration, materials management, production planning, controlling, and workflow management. The relative explanatory power (eigenvalues) for each factor is 5.36, 2.17, 1.93, 1.77, and 1.61, respectively. These factors cumulatively captured 55.84 percent of the variance in the data.

The Kaiser-Meyer-Olkin (KMO) measure, measure of sampling adequacy (MSA) for all items was 0.62 which is ranged within the acceptable level, i.e. between 0.51 and 0.90, in other words, if the MSA values above 0.50 indicate appropriateness (Hair *et al.*, 2006). The Bartlett's test of sphericity was significant, which indicates that there is sufficient number of significant inter-correlations for factor analysis, and the assumptions of factor analysis were met. In fact, if the KMO measure is >0.6 and the Bartlett's test of sphericity is large and significant, and then factorability is assumed (Coakes and Steed, 2007; Pallant, 2001; Tabachnick and Fidell, 2007).

The Cronbach's α of the items is reliable, i.e. 0.76, 0.68, 0.71, 0.71, and 0.67, respectively. These results provide support to discriminate and convergent validity of ERP system. Moreover, the results also show homogeneity within the dimensions and heterogeneity between the dimensions. The results of factor analysis are demonstrated in Table IV.

Factor analysis on SCM performance

The results of factor analysis of the 12 items related to the SCM performance has been rotated in one factor. All items of SCM performance had a factor loading ranged within 0.35 and 0.70. Whereas, the eigenvalue 3.67. The factor cumulatively captured 30.57 percent of the variance in the data. The reliability (Cronbach's α) was 0.78. The KMO measure, MSA was 0.63, and the Bartlett's test of sphericity was significant. The details of the finding are presented in Table V.

Items	Factors loadings 1	2	3	4	5
Integration					
Authorize payment can be made easily to suppliers in company's supply chain	0.68				
Software applications supported the real-time sharing of data across company's supply chain	0.66				
Data are entered only once in order for it to be retrieved by applications in different business units within the company's supply chain	0.66				
Enterprise integration has improved information quality within company's supply chain	0.64				
Software applications across company's supply chain worked seamlessly	0.62				
Sales department representative is very knowledgeable about the products in company's supply chain	0.47				
Inventory is well managed within company's supply chain	0.47				
Materials management					
Company can send back materials to suppliers across its supply chain		0.85			
All materials received as ordered within the company's supply chain		0.74			
Separate location is available for quarantine materials in company's supply chain		0.51			
There are strong connections with suppliers and customers in company's supply chain		0.46			
Production planning					
The budget to produce the product is identified in company's supply chain			0.75		
The product is described before produce in company's supply chain			0.66		
The goals of the product are identified within company's supply chain			0.66		
The raw materials needed to produce the product are identified in company's supply chain			0.59		
Sales department representative handled customers call quickly within company's supply chain			0.40		
Controlling					
Managers regularly receive analytical information that enables them to timely monitor events and activities and to identify what actions need to be taken within company's supply chain				0.77	
Company's supply chain management routinely obtains feedback from suppliers, customers, and other clients regarding supply chain performance or ways to improve services				0.74	
All employees in company's supply chain have the information they need to carry out their assigned responsibilities				0.73	
All customers' complaints fully investigated by personnel who are independent of those involved with the original transaction within company's supply chain				0.48	
Workflow management					
Employees can adjust the appearance of work items in their work lists to their own preferences					0.84
Customers can return feedback to the company's as detailed as possible and as far as possible to the workers in company's supply chain					0.76
Each employee can operate in different roles in company's supply chain					0.62
Reliability	0.76	0.68	0.71	0.71	0.67
Eigenvalue	5.36	2.17	1.93	1.77	1.61
Percentage of variance	14.02	11.52	11.22	9.76	9.31
KMO	0.62				

Table IV.
Summary of factor and reliability analysis on ERP system

Notes: Items with factor loading <0.40 were deleted; items with cross-loading between the factors >0.35 were deleted

