

Business Excellence model for supply chain management

GOPAL K. KANJI¹ & ALFRED WONG²

¹Sheffield Business School, Sheffield Hallam University, Stoddart Building, City Campus, Sheffield S1 1WB, UK & ²Lingnan College, Department of Management, Tuen Mun, New Territories, Hong Kong

ABSTRACT *Supply chain management (SCM) has been increasingly adopted by companies world-wide so as to utilize better their supply chain activities for competitive advantages. This paper reviews the relationships between total quality management (TQM) and SCM and concludes that existing SCM models have inadequacies which can be enriched by TQM principles and concepts. The authors selected Kanji's Business Excellence model, which uses TQM principles and concepts to help companies achieve business excellence, to fulfil the inadequacies of the existing SCM models and to create a new structured model for SCM. The model was tested with the data using the supply chain activities of 139 companies in Hong Kong. The results support that the structured model provides a good fit for the supply chain activities. Business excellence indices, which can be obtained for companies' SCM, can be further developed based on this new model.*

Introduction

Companies world-wide recognize the importance of meeting customers' needs to succeed in the competitive market-place. They realize that optimizing operations within the four walls of their enterprises is not enough to achieve business excellence. They understand that the involvement of suppliers, which is critical to improve quality and meet customer specifications, can enhance their performance. Hence, supply chain management (SCM) is advocated as a means to help companies leverage their suppliers' resources in improving their own competitive edges (Cavinato, 1991; Ellram & Cooper, 1990; Houlihan, 1985; Jones & Riley, 1985; Towill *et al.*, 1992). However, the authors found that there are inadequacies in the existing SCM models which hamper their effectiveness. Therefore, a new SCM model is developed in this paper so that organizations can make use of this new SCM model to achieve business excellence. Here, business excellence is defined by Kanji (1998) as "the simultaneous measurement of customers', employers' and shareholders' delights within an organization to provide overall business success". Total quality management (TQM) principles have been incorporated into the existing SCM model to form the new SCM model.

Christopher (1992) defines a supply chain as the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities

Correspondence: Prof. Gopal K. Kanji, European Centre for Organisational Excellence, Sheffield Business School, Sheffield Hallam University, Stoddart Building, City Campus, Sheffield, S1 1WB, UK. Tel: 0114 225 3137; Fax: 0114 225 5268.

that produce value in the form of products and services in the hands of the ultimate consumer. According to Ellram (1991), SCM is an integrative approach to dealing with the planning and control of the materials flow from suppliers to end-users. It is an approach aimed at cooperatively managing and controlling distribution channel relationships for the benefit of all parties involved, to maximize efficient use of resources in achieving the supply chain's customer service goals. In fact, according to Giunipero and Brand (1996), SCM has evolved into three typologies, represented by different writers: flow of goods approach (Houlihan, 1985; Jones & Riley, 1985; Scott & Westbrook, 1991); flow of goods and information approach (Cooper & Ellram, 1993; Towill *et al.*, 1993); and integrative value added approach (Cavinato, 1991; Langley & Holcom, 1992). Consolidating the different typologies indicates that SCM adopts a systems and integrative approach in managing the operations and relationships among the different parties in a supply chain. SCM is not limited to managing the total flow of goods and information from supplier to end-user, it also includes managing entire value added activities of firms up to final customer so as to provide best value for the customer. Adopting SCM often results in the forming of partnerships between companies and their suppliers.

Relationship between TQM, SCM and partnering

Based on a literature review, some management principles are useful for improving the performance of a company. They include management principles such as process management (Kanji & Asher, 1993; Zairi, 1997), customer satisfaction (Fornell, 1992; Gorst *et al.*, 1998), teamwork (Scholtes, 1992; Tjosvold, 1993), strategic leadership (Edgeman & Dahlgard, 1998; Kanji, 1996; Tribus, 1998), systems thinking (Senge *et al.*, 1994), continuous improvement (Imai, 1986) and scientific management advocated by Frederick Taylor. For a company to perform well, blending together of these various management principles is required. In fact, TQM is a holistic and integrated approach blending together these various principles that are necessary for a company to achieve business excellence. According to Kanji and Asher (1993), because of the holism, TQM can be distinctive in affording a strong philosophical underpinning to its prescriptions. A company which has adopted TQM will normally make use of the total quality principles to achieve business excellence. Within the company, the top management, the middle management and the operational management will work together towards satisfying the needs of the customers. This is the vertical view of TQM as suggested by Youssef *et al.* (1996) and the concept of internal partnering of Goetsch and Davis (1997).

On the other hand, in order to perform well, a company has to rely on the performance of its upstream and downstream organizations, i.e. there is a quality chain or value chain linking these organizations with the customers. This is the SCM concept, which focuses on integrating the different parties together in order to meet the needs of the customers. This customer and supplier chain concept is similar to the horizontal view of TQM as advocated by Youssef *et al.* (1996) and the view of others such as Kanji and Asher (1993), who point out that TQM has to be spread to a company's suppliers. It is also referred to as external partnering by Goetsch and Davis (1997). Hence, partnering is the key element of SCM, while SCM is the horizontal view or part of a company's TQM system.

Customers of a supply chain

There are two parties in a supply chain: supplier and organization. The organization provides information on its requirements to the supplier, and the supplier produces goods or services