Items	Factors loadings
Supply chain management	
Products quality has been improved within company's supply chain	*0.70*
On-time delivery has been improved within company's supply chain	*0.69*
Inventory costs have been reduced within the company's supply chain	*0.65*
Company's customers are satisfied with our products and services	*0.63*
Operational costs have been reduced within the company's supply chain	*0.60*
Information flows quickly along the value chain	*0.58*
Customers' responsiveness has been improved within company's supply chain	*0.50*
Accurate information is usually available for decision making	*0.49*
We continuously renew our competence to meet changing customer needs	*0.48*
We have joint production planning and scheduling among suppliers, manufacturing, marketing, and distributors	*0.44*
We take some actions quickly based on all the information continuously collected along company's supply chain	*0.38*
We link information systems so that each member of a supply chain knows others' requirements	*0.35*
Reliability	*0.78*
Eigenvalue	3.67
Percentage of variance	30.57
KMO	*0.63*

Note: One component extracted, the solution cannot be rotated

Table V. Summary of factor and reliability analysis on supply chain management performance

Summary for the dimensions before and after deleting items during factor analysis

Table VI summarizes the dimensions before and after deleting items during factor analysis. It also shows the items that were deleted after the factor analysis and the reason for deleting those items. Table VI demonstrates four items that deleted during the factor analysis that is P2, D3, T2, and finally C4.

Dimensions (before)	No. of items	Dimensions (after)	No. of items	Items deleted	Reason for deleted
Integration	4	Integration	7	None	None
Production planning	4	Production planning	4	None	None
Controlling	4	Controlling	5	None	None
Materials and workflow management	7	Workflow management	4	Procedures are generally easy to follow (P2) Two items moved to other factor	Cross-loading >0.35
Procurement and distribution	6	Material management	3	The waiting time for having customers' questions addressed (D3) Two items moved to other factor	Loading <0.35
Supply chain management performance	12	Supply chain management performance	12	None	None

Table VI. Summary for the dimensions before and after items deleted

Results and discussion

The usable response rate of this study was 61 percent, in other words 80 usable questionnaires were received from Malaysian manufacturing companies that are using ERP system. Majority of the companies' ownership were of local rating 58.8 percent, and 41.2 percent were of foreign ownership. The size of the companies in term of employees' number shows that the majority of respondents companies were having more than 150 employees constituting 72.5 percent. The geographic scope of most companies was worldwide rating 46.3 percent. In term of customers' and suppliers' number, more than half of the respondents were having more than 150 customers rating 53.8 percent and more than 150 suppliers rating 51.3 percent. In total, 31.3 percent of the target companies selected SAP as the provider of their ERP system. In this research the majority of companies implemented and currently uses ERP system since more than five years rating 47.5 percent. The main two reasons behind adopting ERP system in most of the companies was to improve SCM performance and overall business performance rating 47.5 and 43.8 percent, respectively.

The coefficient αs for the construct was computed in this research through the reliability test in SPSS and presented in Table VII. In this research, the Cronbach's α of the measure was highly reliable since it is above the limit of acceptability which is 0.70 (Cronbach's $\alpha > 0.70$).

A five-point Likert-type scale rating from 1 = strongly disagree to 5 = strongly agree was used for measuring all the items of this study. According to Table VIII, the mean values for ERP system, i.e. integration, material management, production planning, controlling, and workflow management, are 3.99, 3.92, 3.94, 3.78, and 3.88, respectively, which are above the average. The standard deviation ranges from 0.45 to 0.77. These results indicate that the ERP system worked seamlessly and smoothly in the manufacturing companies. Integration considered as the main dimension of ERP system which scored the highest mean value among the ERP system that is 3.99, indicating that there was a very high integration between several business units in the companies' supply chain, and also between software applications across companies'

Table VII.
Reliability analysis

Statistics for	Coefficient Cronbach's α	Mean	SD	No. of items	No. of cases
Scale	0.89	144.5	12.7	37	80
Integration	0.76	3.99	0.45	7	80
Materials management	0.76	3.92	0.55	4	80
Production planning	0.71	3.94	0.54	5	80
Controlling	0.71	3.78	0.61	4	80
Workflow management	0.71	3.88	0.77	3	80

Table VIII.
Descriptive analysis

Construct	Composite	Mean	SD
ERP system dimensions	Integration	3.99	0.45
	Material management	3.92	0.55
	Production planning	3.94	0.54
	Controlling	3.78	0.61
	Workflow management	3.88	0.77
Supply chain management performance	SCM performance	3.89	0.39

supply chain. Eventually, SCM performance obtained mean value of 3.89, and standard deviation of 0.39, which shows improvement in the SCM performance. The summary of descriptive analysis presented in Table VIII.