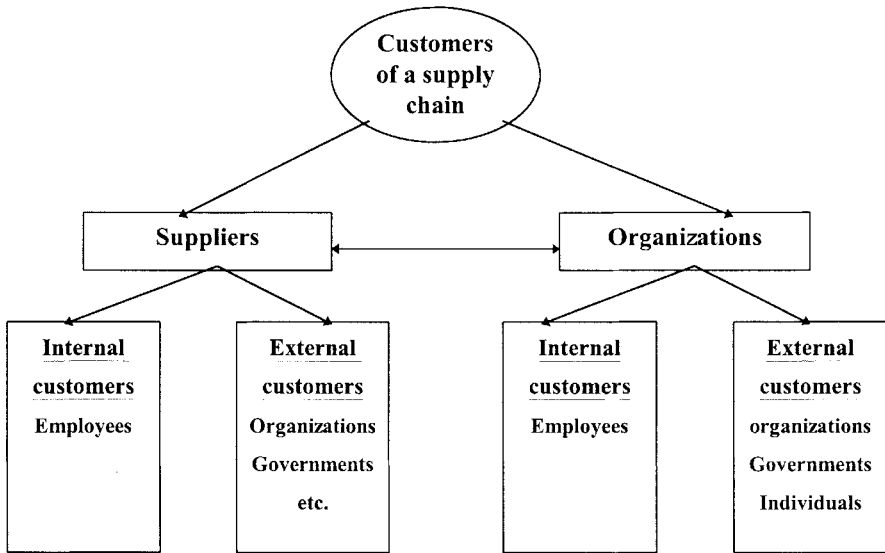


Figure 1. *Customers of a supply chain.*

to meet the organization's needs. The organization should try to develop good relationships and close operation with the supplier, for it can meet the needs of its customers better with the supplier's support. These two parties of the supply chain have both internal and external customers (Fig. 1). The internal customers of the supplier are mainly its employees and the external customers of the supplier refer to organizations, governments, etc. that purchase goods or services from it. Regarding the organization, its internal customers are its employees and its external customers are organizations, governments and individuals that buy its goods or services. In order to meet the needs of the ultimate customers of a supply chain, both the needs of the internal and external customers of the supplier and the organization should be satisfied. For instance, when the supplier does not meet the needs of its employees, which may be appropriate rewards, training, technical support, etc. the quality of their output will be endangered and hence organizations obtaining supplies from the supplier will not be satisfied if they receive its defective goods. If the organization includes the inferior quality of supply from the supplier into its products without knowing it and later sells the finished products to its customers, then they will be dissatisfied when using the products. Hence, dissatisfaction of internal customers will lead to the dissatisfaction of external customers. It is believed that a supplier who has satisfied internal customers should be able to serve best its external customers. Furthermore, if it is satisfied with the relationship and operations with its external customers, it will be even more committed to serving them better in the future. Therefore, a good SCM model should take into consideration simultaneously the supplier's satisfaction of its relationships and operations with the organization, the organization's satisfaction with the contribution of the supplier, the competitive position of the organization and the satisfaction of its external customers.

Existing SCM models and their inadequacies

As shown in Fig. 2, an essential element of the existing SCM model is a long-term relationship between the parties. It is believed that a long-term relationship can generate a close

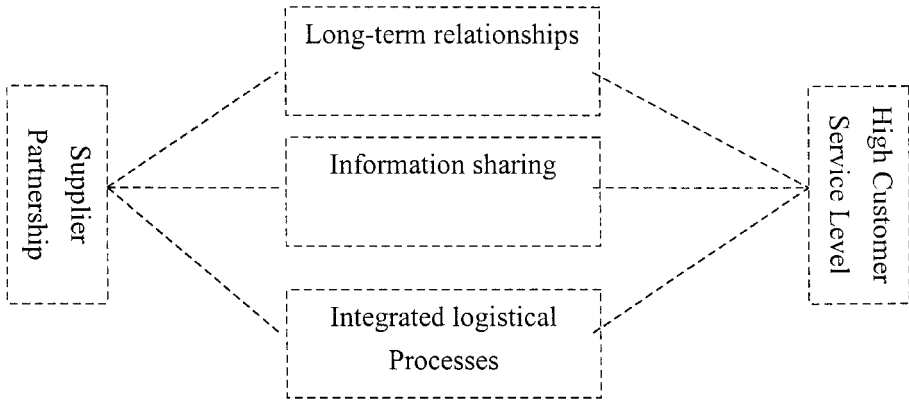


Figure 2. Existing SCM model and its inadequacies.

relationship which will make it easier for the parties to work together and arrive at a common goal of meeting the needs of the ultimate customers. Therefore, supplier partnership is advocated under the existing SCM model. It is useful as a measure to improve the interorganizational relationship and operation. However, a close relationship does not come easily. It may require some cultural changes among the people in the supply chain. This human factor is not covered in most work on SCM. Moreover, there is not much discussion on the way to develop a close relationship between the parties, and the way to maintain and sustain the relationship. A possible area that should be covered in developing a close relationship between the parties is that someone in the supply chain should assume the leadership to integrate the various parties. SCM writers focus mainly on managing the total material flow and the related information flow as the goal of SCM. Thus, a high customer service level is being regarded as the need of the customers that SCM has to meet. However, quality and cost aspects should also be included in order to meet customers' needs. The supply chain should aim to meet the various needs of a customer so as to satisfy fully the customer. Information is required for the smooth operation of the supply chain. However, information being shared among supply chain members should not be limited to logistical information, rather, information on quality and cost should be exchanged. Just having a close relationship is not enough to ensure best performance from the supply chain. Suitable systems and procedures will facilitate the operations of the whole chain in getting the right quantity of goods with best quality at the lowest cost. The process being covered in SCM should not be limited to logistical process, it can also include design process, production process and distribution process. In fact, buyer and supplier should be involved in different processes so as to leverage their combined resources better. Their operations should be integrated so that there is no gap between the buyer and the supplier and the processes will be smoother and quicker. Learning from one another should occur among the supply chain members so that the various processes can be improved. For instance, suppliers can help the buying company design a better product through their expertise in the production of certain parts that can give additional value to the products. On the other hand, the buying company (intermediate customer) can support the suppliers in improving their production process. Continuous improvement of the supply chain is the key towards meeting the ever-changing needs of the ultimate customers.

In conclusion, the existing SCM model focuses mainly on working closely with suppliers in providing a high service level to customers; however, it ignores some fundamental issues

such as leadership's influence on supply chain relationship, the building of cooperative and quality culture, ways to develop close relationship, initiatives to improve continuously, managing processes other than logistics, and quality and cost requirements of customers (Fig. 2).

From Fig. 2 it can be seen that some inadequacies exist in the present SCM model. These inadequacies include:

- creation of cooperative and quality culture
- the way to develop a close relationship
- managing processes other than logistical processes
- leadership's role in the supply chain relationship
- quality and cost requirements of customers
- initiatives to improve continuously.

The purpose of the new SCM model

The purpose of a new SCM model is to fulfil the inadequacies of the existing SCM model. Companies can make use of the new SCM model to understand and manage better and utilize fully their supply chains to achieve organizational effectiveness. This goal of the new SCM model is similar to the goal of adopting TQM by a company which also strives for organizational excellence. However, the new SCM model focuses on achieving organizational excellence through managing better and utilizing fully the resources of the supply chain.

According to Hackman and Wageman (1995), TQM as a management philosophy has been proven to have convergent validity by way of consisting of a common set of assumptions and practices as practised in various organizations. Although some TQM scholars have acknowledged that the applications of TQM differ from one situation to another, nevertheless, most of them have advocated that TQM can be applied uniformly to all organizations (Juran, 1986, cited in Sitkin, 1994). Hence, TQM can be applied generically. TQM implementation is influenced by certain total quality principles and core concepts that are critical for the organizations' success (Kanji & Malek, 1999). It is believed that the generic total quality principles that are useful to a company would also be useful to the supply chain. Where it differs is that the principles would be viewed from an interorganizational approach or from the customer/supplier approach rather than solely from a company's own view. In other words, it is also an extended TQM model, i.e. the horizontal view of TQM. Therefore, the new SCM model should be supplemented by the TQM principles and concepts so as to help companies achieve excellent performance from their supply chains.