The general observation of the correlation in Table IX indicates that the ERP system is significantly correlated with each other except with workflow management. ERP system, i.e. integration ($r = 0.56$, $p < 0.01$), material management ($r = 0.37$, $p < 0.01$), production planning ($r = 0.49$, $p < 0.01$), and controlling ($r = 0.41$, $p < 0.01$), are significantly and positively correlated with SCM performance. However, workflow management is not correlated with SCM performance. These results indicate that there is a significant relationship between ERP system and SCM performance. The summary of the correlation analysis results are presented in Table IX.

This study has found that there is a positive and significant relationship between ERP system (i.e. integration, material management, production planning, controlling) and SCM performance. The workflow management, however, does not have a significant relationship with SCM performance, but still there is a positive relationship between workflow management and SCM performance. These results indicated that the relationships between ERP system and SCM performance are positive and significant relationships.

The finding of this research reveals that there is a positive but not significant relationship between workflow management and SCM performance. The outcome from the analysis of workflow management and SCM performance illustrates a small relationship between workflow management and SCM performance, as it only contributes 4 percent, to explain the shared variance in SCM performance.

In fact, workflow management supports the companies to achieve their business goals efficiently through coordinating work activities and provides the human resources and information related to the work requirements or needed to complete any required work. It can be argued that, the MIS manager in MIS department need to consult the HRM manager in HRM department in order to answer the questions related to workflow management, but because the MIS managers are extremely busy with their own work and they have no enough time to seek the consultation from HRM managers or from HRM department, consequently they do not really observed the significant impact of workflow management on the SCM performance and the questions related to this dimension has been answered with low attention.

	Integration	Material management	Production planning	Controlling	Workflow management	SCM performance
Integration	1					
Material management	0.41**	1				
Production planning	0.47**	0.32**	1			
Controlling	0.34**	0.30**	0.42**	1		
Workflow management	0.19	0.20	0.080	0.16	1	
Supply chain management (SCM) performance	0.56**	0.37**	0.49**	0.41**	0.20	1

Notes: **Correlation is significant at the 0.01 level (two-tailed); *correlation is significant at the 0.05 level (two-tailed)

Table IX.
Summary of correlation analysis

Multiple regression analysis

The relationship between ERP system and SCM performance. The multiple regression analysis has been conducted in order to test the hypotheses as well as to determine the variance of SCM performance that explained by the ERP system. Certainly, preliminary analyses were conducted in order to ensure no violation of the underlying assumptions of sample size, normality, linearity, homoscedasticity, multicollinearity and singularity, outliers, and independence of residuals (Pallant, 2001).

In order to explore the relationships between ERP system (integration, materials management, production planning, controlling, and workflow management) and SCM performance, multiple regression analysis was conducted. The details of this analysis are presented in Table X.

According to the results in Table X ERP system explained 42 percent of the variance in SCM performance ($R^2 = 0.42$). The F-value of 10.45 indicates that there is a significant linear model at $\alpha = 0.01$. On the other hand, integration ($\beta = 0.35$, $p < 0.05$) and production planning ($\beta = 0.23$, $p < 0.05$), positively and significantly associated with SCM (Pallant, 2001).

These results show that integration, and production planning, having the largest β coefficient contribution in ERP system, $\beta = 0.35$ and 0.23, respectively, and they are positively and significantly associated with SCM performance which concludes that ERP system positively and significantly associated with SCM performance (Pallant, 2001).

Furthermore, Table X demonstrates the significant unique contribution of each independent variable to the prediction of SCM performance, and this makes a comparison between the unique contributions of each independent variable to the equation. For example integration with ($\beta = 0.35$, $p < 0.05$) made the largest unique and statistically significant contribution to the equation, followed by production planning with ($\beta = 0.23$, $p < 0.05$) also made the second largest unique and statistically significant contribution to the equation that is ($R^2 = 0.42$), whereas the whole model explain 42 percent of the variance in SCM performance (Pallant, 2001).