Kanji's Business Excellence model

In enriching the existing SCM model, Kanji's Business Excellence model (1998) is used (Fig. 3). It is used because it meets our selection criteria, i.e. general or special-purpose, emphasis on TQM principles, inclusion of critical success factors and model validation. Kanji's Business Excellence model is developed from Kanji's (1996) modified pyramid model. The Business Excellence model translated the pyramid model's principles and core concepts into a structural model for business excellence. Kanji's model consists of four principles: delight the customer; management by fact; people-based management; and continuous improvement. Each principle is divided into two core concepts, that is: customer satisfaction and internal customers are real; all work is process and measurement; teamwork and people make quality; continuous improvement cycle and prevention. Leadership serves as a prime

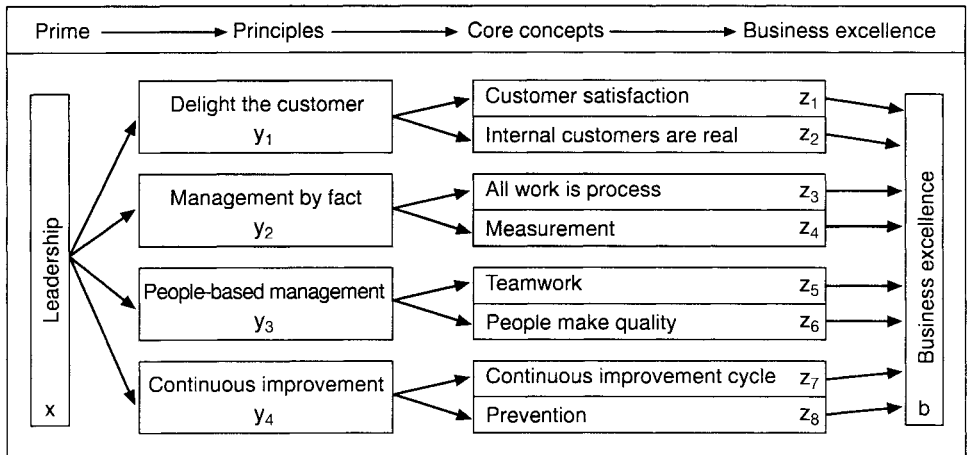


Figure 3. Kanji's Business Excellence model.

in this model that must be transmitted through all the principles and core concepts in order to achieve business excellence. The model components synthesize not only those critical requirements for quality management prescribed by eminent quality practitioners such as Juran, Deming, Feigenbaum, etc. but also other critical success factors for business excellence. Survey results of Kanji and Yui (1997) and Kanji and Malek (1999) indicate that respondents regard the prime principles and core concepts of the Business Excellence model as critical success factors. Moreover, most of the models in use (e.g. Deming, European, Baldrige, Japanese) are indicative models, whereas Kanji's Business Excellence model is an improvement model. The former models are indicative in the sense that they only highlight the important factors for business excellence, they do not utilize suitable statistical methods to determine factor weights, factor scores and total evaluation score. They also do not show structural relationships among factors and how the factor scores contribute to business excellence. On the other hand, Kanji's Business Excellence model is an improvement model because it performs simultaneous computation of mathematical equations of factor relationships to obtain factor indices and business excellence indices which allow organizations to compare themselves against the different organizations with whom they are competing. This is of particular benefit to organizations which are not doing as well as they might, as it will give them an incentive to do something about their failings.

Principles and concepts of the new SCM model

In the development of the new SCM model, the managers responsible for managing the supply chains of two large companies, one medium-sized company and one small company, had been interviewed in-depth to explore the various salient variables relating to managing the supply chain. The general finding from the managers was that the existing SCM model was not sufficient to achieve the best results.

The new SCM model has the role of improving the performance of a supply chain. There is a set of core principles and concepts underpinning the new SCM model. These core principles and concepts were adopted from the Business Excellence model (Kanji, 1998), with special focus on the supply chain level instead of on overall business level of an individual organization. These core principles and concepts are essential for utilizing supply partners'

resources in achieving excellent business performance. They are discussed under the following headings.

Leadership

The top management of different supply chain members should, together, set directions for the operation of the supply chain and create a customer orientation, clear and visible values and high expectations for the supply chain. The top management should commit themselves to the development of the entire supply chain and should encourage participation, learning, innovation and creativity by all supply chain members. The top management should also commit themselves to maintaining and sustaining the relationship among the supply chain partners. The cultivation of a quality culture for the whole chain and the forming of cooperative and congruent goals among supply chain members are important tasks of the top management of each member in a supply chain. Developing a quality culture for the whole supply chain is important for ensuring quality output to ultimate customers (Kanji & Wong, 1998). Kanji (1996) pointed out that the leaders are very important to the implementation of quality management and, in fact, leadership is the base or the 'prime' of his pyramid TQM model (Kanji, 1998). Hence, the leaders should serve as role models for their employees to work together for the betterment of the whole supply chain. They should also demonstrate their commitment to quality.

Customer focus

The supply chain members should all have the goal of satisfying their final customers' requirements. This goal will direct the setting of strategies and plans, the operations and performances of different supply chain members. Besides, in order to meet the needs of the ultimate customers, the needs of different supply chain members should also be satisfied. The different supply chain members are, in fact, operating as internal customers and suppliers within the supply chain. If the needs of a supply chain member are not satisfied, this would affect its performance downstream and the whole chain's performance would be lowered. Hence, customer focus is necessary in the model, which follows Kanji's 'delight the customers' principle.

Cooperative relationship

Members in a supply chain have to work closely together in order to coordinate their work better and obtain a synergistic effect. Hence, teamwork with other supply chain members, i.e. external teamwork, should be encouraged. Teamwork among different members in the supply chain should lead to good performance for the whole chain. For teamwork to be effective, it is essential to have frequent communication, a building of trust and commitment among the chain members. It depends on the dynamics of the teamwork among the supply chain partners. It is believed that having cooperative rather than competitive goals among the partners will lead to best teamwork performance. Therefore, we need a cooperative relationship in the model, which in fact relates to Kanji's 'people-based management' principle.

Integrated process and information management

Process refers to linked activities with the purpose of producing a product or service for a customer (user) within or outside the company. There are different kinds of process: design

processes, production/delivery processes and support processes. Supply chain members can be involved in various processes. As processes often cut across organizational boundaries, they may be broken or disrupted by lack of communication and coordination between organizations. Good linkage between the operations/processes of different chain members is critical for an efficient and effective supply chain. The operation should be smooth and seamless when involving different supply chain members in a process. Therefore, it demands effective and efficient process management.

Generally, processes involve combinations of people, machines, tools, techniques and materials in a systematic series of steps or actions. Therefore, it is necessary to have an integrated structure among different supply chain members so that resources can be channelled together to carry out the operation smoothly.

Information exchange between different supply chain members is necessary for better coordination of work among members and it may also lead to improvements in the chain's operation. Having a system to facilitate the exchange and sharing of information is essential.

Information to be exchanged should be useful to the operation of the whole supply chain. It may be demand forecast, product information, supply market information, technical information, etc. Besides, some indicators that can reflect the performance of the whole supply chain should be established and the relevant information be collected so that the whole chain can know its performance and treat it as a base for further improvement. Integrated process and information management together reflect Kanji's 'management by fact' principle.