Conclusion

This study aimed to investigate the relationship between ERP system and SCM performance. The finding of this study supports the significant relationship between ERP system and SCM performance. This research can conclude that, there is a positive

Independents variables (ERP system)	Dependant variable (SCM performance) Standard β coefficients and significant level
Integration	0.35**
Materials management	0.09
Production planning	0.23**
Controlling	0.16
Workflow management	0.07
R	0.65
R^2	0.42
Adjusted R^2	0.38
F	10.54***

Notes: Significant levels: ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

Table X.
Summary of the relationship between ERP system and SCM performance

and significant relationship between ERP system (i.e. integration, material management, production planning, and controlling) and SCM performance.

In general the findings of this study implies that the successful implementation and the effective usage of ERP system can contribute toward enhancing SCM performance in many ways such as, integration of internal business processes, enhancement of information flow among different departments inside the company, improvement of the company's relationships and collaboration with outsourcing suppliers, customers, and supply chain partners, global sourcing, sharing, exchange and movement of information, goods and services, improvement of product quality, flexibility and customer responsiveness, and finally reduction of inventory and operation costs.

The finding of this study also implies that, those companies who have achieved successful implementation of ERP system and attain effective usage of the system certainly will reap high and effective SCM performance. In other words, successfully implemented ERP system and effectively used will significantly improve and enhance the performance of SCM, and then the company will reap many benefits from ERP system such as, having an easy and reliable access to data and information, adaptability in any changing business environment, improved scalability, improved efficiency, reduced cycle time, reduced time of delivery, reduced costs, avoidance of redundant data, and redundant operations, and reach globally out via CRM and SCM modules throughout e-commerce and e-business.

Malaysian manufacturing companies implemented ERP system with the integration in order to integrate all applications among several departments inside the company as well as across the supply chain to provide a smooth work and quick flow of quality information within the company's supply chain. This integration will provide easy and reliable access to data from any unit within the supply chain and will prevent redundant data and therefore prevent redundant operations, which eventually will contribute toward improving the performance of the SCM.

Future research could focus on other modules of ERP system that are related to finance or to human resource management or any other section in order to improve other parts of business performance such as the financial performance (return on investment and return on assets), marketing performance (sales growth, market share, and new service success), or customer-based performance (customer retention, customer satisfaction), and all these parts will finally contribute to improve overall business performance.

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(The Appendix follows overleaf.)

Appendix

APPENDIX
RESEARCH QUESTIONNAIRE

SECTION 1: GENERAL INFORMATION

In this section we would like to know about your company in general.

1. **Company's name:** _____

2. **Main line of business**: _____

3. **Your job designation:** _____

4. **Company location:** _____

5. **Company ownership:** ☐ Local ☐ Foreign

6. **Please indicate type of your company:**

   ☐ Manufacturing.
   ☐ Services.
   ☐ Construction.
   ☐ Others (please specify).____

7. **Please indicate size of your company in term of employees:**

   ☐ Less than 5 employees.
   ☐ 5 – 50 employees.
   ☐ 51 – 150 employees.
   ☐ More than 150 employees.

8. **Please indicate the geographic scope of your company's operations:**

   a. ☐ Local (*e.g: Johor, Kuala Lumpur, Kedah, Penang, etc).*
   b. ☐ Regional *(e.g: ASEAN).*
   c. ☐ Worldwide *(e.g: China, UK, Australia, etc).*

9. **Please indicate the following:**

   i. Total number of customers:

   a. ☐ < 50 **c.** ☐ 101-150
   b. ☐ 51-100 **d.** ☐ > 150

   ii. Total number of suppliers:

   a. ☐ < 50 **c.** ☐ 101-150
   b. ☐ 51-100 **d.** ☐ > 150

10. Please indicate one of your main products that your company produces: _____

11. Whatv is the Enterprise Resource Planning (ERP) Systems provider that implemented the ERP systems in your company?

1. SAP
2. Oracle
3. PeopleSoft
4. J.D. Edwards
5. Baan
6. Others (please specify)_____

12. What systems did you use before that?_____

13. When did you start using the new ERP systems?

a. Less than 1 year
b. 1 year – 2 years
c. 2 years – 3 years
d. 3 years – 4 years
e. 4 years – 5 years
f. More than 5 years

14. Which of the following reasons led to the decision to adopt the ERP systems? (Answers can be more than one):

1- Improve overall business performance
2- Improve supply chain management performance
3- Enhance decision making
4- Integration of application
5- Increase sales
6 - Competition
7 - Year 2000 problem
8 - Integration of information systems
9 - Cost reduction
10 - Others (please specify)_____