Continuous improvement

In order to meet the ever-changing needs of the customers, the supply chain should also continuously improve its performance. There is always room for improvement in the process of the supply chain so as to make it more integrated. Process improvement may be as a result of benchmarking or going through a close study by the parties themselves on their operations.

The need to improve continuously has to be cultivated in the minds of different chain members. They have to be conscious of preventing problems happening in the supply chain. Problems may be related to the variability of the operation processes in the supply chain. Moreover, there should be some channels or mechanism for chain members to voice their suggestions or to combine their efforts to improve further their operations. Improvements may require joint planning and discussion between members.

Business excellence

The application of the principles and their related concepts should enable the whole supply chain to achieve lower cost, better quality and quicker delivery of products or services to customers. These performance achievements are the combined efforts of different members of the supply chain. Therefore, the new SCM model can provide an effective way for managing the supply chain for business results. The supply chain partners are also satisfied with their relationship and the smooth operation processes. Each supply chain partner is continuously contributing towards meeting the ever-changing needs of the ultimate customers. It is believed that when the chain members are satisfied, they will be committed to using their greatest effort in serving the ultimate customers. When the ultimate customers are satisfied with the products or services they receive from a company, the customers will be loyal to the company and the company can achieve good business results.

These six constructs that have incorporated the principles and concepts of both Kanji's

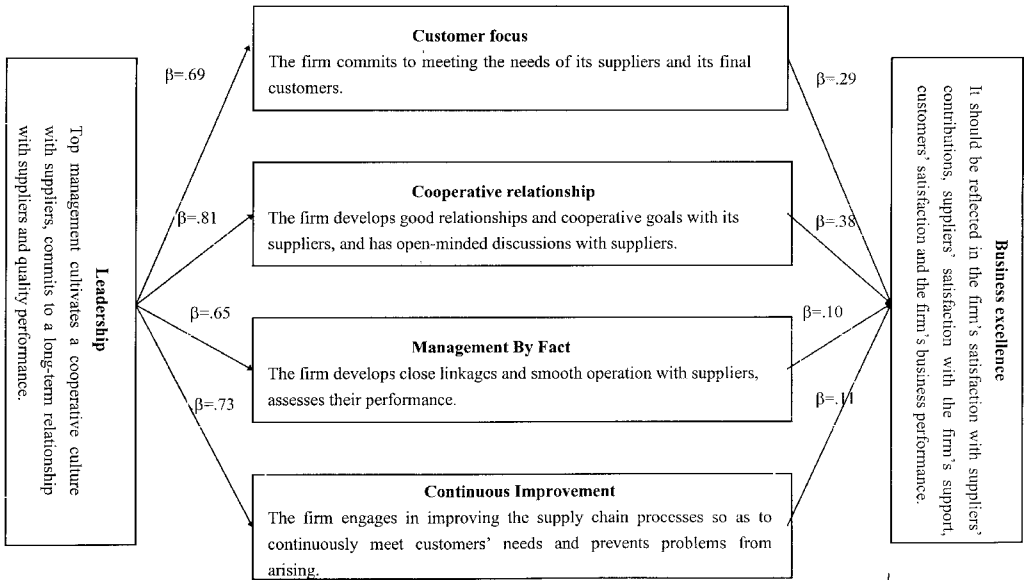


Figure 4. A new SCM model (path estimates β are indicated in the diagram).

Business Excellence model and the existing SCM model are combined to represent a structural Business Excellence model for SCM (Fig. 4). Through a literature review, the model also has some content validity. Leadership of companies displayed in the form of creation of cooperative culture with suppliers, commitment to supplier relationship and commitment to quality would impact the extent of commitment to customer satisfaction, cooperative relationship, integration of processes between companies and their suppliers, the amount of information obtained and exchanged with suppliers and the extent of commitment to continuous improvement with suppliers. These strong relationships and linkages with suppliers in turn result in high contributions to business excellence for companies. A study testing the Business Excellence model for SCM has been carried out and is reported in this paper.

Methods of development of the new SCM model

Participants

Questionnaires were sent to managers with significant responsibility for working with suppliers. From 1050 questionnaires distributed, 145 managers completed and mailed back their questionnaires, resulting in 139 usable responses. Their average age was 34 and had worked for an average of 7.16 years in their organizations, and had been dealing with the supplier they reported on for an average of 5.69 years. Most of the respondents were senior managers, followed by a group of middle managers.

Sampling design

Companies that make a lot of purchases were the targets of this study. They include manufacturers, importers and wholesalers. A convenient and often used directory has been compiled by the Federation of Hong Kong Industries (FHKI). All members contained in the

FHKI Members' Directory 1997, with the exception of the finance companies, were included in this survey.

Measures

Six sets of measures were adopted and used to measure each of the six constructs, namely, leadership, customer focus, cooperative relationship, management by fact, continuous improvement and business excellence. These measures were subjected to a formal pre-test by managers responsible for managing their supply partners. Some minor modifications were carried out to make the meaning of some items clearer.

An internal consistency analysis was performed separately for each variable in the theorized model by calculating the Cronbach- α s, i.e. the reliability alphas. The results in Table 1 show that the Cronbach- α s for all the variables in the model were above the critical value of 0.7 (Nunnally, 1978). Hence, the authors concluded that all the items had been appropriately assigned to each variable. The instrument developed also had content validity, since the selection of measurement items was based on an exhaustive review of the literature and a detailed evaluation by academics and practitioners. Content validity depends on how well the researchers created the measurement items to cover the content domain of the variable being measured (Nunnally, 1978). The study used a five-point rating scale, i.e. from 1 (strongly disagree) to 5 (strongly agree). The reliability alphas (α) of different variables and sample items for each variable are discussed as follows.

Leadership

Leadership consists of the variables of cooperative culture (*Culture*), commitment to relationship (*Longtm*) and commitment to quality (*ComQu*). The view of the top management and the overall policy of a company will affect the company's commitment to its supply partners. Under leadership, the cultivation of a cooperative culture, commitment to supplier relationship and commitment to quality will set the tone and facilitate the operations with its suppliers. Items for cooperative culture and commitment to supplier relationship were developed from one of the authors' previous studies (Wong *et al.*, 1999). Four items were used to measure each variable under leadership. Subjects were asked to respond on a five-point scale to these 12 items (1 = strongly disagree; 5 = strongly agree). Some sample items for the three variables were "Our top management perceives that we and this supplier seek compatible goals"; "Our company considers that maintaining a long-term relationship with this supplier is important to us"; "Our top management supports long-term quality improvement process". Reliabilities (coefficient alphas) of the three variables were 0.73, 0.83 and 0.80, respectively.