15. How many ERP modules were implemented and currently used? Please specify them (You can answer more than one):

1. Production planning
2. Controlling
3. Materials management
4. Workflow management
5. Sales and distribution management
6. Supply chain management
7. Production management
8. Manufacturing management
9. Transportation management
10. Quality management
11. Treasury
12. Project system
13. E-business
14. Human resources management
15. Investment management
16. Plant maintenance
17. Enterprise controlling
18. Industry sol utions
19. Asset Management
20. Financial acco unting
21. Others (please specify) ____

SECTION 2: ERP SYSTEMS DIMENSIONS

In this section, we are trying to measure the dimensions of ERP systems.
Please indicate the degree of your agreement with the following statements by circling the appropriate number against each question using the scale below.

1	2	3	4	5	NA
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Not Applicable

Integration	**Degree of Agreement**
1. Software applications across company's supply chain worked seamlessly.	1 2 3 4 5 NA
2. Software applications supported the real-time sharing of data across company's supply chain.	1 2 3 4 5 NA
3. Data is entered only once in order for it to be retrieved by applications in different business units within the company's supply chain.	1 2 3 4 5 NA
4. Enterprise Integration has improved information quality within company's supply chain.	1 2 3 4 5 NA
Production Planning	**Degree of Agreement**
1. The product is described before produce in company's supply chain.	1 2 3 4 5 NA
2. The goals of the product are identified within company's supply chain.	1 2 3 4 5 NA
3. The budget to produce the product is identified in company's supply chain.	1 2 3 4 5 NA
4. The raw materials needed to produce the product are identified in company's supply chain.	1 2 3 4 5 NA

Controlling	Degree of Agreement
1. Managers regularly receive analytical information that enables them to timely monitor events and activities and to identify what actions need to be taken within company's supply chain.	1 2 3 4 5 NA
2. All employees in company's supply chain have the information they need to carry out their assigned responsibilities.	1 2 3 4 5 NA
3. Company's supply chain management routinely obtains feedback from suppliers, customers, and other clients regarding supply chain performance or ways to improve services.	1 2 3 4 5 NA
4. All customers' complaints fully investigated by personnel who are independent of those involved with the original transaction within company's supply chain.	

Materials and Workflow Management	Degree of Agreement
1. All materials received as ordered within the company's supply chain.	1 2 3 4 5 NA
2. Company can send back materials to suppliers across its supply chain.	1 2 3 4 5 NA
3. Separate location is available for quarantine materials in company's supply chain.	1 2 3 4 5 NA
4. Inventory is well managed within company's supply chain.	1 2 3 4 5 NA
5. Each employee can operate in different roles in company's supply chain.	1 2 3 4 5 NA
6. Employees can adjust the appearance of work items in their work lists to their own preferences.	1 2 3 4 5 NA
7. Customers can return feedback to the company as detailed as possible and as far as possible to the workers in company's supply chain.	

SECTION 3: SUPPLY CHAIN MANAGEMENT PERFORMANCE

In this section, we are trying to measure the supply chain management performance. Please indicate the degree of your agreement with the following statements by circling the appropriate number against each question using the scale below.

1	2	3	4	5	NA
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Not Applicable

Supply Chain Management Performance	Degree of Agreement
1. Inventory costs have been reduced within the company's supply chain.	1 2 3 4 5 NA
2. Operational costs have been reduced within the company's supply chain.	1 2 3 4 5 NA
3. Products quality has been improved within company's supply chain.	1 2 3 4 5 NA
4. We continuously renew our competence to meet changing customer needs.	1 2 3 4 5 NA
5. We take some actions quickly based on all the information continuously collected along company's supply chain.	1 2 3 4 5 NA
6. On-time delivery has been improved within company's supply chain.	1 2 3 4 5 NA
7. Customers' responsiveness has been improved within company's supply chain.	1 2 3 4 5 NA
8. Company's customers are satisfied with our products and services.	1 2 3 4 5 NA
9. Information flows quickly along the value chain.	1 2 3 4 5 NA
10. Accurate information is usually available for decision making.	1 2 3 4 5 NA
11. We link information systems so that each member of a supply chain knows others' requirements.	1 2 3 4 5 NA
12. We have joint production planning and scheduling among suppliers, manufacturing, marketing, & distributors.	

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