Customer focus

Customer focus consists of the variables of commitment to supply partner satisfaction (*COMSU*) and commitment to customer satisfaction (*COMCU*). It represents commitment to the internal customers within the supply chain and the external customers or final customers, respectively. A company's commitment to the needs of its supplier should help it meet the needs of its final customers. Four items were used to measure each variable. Sample items for these variables were "We want our supplier satisfied with the information we give them to facilitate their work"; "Our firm commits to providing high quality products or

Table 1. Constructs for the new SCM model

Constructs and variables	Reliability α	No. of questions	Sample questions
<i>Leadership dimension</i>	0.85	12	
Cooperative culture (<i>CULTURE</i>)	0.73	4	Our top management perceives that we and this supplier seek compatible goals
Commitment to relationship (<i>LONGTM</i>)	0.83	4	Our top management considers that maintaining a long-term relationship with this supplier is important to us
Commitment to quality (<i>COMQU</i>)	0.80	4	Our top management supports a long-term quality improvement process
<i>Customer focus dimension</i>	0.83	8	
Commitment to supply partner satisfaction (<i>COMSU</i>)	0.82	4	We want our supplier to be satisfied with the information we give them to facilitate their work
Commitment to customer satisfaction (<i>COMCU</i>)	0.84	4	Our firm is committed to providing high-quality products or services to our customers
<i>Cooperative relationship dimension</i>	0.90	12	
Supplier dynamics (<i>SUPDY</i>)	0.80	4	An atmosphere of cooperation exists between our firm and this supplier
Cooperative goals (<i>COOP</i>)	0.83	4	We and the supplier want each other to succeed
Cooperative controversy (<i>CC</i>)	0.84	4	We and the supplier listen carefully to each other's opinions
<i>Management by fact dimension</i>	0.90	16	
Seamless operation (<i>OPERAT</i>)	0.73	4	Our firm meets with this supplier's senior management on a regular basis to discuss problems
Integrated structure (<i>STRUCT</i>)	0.75	4	Tight operating linkages are planned for and implemented between our firm and this supplier
Performance measurement (<i>MEASURE</i>)	0.85	4	Our firm assesses the supplier's performance through a formal evaluation programme
Information exchange (<i>INFOEX</i>)	0.76	4	Our firm and this supplier share work improvement suggestions with each other
<i>Continuous improvement dimension</i>	0.83	8	
Process improvement (<i>processim</i>)	0.77	4	We continuously work at integrating the process between our firm and this supplier
Planning and prevention (<i>PREVEN</i>)	0.70	4	Our firm has measures to prevent problems arising from our relationship with the supplier
<i>Business excellence dimension</i>	0.88	16	
Customer satisfaction (<i>CUSAT</i>)	0.79	4	Customers are satisfied with the quality of our product which has incorporated the input of this supplier
Business results (<i>BUSRESU</i>)	0.82	4	Our product quality is very competitive in the market
Supplier contribution (<i>SUPCONTR</i>)	0.85	4	The supply partner helps us reach our quality objectives
Supplier satisfaction (<i>SUPSAT</i>)	0.77	4	Our supplier is satisfied with the information we supply them to facilitate their work

services to our customers". Coefficient alphas for the two variables were 0.82 and 0.84, respectively.

Cooperative relationship

Cooperative relationship consists of external teamwork, i.e. supplier dynamics (*SUPDY*), cooperative goals (*COOP*) and open-minded interaction (*CC*). Supplier dynamics measures a company's general relationship with its supplier. Cooperative goals measure the nature of goal interdependence between a company and its supplier. Open-minded interaction or constructive controversy is the set of behaviours that have been found to develop from cooperative goal interdependence in problem-solving situations. Items for the latter two variables were developed from previous studies based on Deutsch's theory of cooperation and competition (Tjosvold *et al.*, 1986, 1991). Four items were used for each of the three variables. Sample items for the three variables were "An atmosphere of cooperation exists between our firm and this supplier"; "The supplier and we want each other to succeed"; and "This supplier and we listen carefully to each other's opinions". Reliability alphas for the three variables were 0.80, 0.83 and 0.84, respectively.

Integrative process and information management (Management by facts)

Integrative process and information management includes the variables of seamless operation (*OPERAT*) and integrated structure (*STRUCT*). In order to have best performance from utilizing the resources of a company's supplier, operation between them should be seamless and smooth, which also requires an integrated structure or closely linked structure. Seamless operation measures the frequency of communication between the company and its supplier and the supplier's involvement in the company's value creation activities. Integrated structure measures the structural linkage between the company and its supplier, which includes the establishment of channels of communication, boundary spanning roles, etc. Items for these two variables were developed from the studies of Blancero and Ellram (1997) and the Customer-Supplier Trust project of the Lean Enterprise Research Centre (1996). Four items were used for each of the two variables. Sample items were "Our company meets with this supplier's senior management on a regular basis to discuss problems"; "Tight operating linkages are planned for and implemented between our firm and this supplier". Reliability alphas for the two variables were 0.73 and 0.75, respectively.

Information management entails the variables of performance measurement (*MEASURE*) and information exchange (*INFOEX*). Information on the performance of the supply chain members can help members know what should be improved. Besides, information sharing between the members can facilitate their operation. Performance measurement measures how much information the company has on the performance of its supplier. Information exchange measures the extent of information sharing between the company and its supplier. The items of information exchange were developed from the studies of Blancero and Ellram (1997) and Monczka *et al.* (1995). Four items were used for the two variables. Sample items included "Our company assesses the supplier's performance through a formal evaluation programme"; "Our firm and this supplier share work improvement suggestions with each other". Reliability alphas for the two variables were 0.85 and 0.76, respectively.

Continuous improvement

Continuous improvement includes the variables of process improvement (*PROCESSIM*) and planning and prevention (*PREVEN*). Process improvement is always necessary in streamlining

the supply chain processes to meet continuously the customers' needs. Channels or mechanism for solving operational problems should be planned and set up so as to prevent problems from escalating to dysfunctional conflict. Process improvement measures the extent of involvement in process improvement by the company and its supplier. Planning and prevention measures the effort the company and the supplier have spent on planning to prevent problems from coming up and escalating. Four items were used for each of the two variables. Sample items include "We continuously work at integrating the process between our company and this supplier"; "Our company has measures to prevent problems arising from our relationship with the supplier". Reliability alphas for the two variables were 0.77 and 0.70, respectively.

Business excellence

Business excellence includes customer satisfaction (*CUSAT*), business results (*BUSRESU*), supplier contribution (*SUPCONTR*) and supplier satisfaction (*SUPSAT*). It is believed that the new SCM model should lead to business excellence. First of all, the buyer and the supplier should be satisfied with the support of their partner. It is argued that if the supply partner is best managed, they will also try to help the company to meet their customer's needs best. There should also be some relationship between customer satisfaction and the business result of the company. Four items were used for each of the four variables. Sample items for the four variables were "Customers are satisfied with the quality of our product which has incorporated the input of this supplier"; "Our product quality is very competitive in the market"; "The supply partner helps us reach our quality objectives"; and "Our supplier is satisfied with the information we supply them to facilitate their work", respectively. Reliability alphas for the four variables were 0.79, 0.82, 0.85 and 0.77.

Results

Descriptive statistics

Means of different variables

The mean values of the different variables are discussed as follows according to the different dimensions (Table 2).

Leadership

The mean values on a five-point scale (1 = strongly disagree; 5 = strongly agree) of the three variables under leadership were 3.93, 4.21 and 4.19 for cooperative culture, commitment to relationship and commitment to quality, respectively, which indicated that the respondents believed that the top management or the company was committed to the long-term relationship with the supplier partner and also committed to pursuing quality initiatives. The respondents also agreed that there was a cooperative culture between the company and its supply partner.

Customer focus

The responses indicated high mean values of commitment to supply partner satisfaction (*COMSU*) and commitment to customer satisfaction (*COMCU*), which were 4.22 and 4.45,

Table 2. Mean values and correlations among variables

Variable	Mean ^a	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 CULTURE	3.92	1.00																	
2 LONGTM	4.21	0.64**	1.00																
3 COMQU	4.19	0.38**	0.32**	1.00															
4 COMCU	4.45	0.33**	0.33**	0.53**	1.00														
5 COMSU	4.21	0.39**	0.45**	0.26**	0.38**	1.00													
6 SUPDY	4.01	0.65**	0.48**	0.21**	0.30**	0.51**	1.00												
7 COOP	3.90	0.69**	0.66**	0.35**	0.36**	0.56**	0.66**	1.00											
8 CC	3.90	0.51**	0.46**	0.29**	0.29**	0.49**	0.54**	0.61**	1.00										
9 OPERAT	3.29	0.33**	0.23**	0.28**	0.28**	0.12	0.34**	0.33**	0.39**	1.00									
10 STRUCT	3.50	0.38**	0.35**	0.30**	0.28**	0.31**	0.45**	0.47**	0.51**	0.68**	1.00								
11 MEASURE	3.24	0.22**	0.12	0.46**	0.36**	0.12	0.23**	0.23**	0.27**	0.49**	0.51**	1.00							
12 INFOEX	3.39	0.32**	0.22**	0.26**	0.27**	0.20*	0.33**	0.39**	0.44**	0.66**	0.56**	0.56**	1.00						
13 PROCESSIM	3.69	0.40**	0.42**	0.42**	0.40**	0.36**	0.35**	0.44**	0.40**	0.49**	0.58**	0.35**	0.40**	1.00					
14 PREVEN	3.57	0.48**	0.38**	0.38**	0.40**	0.34**	0.40**	0.51**	0.41**	0.44**	0.54**	0.51**	0.46**	0.65**	1.00				
15 SUPSAT	3.82	0.60**	0.46**	0.23**	0.25**	0.56**	0.64**	0.53**	0.55**	0.30**	0.34**	0.20*	0.36**	0.31**	0.46**	1.00			
16 SUPCONTR	3.86	0.51**	0.44**	0.31**	0.29**	0.42**	0.63**	0.62**	0.50**	0.35**	0.45**	0.32**	0.38**	0.51**	0.41**	0.47**	1.00		
17 CUSAT	3.83	0.52**	0.45**	0.35**	0.50**	0.36**	0.48**	0.47**	0.39**	0.28**	0.33**	0.37**	0.27**	0.39**	0.42**	0.41**	0.44**	1.00	
18 BUSRESU	3.71	0.40**	0.31**	0.17**	0.45**	0.30**	0.42**	0.26**	0.24**	0.29**	0.32**	0.29**	0.27**	0.32**	0.38**	0.35**	0.23**	0.65**	1.00

^aMean values are from a five-point scale (1 = strongly disagree; 5 = strongly agree).

*Correlation is significant at the 0.05 level (two-tailed).

**Correlation is significant at the 0.01 level (two-tailed).

respectively. It revealed that the respondents very much agreed that their companies were committed to the needs of their supply partners and their customers.

Cooperative relationship

Concerning the relationship between respondents' companies and their suppliers, the respondents agreed that there was good supplier dynamics, with a mean value of 4.02. For instance, the operations between respondents' companies and their supply partners were smooth. The respondents agreed that the partners in the supply chain had cooperative goals, a mean value of 3.91. Respondents also agreed that the supply chain partners had open-minded interaction with each other, with a mean value of 3.9.

Integrative process and information management (Management by facts)

The mean value of seamless operation was 3.29, which indicated that the respondents were more or less neutral when considered under the five-point scale. This implied that there should be room for improvement in communication with suppliers and involving suppliers in the value creation activities of the companies. The mean value of integrated structure was 3.51, which suggested that the respondents generally agreed that there was structural linkage between their companies and their suppliers.

The mean value of performance measurement and information exchange were 3.24 and 3.4, respectively. The results implied that the respondents were more or less neutral, though skewed towards agreeing that there was information sharing between the company and they have objective ways to measure the performance of their suppliers.

Continuous improvement

The mean values of process improvement (*PROCESSIM*) and planning and prevention (*PREVEN*) were 3.69 and 3.57, respectively. The results suggested that the respondents generally agreed that their companies and their suppliers continuously worked at improving or streamlining the operations and processes between them. The respondents also generally agreed that there was a mechanism set up to prevent problems from arising in the relationship with their suppliers.

Business excellence

The mean values of customer satisfaction, business results, supplier contribution and supplier satisfaction were 3.84, 3.71, 3.87 and 3.83, respectively. The results indicated that the suppliers were satisfied with the assistance given to them by the companies. The respondents generally agreed that their suppliers could have various contributions to their companies. The respondents also generally agreed that their customers were satisfied with their companies' products. Moreover, the respondents also generally agreed that the overall performance of their companies was very competitive in the market.

Correlations between variables

Table 2 shows correlations between different variables and their level of significance (*p*). They are discussed as follows.

Leadership

Under leadership, the three variables had significant correlations with each other, which suggested that companies having a cooperative culture with their suppliers were able to commit to the long-term relationship with their suppliers ($r = 0.649, p < 0.01$), and commit to quality initiatives ($r = 0.386, p < 0.01$). Companies that committed to quality initiatives would also commit to supplier relationship ($r = 0.322, p < 0.01$).

Besides, the three variables also had high correlations with other variables. The results indicated that companies which had a cooperative culture with their suppliers were able to develop cooperative goals ($r = 0.699, p < 0.01$), smooth operations ($r = 0.657, p < 0.01$) and open-minded interactions with their suppliers ($r = 0.518, p < 0.01$). Cooperative culture would also help companies prevent problems from arising in the relationship with suppliers ($r = 0.486, p < 0.01$). Cooperative culture would also lead to the contribution of suppliers ($r = 0.515, p < 0.01$). The end result of cooperative culture would be customer satisfaction ($r = 0.527, p < 0.01$) and competitive business results ($r = 0.4, p < 0.01$).

Customer focus

The two variables (commitment to supplier satisfaction, commitment to customer satisfaction) in the construct of customer focus were related to one another ($r = 0.387, p < 0.01$). Companies which were committed to customer satisfaction were also committed to quality ($r = 0.534, p < 0.01$). In order to meet customers' needs, companies would improve the supply chain's processes ($r = 0.402, p < 0.01$) and prevent problems from occurring ($r = 0.402, p < 0.01$). Companies that commit to customer satisfaction would also have an atmosphere of cooperation within companies ($r = 0.434, p < 0.01$) and cooperative goals among employees ($r = 0.477, p < 0.01$). Commitment to customer satisfaction would lead to customer satisfaction ($r = 0.5, p < 0.01$) and business competitiveness ($r = 0.455, p < 0.01$).

Companies that committed to supplier satisfaction would develop long-term relationship ($r = 0.456, p < 0.01$) and cooperative goals ($r = 0.565, p < 0.01$), and had smooth operations ($r = 0.516, p < 0.01$) and open-minded interactions with their suppliers ($r = 0.497, p < 0.01$). Commitment to supplier satisfaction would also result in supplier satisfaction ($r = 0.565, p < 0.01$) and supplier contribution ($r = 0.422, p < 0.01$).

Cooperative relationships

Companies with good supplier dynamics would have cooperative goals with their suppliers ($r = 0.668, p < 0.01$) and open-minded interactions with suppliers ($r = 0.54, p < 0.01$). Companies that have cooperative goals with their suppliers would have open-minded interactions with their suppliers ($r = 0.618, p < 0.01$).

Companies having good supplier dynamics were committed to supplier satisfaction ($r = 0.516, p < 0.01$), were able to develop an integrated structure with their suppliers ($r = 0.45, p < 0.01$) and prevent problems arising in the relationship with their suppliers ($r = 0.46, p < 0.01$). In return, the companies would have higher satisfaction with their contributions ($r = 0.635, p < 0.01$). Good supplier dynamics would also lead to customer satisfaction ($r = 0.486, p < 0.01$) and business results ($r = 0.42, p < 0.01$).

Integrative processes and information management (Management by facts)

The two variables, i.e. seamless operation and integrated structure, in this construct were closely related to each other ($r = 0.689, p < 0.01$). Companies that had developed seamless

operation with their suppliers also had objective information to measure suppliers' performance ($r = 0.511, p < 0.01$). They would have good information exchange with their suppliers ($r = 0.662, p < 0.01$) and emphasize improving the processes ($r = 0.496, p < 0.01$) and preventing problems arising ($r = 0.444, p < 0.01$) between companies and their suppliers.

Performance measure and information exchange were related to each other ($r = 0.56, p < 0.01$). Companies that had performance measures on their suppliers were also committed to quality ($r = 0.469, p < 0.01$). In general, these two variables were closely related to variables in the constructs of integrated processes and continuous improvement.

Continuous improvement

Process improvement and planning and prevention were closely related to each other ($r = 0.651, p < 0.01$). They were also very closely related to the variables in integrative processes and information management. Companies that paid attention to continuous improvement also had cooperative culture and a long-term relationship with their suppliers. They were also committed to quality.

Business excellence

Contributions of suppliers would lead to customer satisfaction ($r = 0.447, p < 0.01$). Supplier contribution was closely related with companies having a cooperative culture with suppliers ($r = 0.515, p < 0.01$), a long-term relationship with suppliers ($r = 0.447, p < 0.01$) and commitment to suppliers ($r = 0.422, p < 0.01$). Supplier contribution was also closely related with having good relations with suppliers, i.e. supplier dynamics ($r = 0.635, p < 0.01$), cooperative goals with suppliers ($r = 0.623, p < 0.01$), open-minded interactions with suppliers ($r = 0.509, p < 0.01$), and with preventing problems from arising with suppliers ($r = 0.412, p < 0.01$).

Business results was closely related to customer satisfaction ($r = 0.655, p < 0.01$), commitment to customers ($r = 0.455, p < 0.01$), relations with suppliers ($r = 0.42, p < 0.01$) and cooperative culture with suppliers ($r = 0.4, p < 0.01$).

Customer satisfaction was closely related to business results ($r = 0.655, p < 0.01$), commitment to cooperative culture with suppliers ($r = 0.527, p < 0.01$), commitment to customers ($r = 0.5, p < 0.01$) and relations with suppliers ($r = 0.486, p < 0.01$). The companies that had satisfied suppliers had also satisfied customers ($r = 0.419, p < 0.01$). Supplier satisfaction was closely related with companies having cooperative culture with suppliers ($r = 0.6, p < 0.01$) and commitment to suppliers ($r = 0.565, p < 0.01$). Supplier satisfaction was also closely related to having good relations with suppliers, i.e. supplier dynamics ($r = 0.646, p < 0.01$), cooperative goals with suppliers ($r = 0.537, p < 0.01$), open-minded interactions with suppliers ($r = 0.554, p < 0.01$), and with preventing problems from arising with suppliers ($r = 0.463, p < 0.01$).

Structural analysis results

Path analysis was used to examine the underlying relationship among company leadership, customer focus, cooperative relationship, integrative processes and information management, continuous improvement and business excellence. The path analysis of the interrelationship among these constructs was analyzed using the EQS for Macintosh program (Bentler & Wu, 1995).

Structural equation analyses were used to examine possible causal relationships. The

Table 3. *Structural equation analysis of the new SCM model or the Business Excellence model for SCM*

Structural path	Path estimates
Leadership to customer focus	0.690***
Leadership to cooperative relationship	0.813***
Leadership to management by fact	0.654***
Leadership to continuous improvement	0.739***
Customer focus to business excellence	0.292***
Cooperative relationship to business excellence	0.381***
Management by fact to business excellence	0.107**
Continuous improvement to business excellence	0.113*
Model χ^2	5.627
Degree of freedom	1
Comparative fit index (CFI)	0.993
Normed fit index (NFI)	0.991

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

results support the model outlined in Fig. 4. Since the variables in the model are in fact indicators of the six constructs, the values of variables within each construct are aggregated together to give the value of the construct they represent. Hence, cooperative culture (*CULTURE*), commitment to relationship (*LONGTM*) and commitment to quality (*COMQU*) together form the construct of leadership (*LEADERSH*), with a reliability alpha of 0.85 (Table 1). Commitment to supply partner satisfaction (*COMSU*) and commitment to customer satisfaction (*COMCU*) form the construct of customer focus (*CUSTOMER*), with a reliability alpha of 0.83. Supplier dynamics (*SUPDY*), cooperative controversy (*CC*) and cooperative goals (*COOP*) combine into the construct of cooperative relationship (*COOPRELA*), with an alpha value of 0.90. Seamless operation (*OPERAT*) and integrated structure (*STRUCT*), performance measurement (*MEASURE*) and information exchange (*INFOEX*) together form the construct of management by fact (*MGTBYFACT*), with a Cronbach's- α of 0.90. Continuous improvement (*CONTIMPR*) is composed of the variables of process improvement (*PROCESSIM*) and planning and prevention (*PREVEN*), with an alpha of 0.83. Business excellence is made up of the variables of supplier satisfaction (*SUPSAT*), supplier contribution (*SUPCONTR*), customer satisfaction (*CUSAT*) and business results (*BUSRESU*), with an alpha of 0.88. All the reliability alphas of the six constructs indicated that they had good internal consistency.

The new SCM model relates leadership directly to the setting up of integrative processes, information management, the devotion to continuous improvement, commitment to customer and supplier satisfaction and development of cooperative relationship. In turn, these factors are related to the business performance of the companies. The analysis in Table 3 shows that the model has a χ^2 of 5.627 (df = 1), a comparative fit index (CFI) of 0.993 and a normed fit index (NFI) of 0.991. Values for both the NFI and CFI range from zero to 1.00 and, according to Bentler (1992), a value greater than 0.90 indicates an acceptable fit to the data. Hence, the new SCM model fits the data very well.

Assessment of parameter estimates

When examining z statistics associated with the structural estimates of the model, we can determine some parameters estimates that are statistically significant at the 5% level, i.e. test statistics greater than ± 1.96 .

In the new SCM model, nearly all the structural estimates are significant at the 5% level, except business, *Contimpr*, which is significant at the 10% level. The results of z values using the EQS program are as follows: *Leadersh, Customer* (12.341); *Leadersh, Cooprela* (14.493); *Leadersh, Mgtbyfct* (7.583); *Leadersh, Contimpr* (10.864); *Businese, Customer* (4.398); *Businese, Cooprela* (6.086); *Businese, Mgtbyfct* (2.158); *Businese, Contimpr* (1.791).

Path coefficients

The path coefficients (β) of the theorized new SCM model help to explore the findings more specifically (Table 3). Leadership had a significant impact on commitment to suppliers and customers, i.e. customer focus ($\beta = 0.69$, $p < 0.01$), on cooperative relationship with suppliers ($\beta = 0.813$, $p < 0.01$), on management by fact ($\beta = 0.654$, $p < 0.01$) and on continuous improvement ($\beta = 0.739$, $p < 0.01$). Customer focus in turn had a significant impact on business excellence ($\beta = 0.292$, $p < 0.01$). Cooperative relationship also had a significant impact on business excellence ($\beta = 0.381$, $p < 0.01$). Management by fact had an impact on business excellence ($\beta = 0.107$, $p < 0.05$). Also, continuous improvement had an impact on business excellence ($\beta = 0.113$, $p < 0.1$). These findings on path coefficients provide good support for the study's hypotheses. They, along with the analysis of the structural equation models, suggest that leadership would lead to customer focus, cooperative relationship, management by fact and continuous improvement, which help companies achieve business excellence.

Discussion and conclusion

Results support the theory that companies focusing on creating cooperative culture with suppliers and commitment to supplier relationship and quality, commit themselves to supplier satisfaction and develop cooperative relationships with supply partners. These strong relationships with suppliers would lead to suppliers' quality contributions to the companies. Besides, the evidence suggests that companies that have a cooperative culture with suppliers, commitment to supplier relationship and quality, develop integrative processes with suppliers, obtain and exchange information with suppliers and engage in continuous improvement activities with suppliers. These close linkages and interactions also lead to suppliers' quality contributions to the companies, which enables companies to achieve business excellence.

It can be argued that when the top management of a company adopts a cooperative culture in its relationship with its supply partners and commits to quality improvement, it will make the company more committed to meeting its suppliers' needs and satisfying its customers. It also enables the company to develop effective teamwork with its supply partners, i.e. through cooperative goals, instead of competitive goals, and through constructive controversy or open-minded discussion in the interaction with its suppliers. These are the 'soft' factors that are essential for achieving good relationship with supply partners. As a result, the suppliers are more satisfied with the relationship with the company and they are more willing to contribute their best in helping the company improve its competitiveness through providing quality inputs and improvement suggestions to the company. The end result will be that the customers are more satisfied with the company's product or service and the company can thus achieve a better competitive advantage than its competitors.

On the other hand, leadership will also help a company establish integrated operations with its supply partners. Under the auspices of the top management, integrative processes can be set up, information can be exchanged more frequently and more effort can be spent on continuously improving the operation processes with its supply partners. These are the

'hard' factors that have to be taken care of in order to get the best performance from suppliers. When the operations are smooth and close, suppliers' contributions can be facilitated. With suppliers' contributions, companies are in a position to serve better their customers and finally achieve competitive positions. Besides, continued close interactions may somehow help to breed cooperative culture between the company and its suppliers. However, relatively speaking, the 'soft' factors are more important than the 'hard' factors. Sometimes, companies do not necessarily require a high level of smooth and close operations with their suppliers as long as the suppliers are cooperative enough to do their best at their end. Hence, developing a cooperative relationship is much more important. The new SCM model also reflects that the 'soft' factors, i.e. customer focus (*Customer*) and cooperative relationship (*Cooprela*) have more statistically significant relationships with business excellence than the 'hard' factors, i.e. information management (*Informat*), integrated process (*Integpro*) or the construct of management by fact.

Regarding the development of a cooperative relationship, the Business Excellence model of SCM has also made use of Deutsch's theory of cooperation and competition. Deutsch suggested that the way in which people believe their goals are related is an important variable affecting the dynamics and outcomes of their interaction. He identified three alternatives of people's interpretation of their goal interdependence: cooperation, competition and independence. Perceptions of goal interdependence affect interaction outcomes significantly because these perceptions affect their expectations and actions.

The results confirm that once cooperative goals with suppliers have been developed under the leadership of the top management, the company and its suppliers are able to acknowledge each other's perspective, communicate and influence effectively, assist and support each other and discuss opposing ideas openly. This study has extended the application of the theory from focusing on the individual-to-individual level of previous studies (Deutsch, 1973; Johnson & Johnson, 1989) to focusing on firm-to-firm level. This study also shows that cooperative goals and open-mindedness contribute to effective and productive relationships. The results also have support from the findings of the studies of one of the authors (Wong *et al.*, 1999).

From structural analysis, the new SCM model or the Business Excellence model for SCM provides a good fit to the data, which implies that the causal relationships of the different constructs or the structure of the model should be valid. This model is better than other existing SCM models because the other models do not show the causal relationships for the different constructs. Since the new SCM model has incorporated in it the success factors of the TQM principles and concepts, it can enable companies adopting this model successfully to manage and utilize the resources of its suppliers so as to achieve business excellence. The business excellence index (*BEI*) for companies' SCM can be further derived from the model using statistical methods. The *BEI* for companies' SCM will allow organizations to compare their SCM performance against those of different organizations with whom they are competing. This is of particular benefit to organizations who are not doing as well as they might, as it will give them an incentive to do something about their failings.

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